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ABSTRACT

This 14th annual ED-MEDIA conference serves as a multi-disciplinary forum for the discussion and exchange of information on the research, development, and applications on all topics related to multimedia, hypermedia and telecommunications/distance education. ED-MEDIA, the premiere international conference in the field, spans all disciplines and levels of education and attracts more than 1,000 attendees from over 50 countries. This document contains papers from attendees representing researchers in over 60 countries, with 162 Full Papers, 255 Brief Papers, and 220 Posters. The focus of ED-MEDIA is technology in education with many different approaches to using the available technology for the realization of educational aims. Topics of papers include: evaluations of new teaching designs, techniques and tools; case studies on the use of technology in physical or virtual classrooms; discussion of new technologies and applications; applications of educational technology in a variety of disciplines; theoretical considerations of the motivations and impact of technology; partnerships and cooperative programs; and accessibility issues for the disabled. There are 2 poster sessions (with 225 posters), 10 panels, workshops, and an evening of special interest group (SIG) sessions. (AEF)

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ED-MEDIA 2002 World Conference on Educational Multimedia, Hypermedia & Telecommunications

Proceedings

(14th, Denver, Colorado, June 24-29, 2002)

Editors
Philip Barker and Samuel Rebelsky

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ED-MEDIA 2002

World Conference on Educational Multimedia, Hypermedia & Telecommunications

Edited by
Philip Barker
Samuel Rebelsky

Proceedings of ED-MEDIA 2002

WORLD CONFERENCE ON EDUCATIONAL MULTIMEDIA, HYPERMEDIA & TELECOMMUNICATIONS

June 24-29, 2002; Denver, Colorado, USA

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Preface

Welcome to Denver, Colorado, USA and to ED-MEDIA 2002. We hope you will discover many exciting ideas, be challenged, meet new people, and find yourself energized by the conference!

This year marks the fourteenth appearance of the ED-MEDIA conference, making ED-MEDIA one of the oldest and well-established conferences in the area of educational technology. In celebration of our longevity, we have complimented our strong paper program with some particularly notable keynotes and invited speakers. We are particularly proud of this year's keynote speakers, each of whom has made strong contributions to the founding of educational computing as a field of study. Alan Kay, one of the leading visionaries in personal computing, has also taken an early leadership role in thinking about ways to use computers to teach children (and about ways to teach children about computers). Andy Van Dam built one of the first hypertext systems (in the late 1960s, for those who think hypertext started with the World Wide Web) and is a leader in computer graphics. Anne Wright has been a leader in educational technology in the UK and beyond and recently served as Chief Executive of Ufi Ltd (which provided an online "University for Industry"). She is currently an E-Learning Strategic Adviser to the Department for Education and Skills in the UK. Finally, Hermann Maurer helped found the ED-MEDIA series of conferences and developed two leading hypertext systems. Dr. Maurer will reflect on the history of multimedia in education.

ED-MEDIA prides itself on being an international conference, and you can see many countries and perspectives reflected in our 162 Full Papers, 255 Brief Papers, and 220 posters. This year, we have papers and posters from researchers in over 60 countries. This program was assembled by the members of our valued international Program Committee, who carefully and rigorously reviewed the many submissions received. The Full Papers received particular attention, with each being reviewed by at least two Program Committee members and only the most meritorious being accepted to the conference. The Program Committee members are asked to consider a number of aspects of each paper, particularly the quality of the work and the expected benefits to the educational community. After the review process, the Chairs and Steering Committee assembled to make final decisions. This year, we accepted slightly less than half of the Full Papers submitted to the conference.

Behind the scenes, much was different in the review process. We have installed a new online reviewing system that makes it easier for Program Committee members to make and add comments on papers and for the Steering Committee to review the work of the Program Committee. We hope that those of you who submitted papers found the online submission system also worked more smoothly. The wonderful folks at AACE are continually working to make the system better and we expect many more improvements in the years to come. In the near future, ED-MEDIA attendees can expect to see an online "plan your conference" system and access to a new AACE Digital Library. If you'd like to learn more about the reviewing process or are interested in joining the Program Committee, please attend the special session on "Reviewing for ED-MEDIA."

This year, as in recent years, we identified a set of papers as "outstanding". We began with the Full and Brief Papers that received a score of 5 (on a 5 point scale) from the reviewers and the Full and Brief student papers that received a score of 4.5 or above from the reviewers. The Program Chairs re-reviewed those papers and accepted as outstanding only those that clearly stood out from the rest. Papers were judged on a number of important criteria such as originality/novelty, writing style, technical content, future impact, evaluation, and so on. We

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found that the outstanding papers reflected the topical diversity of ED-MEDIA. In the designated outstanding papers, you will find careful studies of the effects of certain technological interventions, case studies that provide more narrative descriptions of the use of technology in teaching (and which we often found to be "real page turners" to use an American colloquialism), descriptions of new projects in educational technology, and even instruments to use in future studies.

As you scan through the papers, you will find many different kinds of paper tied together by some common threads. While the focus of ED-MEDIA is technology in education, there are many different approaches to using the available technology for the realisation of educational aims.

These include:
- Preliminary evaluations of new teaching techniques and tools;
- Case studies on the use of technology in physical or virtual classrooms;
- Discussion of new technologies and applications;
- Applications of educational technology in a variety of disciplines; and
- Theoretical considerations of the motivations and impact of technology.

We expect you'll see this variety reflected in the program.

This year, we have added a special strand on accessibility issues for the disabled. As the Web has grown, so has the importance of making Web materials accessible to all kinds of readers. Accessibility encompasses a wide variety of issues, including access to the Internet, support for multiple languages and multiple cultures, and support for users with disabilities. As the premiere international conference in educational multimedia and hypermedia, ED-MEDIA has long been a leader in publishing papers which consider issues raised by different languages and cultures. This year's special strand both broadens and solidifies our emphasis on accessibility. We both hope and expect that it will be continued at future sessions of ED-MEDIA.

The best educational technology projects look to accommodate different learning styles. While it is not possible to accommodate every learning style in a conference, we have tried to provide a variety of different types of session. Hence, in addition to the keynote speakers, invited speakers, and paper presentations, all of which are generally held in a lecture plus question-and-answer format, we have included a number of other venues for learning and talking about educational multimedia, hypermedia, and telecommunications. These other venues include two poster sessions (with 225 posters), which provide more time for careful consideration and discussion with researchers; 10 panels, which present different perspectives on topics and give attendees a chance to discuss issues with panelists; tutorials, which provide small-group learning situations on a variety of topics; workshops, which provide small-group, hands-on learning sessions on a variety of topics; an evening of special interest group (SIG) sessions, in which attendees with similar interests can discuss particular topics; a varied social program, which gives attendees the chance to interact informally; a group dinner program, which gives attendees better chances to meet new people and discuss topics informally; a variety of meet-the-speakers sessions to give you a chance to interact with keynote speakers, invited speakers, and outstanding paper presenters; and a newcomers session to help new attendees plan how to make the best use of the many compelling opportunities at the conference.

As Conference Program Co-chairs, we have been aided considerably by a number of volunteers and helpers who have given tirelessly of their time. In particular, we must thank the Conference Steering Committee of Erik Duval (Chair), Shelly Heller, Gary Marks, Craig Montgomerie, and Ron Oliver, who led and coordinated the conference this year. We would like to thank the Chairs

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of the various Program Sub-Committees: Karen Swan, Panels Chair; and Catherine McLoughlin, Tutorials/Workshops Chair. We would also like to thank the 85 members of the international Program Committee who provided timely and insightful reviews without complaint and little credit. Finally, we would like to thank Gary Marks and the staff at the Association for the Advancement of Computing in Education (AACE), who organize and sponsor this conference, for their support in this massive endeavor. These folks work incredibly hard behind the scenes to manage all the aspects of the conference. They deal with many complicated situations and handle a variety of requests from the Steering Committee and others.

We look forward to meeting with you during the conference. Remember to spend time talking to colleagues from previous ED-MEDIA conferences and make new friends. As long-time attendees will tell you, what you learn during informal conversations can have as much or even greater impact than what you learn during more formal parts of the program. Think about new collaborations, new projects, and new uses of the work you hear about at this conference. We hope that you will develop new work that you can present next year at ED-MEDIA 2003 in Honolulu, Hawaii, June 23-28, 2003 or at the following year's ED-MEDIA, which is still in its planning stages. However, we do know that it will be held at a European venue.

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Fidel Salinas, University of the Pacific, USA; Denise Smith, Path to Excellence, USA

Java WEB-based K12 Experimental Research: Formative evaluation of Research Tools 1817
Glenn Smith, State University of New York at Stony Brook, USA

Math and Distance Learning threaded discussions 1819
David Ferguson, Janice Grackin, Glenn Smith, Risako Izubuchi, State University of New York at Stony Brook, USA

Technology Innovation through Collaboration in a Teacher Education Program 1825
Steven Smith, Sean Smith, Joseph O'Brien, University of Kansas, USA

MERLOT: Reaping the On-line Vineyard 1831
David Wicks, Seattle Pacific University, USA; Karen Smith-Gratto, North Carolina A & T State University, USA; Carl Berger, University of Michigan, USA

Using Streaming Technology to Build Video-Cases that Enhance Student Teaching on IT 1833
Simon So, Sai-wing Pun, Hong Kong Institute of Education, Hong Kong

Promoting and Diagnosing Collaborative Knowledge Building in Web-based Learning: In Search of the Analytical Unit 1838
Elsebeth Korsgaard Sorensen, Aalborg University, Denmark, Denmark; Eugene Takle, Iowa State University, USA

Virtual Portfolios for Collaboration in Distributed Web-Based Learning 1840
Haakon Tolsby, Elsebeth Korsgaard Sorensen, Lone Dirckinck-Holmfeld, Aalborg University, Denmark, USA

Adaptive Learning Environment in WINDS 1846
Marcus Specht, Milos Kravcik, Roland Klemke, Rüdiger Hüttenhain, Leonid Pesin, Fraunhofer Institute for Applied Information Technology FIT, Germany

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Carol Hansen, Shaun Spiegel, Weber State University, USA

Hierarchy of Navigation and its Effect on Content: A Designer's Perspective 1854
Cary Staples, University of Tennessee, USA

Over-hyping the Web: Directories, Gateways, Resources, and Higher Education Pedagogy. 1856
Stuart Stein, University of the West of England, UK

wireless meets wireline eLearning 1858
Claudia Steinberger, University Klagenfurt, Austria

Open Classes in Closed Schools - Six Pedagogical Issues 1864
Ken Stevens, Memorial University of Newfoundland, Canada

To make e-learning work, send clear messages! 1866
Dolf Steyn, University of Pretoria, South Africa

A Case for Multimedia: Designing a Problem-Based Interactive Learning Environment 1872
Anne Strehler, Carina Eksteen, University of Pretoria, South Africa

Learning to Integrate Technology in the Classroom: A Case-Based Reasoning Approach 1878
Joi Moore, Johannes Strobel, John Wedman, David H. Jonassen, Wu He, University of Missouri-Columbia, USA; Feng-Kwei Wang, University of Missouri - Columbia, USA; Dan Cernusca, Hui-Chuan Hsieh, Chi-Ren Shyu, Tawnya Means, Jaturon Harnsomburana, University of Missouri-Columbia, USA

Debunking the Buzz Words OR Can hermeneutic analysis be used to evaluate pedagogically based learning objects designed from constructivist epistemological ontologies defined in XML Metadata? 1880
Jim Hensman, Coventry University, UK; Barbara Dewey, University of Tennessee, USA; Bronwyn Stuckey, Queensland University of Technology, Australia; Tobias Hofmann, Bauhaus University Weimar, Germany; Sonja Cameron, University of Glasgow, UK; Helen Brown, BECTA, UK

Introducing a "Means-End" Approach to Human-Computer Interaction: Why Users Choose Particular Web Sites Over Others 1886
DEEPAK SUBRAMONY, INDIANA UNIVERSITY-BLOOMINGTON, USA

Automatic Camera Control System for a Distant Lecture with Videoing a Normal Classroom 1892
Akira Suganuma, Shuichiro Nishigori, Kyushu University, Japan

Automatic Generating Appropriate Exercises Based on Dynamic Evaluating both Students' and Questions' Levels 1898
Akira Suganuma, Tsunenori Mine, Takayoshi Shoudai, Kyushu University, Japan

Instructional Design of Scientific Simulations and Modeling Software to Support Student Construction of Perceptual to Conceptual Bridges 1904
Moustapha Diack, Southern University-Baton Rouge, USA; Jerry P. Suits, McNeese State University, USA

Learning through online discussion: Where's the beef? 1910
Karen Swan, University at Albany, USA

Situated Professional Development: The CATIE Model 1915
Karen Swan, University at Albany, USA; Sybillyn Jennings Jennings, The Sage Colleges, USA; Lester Rubenfeld, Rensselaer Polytechnic Institute, USA

Technology and Literacy Learning: A National Survey 1921
Ron Dugan, Annie Moore-Cox, Joseph Baltrus, Karen Swan, Robert Bangert-Drowns, University at Albany, USA

Turning terror into discovery: Traditional narrative strategies and interactive educational media 1924
Geo Takach, University of Alberta, Canada

Could oral communication be successfully taught entirely online? 1926
Kandy James, Sherryl Tanian, Edith Cowan University, Australia

Skills Needed for Managing Multimedia Development – Invisible or Visible? 1928
Pina Tarricone, Joe Luca, Edith Cowan University, Australia

Construction of Web-based Japanese Listening Program and the results of its Preliminary Experimental Results 1934
Lumi Tatsuta, Dokkyo University, Japan; Giichi Tomizawa, Science University of Tokyo, Japan; Yaeko Nakanishi, Masayuki Ohnishi, Atsuo Iguchi, Dokkyo University, Japan

Modeling of Courses through Workflow using the standard SVG/XML 1940
Tiago Telecken, Universidade Federal do Rio Grande do Sul, Brazil

LOMster: Peer-to-peer Learning Object Metadata 1942
Stefaan Ternier, Pieter Vandepitte, Erik Duval, Katholieke Universiteit Leuven, Belgium

Mental Models: Do they exist, how are they taught, can they be measured? Preliminary research findings using computer based systems 1944
Martin Tessmer, University of Colorado at Denver, USA

Teachers,Identity, Psychological Capital and Electronically Mediated Representations of Cultural Consciousness 1946
Sharon Tettegah, University of Illinois, Urbana Champaign, USA; Sharon Tettegah, University of Illinois, USA

A Brief Overview of An Instructor Facilitated Instructional Chat System (IFICS) 1948
M.O. Thirunarayanan, Aixa Perez-Prado, Florida International University, USA

On the Effectiveness of a Programming Coach in a Distance Learning Environment 1950
Pete Thomas, Open University, UK

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The Computer, The Discipline and the Classroom: Two Perspectives 1956
Barton Thurber, University of San Diego, USA
Students' Epistemological Beliefs and the Learning of Introductory Computing Concepts 1961
Denise Tolhurst, University of New South Wales, Australia
International Education Online: Project THRO 1967
Howard Tolley, University of Cincinnati, USA
Task Generator: A Portable System for Generating Learning Tasks for Intelligent Language Tutoring Systems 1972
Trude Heift, Janine Toole, Simon Fraser University, Canada
Interactivity and Threaded Discussion 1978
Wayne Tousignant, Centre for Flexible Learning, University of Windsor, Canada
Barriers in Using Technology 1980
Burcu Tunca, The George Washington University, USA
The Relevance of Haptic Experience in Remote Experiments 1983
Joerg Tuttas, Bernardo Wagner, University of Hannover, Germany
Evaluating the Effectiveness of Online Courses 1985
Hakan Tuzun, Indiana University, USA
Instructor Support in Web-Based Instruction 1987
Ozgul Yilmaz, Hakan Tuzun, Indiana University, USA
Returning power to users: the effect of computers that apologize 1993
Jeng-Yi Tzeng, Indiana University, USA
Novice designers of online learning: A contribution to principles for instructionally effective online learning design. 1995
Geoffrey Lautenbach, Duan vander Westhuizen, Rand Afrikaans University, Johannesburg, South Africa
Using Computer-Assisted Case-Based Instruction in Corporate Training 1997
Nancy Vye, Vanderbilt University, USA
Patterning Evaluation Models: Assessment in Support of Institutional Goals for Learning 1999
Karen Belfer, Ron Wakkary, Technical University of British Columbia, Canada
Role with IT... the Evolution of Faculty and Faculty Support Roles and Responsibilities in the Rapidly Changing Climate of Educational Technology 2001
Sarah Walkowiak, Worcester Polytechnic Institute, USA
Back to Basics: Non-Technical Tips for Improving Technology-Based Presentation Skills 2003
Joseph Walsh, University of Montevallo, USA; Kristie Pretti-Frontczak, Kent State University, USA
On Using Data-Mining Technology for Browsing Log File Analysis in Asynchronous Learning Environment 2005
Feng-Hsu Wang, Department of Computer and Communication Engineering, Ming Chuan University, Taiwan
A Knowledge Management Framework of Building a Technology Integration Community of Practice 2007
Feng-Kwei Wang, John Wedman, Ch-Ren Shyu, University of Missouri - Columbia, USA
Missouri-Specific Web-based Lesson Planning System 2009
Feng-Kwei Wang, Guan-Yu Lin, University of Missouri - Columbia, USA
Investigating Education Faculty's Perspectives of Their Experiences in a Technology Project: Issues and Problems Related to Technology Integration 2011
Li Wang, Richard Speaker, University of New Orleans, USA
Student Perceptions of Relative Advantages in Physical Versus Online Submission of Multimedia ePortfolio Projects in Graduate Coursework 2017
Lih-Ching Chen Wang, Cleveland State University, USA
Electronic Cognitive Apprenticeships: Building Students' Understanding of ID 2019
Ling Wang, Purdue University, USA
An Investigation of a Web-Based Learning Environment Designed to Enhance the Motivation and Achievement of Students in Learning Difficult Mental Models in High School Science 2022
Shiang-Kwei Wang, Chia-chi Yang, Dept. of Instructional Technology at University of Georgia, USA
If you build it, will they come? Helping Instructors Change Their Role 2028
Diane Schuch-Miller, Greenfield Coalition at Focus:HOPE, USA; Jenny Wang-Chavez, Greenfield Coalition at Focus: HOPE, USA

Yes I Can: Teachers Developing Interactive Classroom Activities Using Digitized Resources 2030
Wendy Trivette, AAM Cluster Coordinator, USA; marrion ward, montreat college, USA
Mitigating Risks During the Transition to Fully Automated Exams 2032
Edgar Weippl, Software Competence Center Hagenberg, Austria
The Transition from Computer-Based Training to eEducation 2034
Edgar Weippl, Software Competence Center Hagenberg, Austria
XML based content and its integration into existing e-learning solutions: results and consequences of a survey 2040
Elfriede Kelp, Technical University of Munich, Germany; Franz Weitl, Institute of information systems and software engineering, Germany; André Wiesner, Technical University of Karlsruhe, Germany
Towards a Discipline Based Reflective Thinking Process for K-12 Students and Teachers Through On-line Discourse and Action Research 2042
Elizabeth Wellman, California History-Social Science Project, UCLA, USA
The SASK Mentor Project: Using Software and Socratic Methods to Foster Reflective Thought in a Learning Environment 2048
Baba Kofi Weusijana, Joseph Walsh, Christopher Riesbeck, Northwestern University, USA
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Simon Wiest, Andreas Zell, Wilhelm-Schickard-Institute for Computer Science, University of Tuebingen, Germany
Software Agents, Activity Theory, and Mentoring - A Preliminary Model 2058
Kay Wijekumar, The Pennsylvania State University Beaver, USA
Making web-based academic and student services section 508-compliant: Whose job is it anyway? 2060
Shahron Williams van Rooij, Datatel, Inc., USA
Web based learning support for experimental design in Molecular Biology 2063
Ton Bisseling, Rob Hartog, Tinri Wilmsen, Wageningen University, Netherlands
The Role of Group Development and Facilitative Teaching in Online Courses 2069
Jean Wilson, University of Kansas, USA
Completing a Life: Content and Design Challenges in Creating Educational Multimedia Addressing End-of-Life Care 2071
Brian Winn, Karen Ogle, Michigan State University, USA; Angela Lambing, Leslie Bricker, Henry Ford Health Systems, USA; Darcy Greene, Michigan State University, USA
E-Learning, Semantic Web Services and Competency Ontologies 2077
Darrell Woelk, Elastic Knowledge Solutions, USA
It takes a village: Cultivating effective online instruction 2079
Victoria Wood, Scott Grabinger, Travis Chillemi, Dana Ewald, Veronika Eskova, Apryl Johnson, Luci Mello, Nancy Clayton, University of Colorado at Denver, USA
MASTER: A Computer–Mediated Tool for the Development of Probability Mental Models 2082
Danielle E. Kaplan, Chia-Ling Wu, Teachers College, Columbia University, USA
IDIOMA-TIC © A CALL authoring system for web and cd-rom with intelligent feedback and half-open questions 2085
Ludo Melis, K.U Leuven Campus Kortrijk, Belgium; Piet Desmet, Bert Wylin, K.U.Leuven Campus Kortrijk, Belgium
A New Model for Teachers' Development in the Information Age 2087
Edna Yaffe, The Open University of Israel, Israel
Digital Video as an Educational Tool in Distance Education 2089
Edna Yaffe, The Open University of Israel, Israel
The Development of The Learning Object Standard Using A Pedagogic Approach: A Comparative Study 2091
John Jenkins, Chai Wan IVE, Hong Kong; Mohammed Yusoff, Yazrina Yahya, National University Malaysia, Malaysia
Integration of laptops into a K-12 learning environment: A case study of a science teacher in the middle school 2097
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Cyndi Rowland, Utah State University, USA

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15TH ANNUAL **CALL FOR PARTICIPATION**

ED-MEDIA 2003

World Conference on Educational Multimedia, Hypermedia & Telecommunications

June 23-28, 2003
Sheraton Waikiki • Honolulu, Hawaii

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- Keynote & Invited Speakers
- Full & Brief Papers
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- Roundtables
- Video Festival NEW
- Interactive Sessions NEW
- Tutorials & Workshops
- Posters/Demonstrations
- Corporate Demos & Showcases
- SIG (SPECIAL INTEREST GROUP) Discussions

➤ **Submission Deadline: December 19, 2002**

➤ **Authors Notified: February 24, 2003**

➤ **Proceedings File Due: May 6, 2003**

➤ **Early Registration Deadline: May 6, 2003**

AACE *Estab. 1981*
Association for the Advancement of Computing in Education
Advancing Knowledge & Learning with Information Technology Worldwide

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Invitation

ED-MEDIA 2003 – World Conference on Educational Multimedia, Hypermedia & Telecommunications is an international conference, organized by the Association for the Advancement of Computing in Education (AACE). This annual conference serves as a multidisciplinary forum for the discussion and exchange of information on the research, development, and applications on all topics related to multimedia, hypermedia and telecommunications/distance education. ED-MEDIA, the premiere international conference in the field, spans all disciplines and levels of education and attracts more than 1,500 attendees from over 60 countries.

We invite you to attend ED-MEDIA 2003 and submit proposals for papers, panels, tutorials, workshops, posters/demonstrations, corporate demos, and SIG discussions. Each proposal will be peer-reviewed by three reviewers for inclusion in the conference program, proceedings book, and CD-ROM proceedings.

Information for Presenters

Details of presentation formats are given on the following pages. The general principles applying to all are:

- ➤ All communication will be with the contact presenter who is responsible for communicating with co-presenters of that session.
- ➤ All presenters must register and pay the registration fee (approximately $395 members, $435 non-members (US$).
- ➤ The conference will attempt to secure basic equipment needed for presenters. However, when special equipment cannot be obtained, presenters may need to bring or rent equipment.

Proceedings

The Proceedings book and CD-ROM are published by AACE. These proceedings serve as major sources in the multimedia/hypermedia/telecommunications community, reflecting the current state of the art in the discipline. In addition, selected papers may be invited for publication in the *Journal of Educational Multimedia and Hypermedia* (JEMH), *International Journal on E-Learning* (IJEL), or *Journal of Interactive Learning Research* (JILR).

Hotel & Travel Arrangements

Special hotel room rates will be available to conference attendees. Discount airfares will be available from a designated airline carrier.

Paper Awards

Papers present reports of significant work or integrative reviews in research, development, and applications related to educational multimedia, hypermedia and telecommunications/distance education.

All presented papers will be considered by the Program Committee for Outstanding Paper Awards. There is also be an award for Outstanding Student Paper (therefore, please indicate if primary author is a full-time student).

ED-MEDIA 2003 Topics

The scope of the conference includes, but is not limited to, the following major topics as they relate to the educational and developmental aspects of multimedia/hypermedia and telecommunications:

Infrastructure
- Architectures for Educational Technology Systems
- Design of Distance Learning Systems
- Distributed Learning Environments
- Methodologies for System Design
- Multimedia/Hypermedia Systems
- WWW-Based Course-Support Systems

Tools & Content-Oriented Applications
- Agents
- Authoring Tools
- Evaluation of Impact
- Interactive Learning Environments
- Groupware Tools
- Multimedia/Hypermedia Applications
- Research Perspectives
- Virtual Reality
- WWW-Based Course Sites
- WWW-Based Learning Resources
- WWW-Based Tools

New Roles of the Instructor & Learner
- Constructivist Perspectives
- Cooperative/Collaborative Learning
- Implementation Experiences
- Improving Classroom Teaching
- Instructor Networking
- Instructor Training and Support
- Pedagogical Issues
- Teaching/Learning Strategies

Human-Computer Interaction (HCI/CHI)
- Computer-Mediated Communication
- Design Principles
- Usability/User Studies
- User Interface Design

Cases & Projects
- Country-Specific Developments
- Exemplary Projects
- Institution-Specific Cases
- Virtual Universities

About AACE

AACE is a non-profit, international organization whose purpose is to advance the knowledge and quality of learning and teaching at all levels through the encouragement of scholarly inquiry related to information technology and education and the exchange of research results, developments, and their applications through publications and conferences for its members.

JOURNALS
- *International Journal on E-Learning (IJEL)*
  (Corporate, Government, Healthcare, & Higher Education)
- *Journal of Educational Multimedia and Hypermedia (JEMH)*
- *Journal of Computers in Mathematics and Science Teaching (JCMST)*
- *Journal of Interactive Learning Research (JILR)*
- *Journal of Technology and Teacher Education (JTATE)*
- *Information Technology in Childhood Education Annual (ITCE)*

ELECTRONIC JOURNALS
- *Educational Technology Review (ETR)*
- *Contemporary Issues in Technology & Teacher Education (CITE)*

Article abstracts for each journal are available at http://www.aace.org/pubs

CONFERENCES

ED-MEDIA – World Conference on Educational Multimedia and Hypermedia & Telecommunications
June 23-28, 2003; Honolulu, Hawaii USA

E-Learn – World Conference on E-Learning in Corporate, Healthcare, Government, and Higher Education
October 15-19, 2002; Montréal, Canada

SITE – Society for Information Technology & Teacher Education International Conference
March 24-29, 2003; Albuquerque, New Mexico USA

ICCE – International Conference on Computers in Education (Asia-Pacific Chapter)
December 3-6, 2002; Auckland, New Zealand

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Submission Information

FULL PAPERS

Presentation time: 25 minutes
Submission length: 4-6 pages (2,500-3,750 words)
Proceedings length: 6 pages maximum
AV equipment provided: PC, Projector, Internet, VCR

Papers present reports of significant work or integrative reviews in research, development, applications, and societal issues related to all aspects of the conference topics.

Systems & Resources

Papers related to projects, technical developments, systems, and resources.

The paper should include:

- Whether this work is just beginning, on-going, or completed;
- The partners involved;
- The major goals and the basic approach - this includes the educational problem addressed or the new educational opportunity created;
- A brief review of previous work as a background;
- A clear description of what has been developed, including schematic overviews and screen dumps (if applicable);
- Any validation (usability testing, pilot testing, expert evaluation, etc.) that has taken place; and
- Future work and implications for others.

The reference list for this kind of paper should include URLs for the work, and at least a few literature references.

Conceptual & Empirical Studies

Reviews, conceptual overviews, evaluations, and empirical studies.

The paper should include:

- The topic;
- The motivation for the work;
- The major questions addressed;
- The general process and conceptual framework, with references to literature;
- The concrete method, with sufficient detail on instruments and procedures;
- Major points or results; and
- Implications.

This paper category requires a strong and up-to-date well synthesized literature review, with work from a variety of sources (not just the research team of the author), and also an appropriate writing and presentation style for a scholarly review or overview.

Case Studies

Papers related to local experiences (e.g., a course or a prototype tested in a local situation).

The paper should include:

- The most important features of the context;
- A description of the problem in both local and conceptual terms;
- A description of who, what, why, and how, including screen dumps if relevant;
- Implications for the local setting or the local prototype; and
- Implications for others outside the local setting.

This paper category should include a reference list with relevant URLs, and a few citations to papers related to the local problem, but from outside the local setting. The latter is to indicate that the author can see the local situation in a broader and more general context.

Other

For authors who do not feel they fit in any of the above. The Program Committee may request that the author revise the paper to relate to one of the above categories, or may accept it as submitted.

BRIEF PAPERS

Presentation time: 15 minutes
Submission length: 2-3 pages, 1,250-1,875 words
Proceedings length: 2 pages maximum
AV equipment provided: PC, Projector, Internet, VCR

These papers are brief, more condensed presentations or work-in-progress projects.

New Developments

Descriptions of new extensions to existing projects or newly initiated projects.

Project Opportunities

Descriptions of projects underway that include opportunities for additional project partners.

Demonstrations

Other

For authors who do not feel they fit in any of the above. The Program Committee may request that the author revise the paper to relate to one of the above categories, or may accept it as submitted.

The submission should include:

- What is going to be shown or demonstrated or offered;
- The major aspects;
- The context or motivation; and
- Relevant URLs or literature references.

PANELS

Presentation time: 1 hour
Submission length: 2-3 pages, 1,250-1,875 words
Proceedings length: 4 pages maximum
AV equipment provided: PC, Projector, Internet, VCR

A panel offers an opportunity for 3-5 people (including the chair) to present their views or results on a common theme, issue, or question and discuss them with the audience. Panels should cover timely topics related to the conference areas of interest. Panel selection will be based on the importance, originality, focus, and timeliness of the topic; expertise of proposed panelists; as well as the potential for informative (and even controversial) discussion.

Panels must allot at least 50% of the time for interaction and discussion with the audience.

The panel proposals should include:

- Description of the panel topic, including why this topic is important to Conference attendees; and
- Brief position statement and qualifications of each panelist.

ROUNDTABLES

Presentation time: 1 hour
Submission length: 2-3 pages, 1,250-1,875 words
Proceedings length: 150 words (to be published only in Abstract Book)
AV equipment provided: electricity

These sessions allow maximum interaction in informal, small-group discussions on a single topic. The format is appropriate for papers, projects, or works-in-progress that encourage discussion. Roundtables share a room with 2-3 other concurrently held Roundtables.

VIDEO FESTIVAL

Presentation time: 1 hour
Submission length: 2-3 pages, 1,250-1,875 words
Proceedings length: 2 pages
AV equipment provided: VCR, PC, Projector, Internet

The field has matured to the point that we have a growing number of video resources – cases, classroom/training video clips, and many other forms. Presenters should have a short handout on the video and use most of the time showing the video.

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Submission Information

INTERACTIVE SESSIONS

Presentation time: 1 hour
Submission length: 2-3 pages, 1,250-1,875 words
Proceedings length: 3 pages
AV equipment provided: PC, Monitor, Internet

If you have mastered a new piece of software (or a new version) that others would be interested in learning about, submit a proposal for an Interactive Session. In this informal session, you will demonstrate the software, illustrate the process of using it, show participants some of the complexities and tricks about it, and give them an opportunity to try it themselves.

These sessions are also appropriate for instructional strategies, procedures, and evaluation procedures. The idea is not to give a definitive workshop on the topic, but to provide participants with enough information to help them decide whether their needs can be met with the program or procedure.

Include a description of the software to be used by participants, the objectives of the session, and the intended audience (experience level and prerequisites). These presentations share a room with 2-3 other concurrently held Interactive Sessions.

TUTORIALS / WORKSHOPS

Presentation time: 3.5 or 7 hours
Submission length: see information below
Proceedings length: no pages
AV equipment provided: PC, Projector, Internet (Tutorial);
PC, Projector, PC Lab, Internet (Workshop)

Tutorials and Workshops are intended to enhance the skills and broaden the perspective of their attendees. They should be designed to introduce a rigorous framework for learning a new area or to provide advanced technical training in an area. Submissions will be selected on the basis of the instructors' qualifications for teaching the proposed Tutorial or Workshop and their contribution to the overall conference program. Workshops differ from Tutorials by involving hands-on experience with hardware/software provided.

Note: Few Workshops are selected because a lab of equipment is required for each. If you submit a Workshop proposal, please indicate if your proposal is also appropriate for presentation as a non-hands on Tutorial.

Tutorial/Workshop proposals should include:

- Clear description of the objectives;
- Intended audience (experience level and prerequisites);
- Proposed length (3.5 hours or 7 hours);
- 200-word abstract;
- 1-page topical outline of the content; and
- Summary of the instructor's qualifications.

POSTER / DEMONSTRATIONS

Presentation time: 2 hours
Submission length: 2-3 pages, 1,250-1,875 words
Proceedings length: 2 pages
AV equipment provided: 4'x8' poster board, 6' table, 2 chairs, electricity, Internet if wireless card & PC brought

Poster/Demonstration sessions enable researchers and non-commercial developers to demonstrate and discuss their latest results and developments in progress in order to gain feedback and to establish contact with similar projects.

Poster/Demonstration proposals should include:

- Description of the planned Poster/Demonstration; should emphasize the problem, what was done, and why the work is important.

Poster/Demonstration presenters will be required to arrange for their own systems software and hardware.

CORPORATE DEMONSTRATIONS/ LITERATURE

Presentation time: 2 hours
Submission length: 1-2 paragraphs
Proceedings length: no pages
AV equipment provided: 4'x8' poster board, 6' table, 2 chairs, electricity, Internet if wireless card & PC brought

Demonstrate and discuss your company's products, services, developments, applications and research, inform the audience of your future directions, gain feedback, and establish contacts.

Scheduled with Poster/Demonstrations grouped together in open exhibition-style, usually all in one hall. This is an informal event with a circulating conference-wide audience. Sales are permitted. You may stock and sell your product at your table.

CORPORATE SHOWCASES

Presentation time: 30 minutes
Submission length: 1-2 paragraphs
Proceedings length: 150 words (to be published only in Abstract Book)
AV equipment provided: PC, Projector, Internet, VCR

Demonstrate and discuss your company's products, services, developments, applications and research, inform the audience of your future directions, gain feedback, and establish contacts.

Scheduled concurrently only with other Showcases. Presentation rooms generally accommodate 50-150 people, theatre-style. This is more of a formal presentation than the Corporate Demonstration.

SIG (SPECIAL INTEREST GROUP) DISCUSSIONS

Presentation time: 1 hour
Submission length: 1-3 pages (625-1,875 words)
Proceedings length: no pages
AV equipment provided: PC, Projector, Internet, VCR

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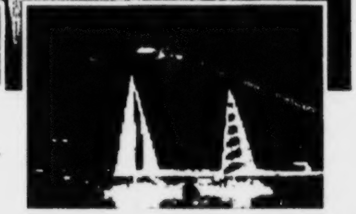
Waikiki Beach Honolulu, Hawaii



The exciting island of O'ahu, Hawaii, the home of Honolulu and Waikiki is the site of ED-MEDIA 2003.

Whether your idea of fun is soaking up the sun on a pristine, white sand beach or nightclubbing in Waikiki, hiking the trails or sampling some of the fantastic Hawaiian Regional Cuisine, we know that you're going to enjoy yourself on O'ahu.

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Advancing Knowledge and Learning with Information Technology

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KEYNOTE PAPERS

What Have we Learnt in 15 Years About Educational Multimedia?

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Abstract: This talk consists of three parts: First, I start with a brief review of the history of multimedia in education as we have experienced it since the first ED-MEDIA: it was then still called ICCAL and held in Calgary in 1987.
I will argue that the progress in handling media has helped, but that the major breakthroughs have been on other fronts, such as the better understanding of different learning models (behaviorism, cognitivism and constructivism or incidental vs. explicit learning). We have a more realistic appreciation of what intelligent tutoring systems can do and cannot do.
We have learnt that the administration of students, authors, tutors, courses etc. is much more important than previously thought. We seem to agree that powerful authoring tools are essential, but substantial courseware libraries cannot be built unless systematic re-use of modules based on meta-data and presentation standards is supported. We also have learnt that standardization as a whole is a very central issue.
In the second part of the talk I concentrate on the current state of affairs: After all we now realize that computer networks have opened the way for entirely new approaches involving much more communication, collaboration and team work: some ideas of intelligent tutoring systems have e.g. been successfully replaced by techniques involving networks; I will mention the importance of feedback, active documents and knowledge management in this context. In general, the most dramatic step forward has been the recognition that individual multimedia packages cannot be as effective as they should be in the absence of powerful, networked learning environments. Such environments are starting to be visible on the horizon. I also mention how the role and success of educational multimedia is rather different in schools and universities when compared to industrial applications.
In the third part of the talk I take a peek into the future, by presenting one scenario for mobile computing and the serious implications this has not just for how we will learn in the future, but also for what we will have to learn.

1. A Short Overview of Some Developments Between the First ED-MEDIA (ICCAL) Conference in 1987 and Today.

It is well known that the first serious attempt to use computers for educational purposes was the PLATO system developed in the early sixties at the University of Illinois and later commercialized by the then powerful Control Data Corporation. Of its many competitors, PLATO did fairly well for quite a long time. PLATO went through many versions, but the basic idea was to offer a central computer with courseware and use the material from a (then very rudimentary) terminal. However, the fact that all students accessed the same computer allowed for some communication between participants, for keeping track of scores and other statistical information, including feedback on the quality of the courseware. Despite all these features, PLATO never achieved a real breakthrough.

Because of this, alternatives started to be considered. It is typical that at the first of our meetings (Calgary, 1987) topics such as hypertext (allowing for more freedom in the navigation of material), pedagogical and didactic rules for preparing courseware, using the emerging color-graphic features on PC's and using (analog) videodisks that then represented the ultimate multimedia technology were main topics. The networking aspect, one of the main assets of PLATO, was almost forgotten. I happened to be one of the program chairs of that first conference

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and was probably one of the few who had emphasized the need to not forget networking already even before this first meeting in Calgary at the major IFIP conference in Ireland [1].

It is intriguing to see that the topics mentioned, combined with attempts to use elements of artificial intelligence for intelligent tutoring systems (student modeling) and the advent of all kinds of authoring systems including Hypercard on Apple computers kept dominating our conference series for the next three meetings in Dallas 1989, Hagen 1990 and Wolfville 1992. Indeed, no researcher in the field dared not to produce such a system: I was no exception [7]. Mind you, the underlying technology started to change: instead of videodisks, CD ROM's and CD-I's (the latter now almost forgotten) and the examination of strategies for learning gained importance, and networks started to play a more prominent role again, mainly due to the impact Hypermedia systems (such as Intermedia at Brown University); also, the first signs of Internet based systems from Gopher to Hyper-G (now Hyperwave) and WWW started to appear.

By the time ICCAL had changed its name and had become ED-MEDIA (Orlando 1993) Hypermedia based ideas (indicating of what would happen with WWW) and advanced authoring facilities competed with the continuous discussion of learning models. It is now recognized that the behavioristic approach is justified only for "rote learning of facts", and that cognitivistic approaches (requiring real understanding) or constructivistic techniques (where learners have to actually discover, not just to understand situations and solutions) are more desirable. However, the battle between cognitivism and constructivism continued well beyond ED-MEDIA 94 (in Vancouver): we believe that most persons are now happy to accept that both approaches have their role to play, yet some extremists will still claim that one of the two will be ideal for all situations. Also, other ideas that are kind-of orthogonal like explicit vs. implicit learning are still being discussed till today [9]. ED-MEDIA 95 in Graz, Austria, was the first ED-MEDIA where the Internet and WWW started to become central topics... and this has not changed since. The importance of communication and computer supported collaborative work as component of Web-based teaching support systems started to grow increasingly, as is witnessed by a slate of papers in this area presented at ED-MEDIA 96 in Boston. Despite the fact that a new conference series WebNet (now e-Learn with WebNet symposium, this year in Montreal, see www.aace.org/conf/webnet) was split off from ED-MEDIA in 96, ED-MEDIA continued to explode: the 1997 conference that returned to its roots in Calgary was the first one where the printed proceedings consisted of two volumes (to expand to three volumes by 2001!). The fact that the 97 conference had as subtitle ED-TELECOM 97 says it all: educational applications without communicational networks started to look very obsolete. This trend continued in 98 at ED-MEDIA in Freiburg and 99 in Seattle: however, the continuing spread of large educational environments made it more and more important to talk about standardizing formats and using meta-data and meta-data standards. To use electronic educational material on a large scale it is necessary to be able to locate and re-use material created elsewhere. It is with satisfaction that we can observe a continued harmonization between North-American and European efforts in this important area. It is also gratifying to see that the necessity for communication, collaboration and large digital libraries accessible via the Web is now universally accepted as basis for viable learning systems as is clearly documented in the large number of papers in this area both at ED-MEDIA 2000 in Montreal and 2001 in Tampere, Finland. It has also become clear that a substantial learning system needs a huge array of administrative features and that the authoring of material is just a small part of what is necessary to make e-Learning work: this is quite in contrast to the days when e -Learning and authoring of material was almost used synonymously.

2. Current State and Lessons Learnt

Typical for today's situation is the fact that we have ceased to talk about learning applications, are using the term learning-platform less and less, and seem to be moving to the terminology "Learning Environment". Such a learning environment consists of (a network of) servers that offer a variety of components:

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- Courseware modules (re-usable since they follow one of the accepted standards and are searchable due to meta-data that is attached to the modules and is also hopefully standardized)
- Tools to create, combine and modify such modules into new ones
- Tools that allow the administration of the modules mentioned, of authors, teachers, tutors and students, each with a block of statistical data that is gathered as the system is used
- A set of features for communication and collaboration including e.g. chats and discussion forums
- Facilities that allow to use the system for various learning paradigms, different level of learners, provides a high degree of interactivity and powerful tools for (self) testing and feedback

Above list looks innocently simple and complete. It is certainly neither.

First, throughout the discussion we have been using the term "courseware module" without further explanation, nor have we ever stated what it means to have a "high level of interactivity". In fact, both things are closely related. An interactive courseware module is not a sequence of Web pages that one can click through, and it does not become much more interactive if a movie, even a simulation allowing various parameters, or some fill-in questions are allowed. In a cognitivistic approach (and this is still more true in the case of constructivism) a courseware module will be a sophisticated piece of software, hardly the kind of thing one can create with a WWW editor, or the standard authoring system. A high level of interactivity also implies facilities for customization, personalization and active documents, as will be discussed below!

Second, it would take a lengthy paper on its own to describe tools for handling and modifying courseware modules to the extent desirable; and this is even more true of administrative tools that can range from trivial (and hence useless) to very, very sophisticated. Some more details can be found in [8].

Third, innocent looking words like "discussion forum" are really like the mythical box of Pandora: once you start to seriously use a discussion forum with a sizeable group of users the number of issues arising is mind boggling: from questions of the levels of anonymity, to tools for structuring a discussion, to the issue of meta-data for contributions (!), to the issue of active notification of users, to the fact that any large discussion forum has to provide a substantial number of different views of the contributions, to tools for "positive" and "negative" filtering, just to name a few examples. If more complex collaboration tools are to be involved (and they should be) all issues surrounding computer supported collaborative work (CSCW), now discussed in entirely separate conferences, start to be important.

Fourth, systems that really support all kinds of learning paradigms (from e.g. behavioristic fact learning to constructivistic knowledge discovery) are not available "from the rack" but can at best be customized on the basis of generic platforms. To build Learning Environments catering to various learning styles and levels of knowledge requires sophisticated pre-tests both on a cognitive and a knowledge level: again, both tasks have not even been solved in full generality, so far.

Fifth, systems should at least allow to work with them by adding notes (for oneself or a group). They should allow to insert stuff from other sources (marked as such), including of course links, and must provide access to rich background libraries [2]: it must be possible to incorporate parts of material found in such libraries into the courseware modules for the benefit of an individual or a whole group of persons. They must allow asking questions at any point, with the system answering automatically if similar questions have been asked before (as is done in the "active document concept" [3]) or else they pass on the question to tutors or experts who answer them immediately (if online) or "asynchronously", otherwise. Customization should go beyond the courseware module level: it should allow persons to view the catalogue of material offered from their perspective.

Above points are not supposed to be exhaustive (e.g. the self-testing and evaluation aspect have not even been touched upon), but just serve to show how complex good e-Learning environments are. In this sense we have learnt that e-Learning goes much beyond a sequence of beautiful Web-pages with some question/answer material and a few simulations plus Email for communication thrown in. Rather, much effort is required to build a

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credible e-Learning platform. My team and I have worked on a system Hyperwave that is the basis of an advanced e-Learning system for many years [4]: it is available for non-commercial use free of charge for schools and accredited universities. It is the outgrowth of hundreds(!) of person years. It keeps amazing me that such huge efforts keep being ignored by some groups who start to re-invent the wheel all by themselves, not realizing how complex a system has to be to be really successful.

In passing, let me also mention that using e-Learning environments in schools and universities is rather different from using them in companies. In the latter case, they are seen as cost effective tools for in-time learning with high self-motivation of the learners, in the former they are seen as improving the teaching and easing the learning process for persons often requiring external motivation (through grading or such). It is surprising that many people do not seem to grasp that the two situations described are sufficiently different to require rather different e-Learning environments!

3. The Future

While we are still groping for the ultimate approach to e-Learning environments, technology is moving on with tremendous speed. It will not only change **how** we learn but much more crucial **what** we learn. I believe that this should be taken into account as of yesterday ☺ , and much research should go into this direction. To show dramatically what will happen I will present one scenario what the computer of the future (say ten years from now) will look like. The visible part of this computer (basically its I/O device) is shown in Figure 1. The actual computer consists of an innocent looking little box (a bit larger than a box of matches) and contains:

- a high speed processor (working at 10 Giga-Hertz)
- a large internal memory (50 Gigabytes)
- an I/O device for memory cards (like the ones now used in digital cameras but with a capacity of some 100 Terrabytes)
- a mobile phone unit using fast packet-switched technology like UTMS or its successor
- a global positioning system (GPS)
- all this connected wireless (with next generation Blue-Tooth) to a device like the one shown in Figure 1.

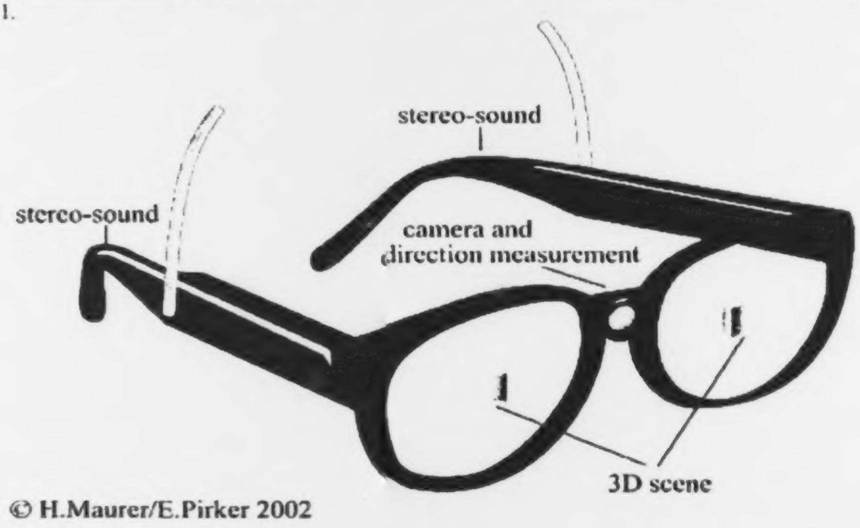

Figure 1

The glasses shown in Figure 1 have a number of special features built-in: they have two loudspeakers near the back end (providing stereo sound to the wearer), they have two small mirror-like gadgets that allow to project a picture generated by the computer into each eye (thus e.g. providing full three dimensional scenes), it has a direction measurement (electronic compass) built in so that together with the GPS the computer knows not only where the person is, but what direction (at what) the user is looking. It also has a camera and a microphone (seen in the middle of the glasses) that records all that is going on, with image processing capabilities, including gesture recognition of the wearer for data input. The two spikes going upward at the end of the glasses are optional: in the further future they will be able to detect a variety of states of the brain, providing a direct brain-computer interface that will further enhance facilities for data input. Much of the power of such a device is not necessary for the discussion in this paper: rather, it is the subject of a separate paper [5]. The main point is that through novel input devices (such as voice, gesture recognition as mentioned, or even input directly from the brain) users can access (through the computer) at any time both huge local data-bases and through the mobile phone future versions of the WWW, i.e. also remote ones; thus users can retrieve just about any information desired, or solve most problems imaginable, with the results communicated through 3D scenes and stereo sound through the glasses shown in Figure 1. Of course this will require advanced techniques of searching to find the relevant information, and only relevant and reliable items: this is exactly one of the main areas addressed in modern Knowledge Management systems such as Hyperwave [4]. Deeper aspects are explained in the paper [6].

Let us stop and ponder for a moment only the trivial aspects of such a situation, where information and problem solving is not just available "at your fingertips" but even more, at the "wink of your eye or hand": in this case, external databases are very much a more or less direct extension of the human brain. How much factual knowledge about history, geography, nature, medicine (you name it) will we still have to learn when it is available any time we need it? If we want to know what we see and what the history of it is, GPS and the direction measurement will allow to give us all the information we care for; if we want to know what kind of flower we are looking at, the flower held against the camera and image processing software will give us the answer; the composition of a certain medication and all its benefits and side effects will flash on our screen when we need it. Specific first aid help will be made available to us after we have performed a computer-supported diagnosis. And, of course, the voice of someone talking in any language to us will have been picked up, translated into English and spoken into our ears, not noticeable to others. Similarly, if a problem in mathematics, or physics, or chemistry comes up, it will be easy to solve it, using the power of the computer and the databases of tools and problem solvers it has available.

Thus, what (beyond skills, like skiing, riding a bike, juggling balls, or doing a surgical operation) do we still have to learn if we have all what we usually learn available to us any time, any place? This is one of the most serious problems that will confront us faster than we will be ready to answer it: what I have outlined will be reality soon. Much of the material we learn today will not be on the curricula of future students. Yet, since it is not easy to imagine an intelligent discourse without having certain basic facts in the brain (rather than in an "external brain") what will those basics look like?

I do hope to hear attempts of partial answers at future ED-MEDIA conferences!

4. References

To write about the development of ED-MEDIA from 1987 to 2002 is to write about the history and the developments of all of e-Learning. After all, the proceedings of the conferences contain a total of some 3000 contributions and many thousands of references to important material. Thus, discussing all this at any level of detail would require a major book, and a very long bibliography. I have thus decided to omit names and references and to only include a very few references to some of my own contributions. Anyone interested in seeing a bit more of what I have done, please visit my website. Anyone interested in more than my brief historic outline is urged to consult the proceedings of ED-MEDIA, many of them available at AACE' s website: they

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very much reflect what has happened in the last 15 years! I apologize to all my colleagues since I have not mentioned any by name, but once I would have started to include some, others would have complained with justification that I have omitted them.

[1] Maurer, H.: Nation Wide Teaching through a Network of Microcomputers; IFIP Congress, Dublin (1986), 429- 432.

[2] Maurer, H.: Beyond Classical Digital Libraries, Proceedings of NIT, Beijing (2001), 165- 174.

[3] Maurer, H., Heinrich, E.: Active Documents: Concept, Implementation and Applications; J.UCS 7, 12 (December 2001), 1197- 1202.

[4] The e-Learning Suite of Hyperwave: http://www.hyperwave.com

[5] Maurer, H.: A Scenario for a Computer of the Future. To appear in: J.UCS 8, 9 (September 2002)

[6] Maurer, H., Tochtermann, K.: On a New Powerful Model for Knowledge Management and its Applications; J.UCS 8, 1 (January 2002), 85-96.

[7] Maurer, H.: Authoring Systems for Computer Assisted Instruction; ACM annual conference, Denver (1985), 551-561.

[8] Maurer, H.: Using the WWW System Hyperwave as a Basis of a General Networked Teaching and Learning Environment; CIT 6, 1 (1988), 63-72.

[9] Almer, W., Holzinger, A., Maurer, H., Pichler, A.: TRIANGLE: A Multi-Media Testbed for Examining Incidental Learning, Motivation and the Tamagotchi-Effect within a Game-like Show; Proc. ED-MEDIA 2001, Tampere, Finland (2001), 1249-1253.

PAPERS

Macromedia-Washington State Digital Design Curriculum Partnership

This partnership highlights a successful public/private partnership designed to develop the IT workforce—specifically in Web design. By working together, Macromedia and Washington State Office of Superintendent of Public Instruction were able to maximize the quality of the curriculum by focusing on teacher and student needs.

Program developers at the Washington Office of the Superintendent of Public Instruction (OSPI) knew that they wanted to develop their students' professional technology skills. They wanted a project-based, state-of-the-art program that helped teachers teach technology in ways that engaged students in real-world learning. But they didn't have the resources or broad expertise to build it all on their own. Many states face this challenge. They understand the problem but can't afford the solution—without taking an innovative approach.

Knowing that corporations want to grow technically skilled workers, OSPI sought a corporate partner with whom they could collaborate on the curriculum. They selected Macromedia because it produced industry-standard professional Web design tools that their students were clamoring to learn. Macromedia was, in turn, looking for a school system that could provide valid—and vital—educator feedback from concept through to the classroom on its new curriculum.

What OSPI brought to the partnership:

- Teachers excited and willing to try something new with their students
- Cross-demographic group of schools to pilot test curriculum
- Insight into the NWCET Pathway standards
- Opportunity for change in Ed system

What Macromedia brought to the partnership:

- Expertise in technology curriculum development
- Corporate approach, and funding, to get a curriculum project done
- Opportunity for teachers to work with industry professionals
- Business people taking teachers seriously

In the last year we have brainstormed the course content, beta-tested ideas, reshaped the syllabus based on a wide base of faculty input and pilot-tested with teachers across Washington. We've developed a curriculum that addresses classic design principles and professional design processes, but we've made it approachable to teachers relatively new to technology. We've found that students really want to learn technology. But they need projects that are relevant to them—and they want to start right away! In this session we will talk about how to make a successful partnership, describe the benefits from business/education collaboration, and share what we've learned along the way.

Qualitative Analysis of Information Communication Technology Use on Teaching-Learning Process

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Abstract: This paper describes some of the features of Information Communication Technology (ICT) and its uses in the teaching-learning process in elementary schools. A number of articles have addressed various issues concerning the many difficulties of how to integrate ICT into the school curriculum. In most schools, it is difficult for ICT to be used effectively in the teaching-learning process. The author participated and observed many classes using ICT in elementary schools. Qualitative data such as interviews with teachers and observation of student conversations and behaviors were analyzed. The research findings were based on ethnographic case studies and are summarized as statements. The findings were summarized and are presented as a causal relation graph. The main results were: (1) Basic computer operating skills such as type writing depends largely on the classroom teacher's attitude and computer literacy. (2) Most computer operation skills such as file saving, and design skills such as designing and developing a homepage were mastered through reciprocal teaching and modeling among children. (3) Teacher's advice helps children to search and access information related to their topics and it was further found that to access topic relevant information was the result of a comprehensive understanding of the information domain rather than operational skills. (4) Learning motivation was highly promoted by collaborative and competitive group activities. (5) Integration of synchronized system such as videoconference into classes' needs professional technical support.

Introduction

There are many articles addressing the difficulties facing those who wish to integrate Information Communication Technology (ICT) into school curriculums. Tebbutt, M. (1999) highlights that there are various influences on the process of implementing ICT in science: the infrastructure for ICT in science, the philosophy for ICT in the school/department, and the external influences on philosophy/practice (refs. [1]). Lawson, T. and Comber, C. (1999) have also identified four factors: teachers' attitudes prior to the innovation, the role of the ICT coordinator, the attitude of senior management and the existence of adequate support and training (refs. [2]). Ertmer, P.A. has discussed two kinds of barriers on technology integration (refs. [3]), and some articles have identified that it is not easy to integrate ICT into school curriculums (refs [4],[5]), as Selwyn, N. describes ICT can be a headache for teachers (refs.[6]). Collis, B., Peters, O. and Pals, N. further detail (refs.[7]), many factors that can influence an individual's decision to make or not make use of some form of ICT in his or her learning-related activities. They highlight the four most important factors, the 4-E model, as being environmental factors, effectiveness, ease of use and personal engagement. This model was tested using statistical analysis using the questionnaire method. The author has also been engaged in research concerning the use of ICT in schools such as project study, in-service teacher training and so on (refs.[8],[9]).

In order to further investigate the factors that affect the integration of ICT in schools an ethnographic study was undertaken where the author participated in actual classes in elementary schools for a one year period (refs [10]). The chosen research approach was based on a partnership between the university and schools, which has been reported as an effective approach (refs.[10],[11]). Almost all data was gathered through interviews, informal conversations, observation of classes, meetings and so on

Research objectives and methodology

The purpose of this paper was to find some features of ICT use in practical classes and to derive findings useful to teachers and educators in aiding ICT integration into classes. In order to conduct the research, the author visited

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two elementary schools and observed 15 classes for a period of one year. The author recorded the scenes, teachers' student conversations and the behavior of classes in field notes, pictures and videotapes, which were selected based upon the author's impressions.

In order to find the definitive variables that affect the use of ICT in classes, the author adopted the following methodology.

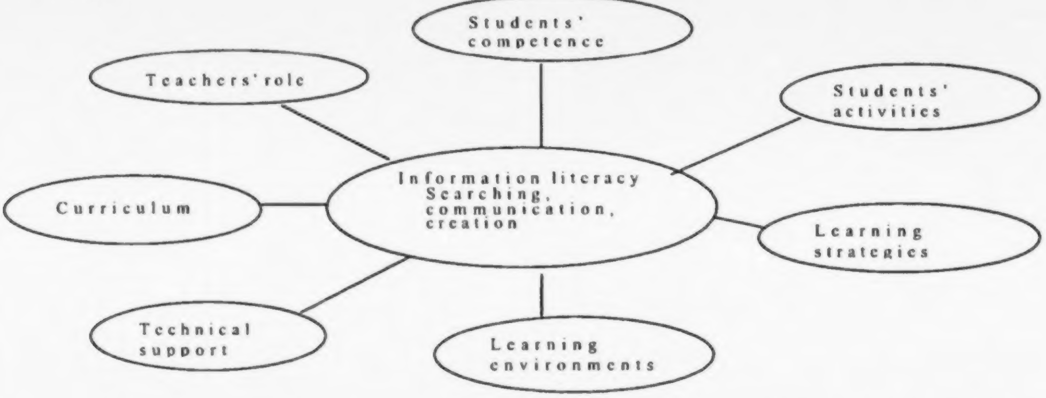

Figure 1. Configuration of large-scale variables as assumption

1. To list large-scale variables (as assumptions)

- Large-scale variables (shown as ovals) are assumed variables and were elicited based from researchers own experiences, their pedagogical view and their view of the learning environment (See Figure 1).

2. Qualitative data collection

- Data collection was conducted based upon qualitative research methodology. Data was collected by observational participation of actual classes; observation of teacher's talk, students' talk and behaviors, and interviews with teachers and students.
- Most of the data was recorded using video, pictures and notes. Lesson plans, teaching materials, the configuration of the computers in the classroom, the atmosphere of the classroom and social relations between students and teachers were recorded. These factors were often found toplay an important role in the success of lessons. However, it is difficult to record inner factors such as human relations or teacher's classroom management competency through observations and interviews, even though these factors are important.

3. To pick up definitive keywords through interpretation of qualitative data

- Keywords were added to these data. By observing pictures and videotapes, reading notes and interviews' records, researchers were able to think of many keywords corresponding to the classroom scenes that had been recorded. These are ranged from simple facts to more meaningful findings. These keywords leading to meaningful findings are defined as 'definitive keywords' in this paper and were added to the casual relation graph as sub-variables (rectangle in shape).
- Researchers picked up definitive keywords, which were selected based upon their impression and interpretation of data.

4. To find a relation between large-scale variables and keywords

- Researchers linked these definitive keywords to the large-scale variables based upon their judgment. Because definitive keywords are crucial, important keywords, these can be related to large-scale variables in most cases.
- Keywords were added to the large-scale variables. All variables could be listed by adding definitive keywords to the large-scale variables.

5. To express some findings as statements and to produce a causal relation graph

- By analyzing the data generated by the observational study, researchers were not only able to identify keywords but also identify key features of the class. Researchers attempted to investigate the reason why

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teachers' and students' talk occurred, tried to extract background theory and models connected to these activities and tried to find new features of the class by comparing it to other classes.

- The extracted findings were expressed as statements these were added to our graph with causal connections being drawn to signify the relationship between one issue and another and specific examples of the observations listed below being denoted as dotted rectangles (See Figure 2).

Findings based on the observation of teachers and student activities.

Twelve findings are summarized and presented as the following statements.

(1) Keeping and memorizing a password is difficult for children. **Example:** A teacher comments "Some children often forget their own passwords, therefore requesting children to change their passwords for protecting security is impossible. So, we introduced a password-card and asked the children to keep the card."

(2) Children's keyboard typewriting skills were affected by the classroom teachers' aptitude.

A variety of skills were found amongst the children from high-level skills such as blind touch-typing to the low level skills such as one fingered-typing. The development of these skills seemed mainly dependent on the frequency of access to computers for these children. **Example:** A teachers comments "There is some evidence showing the reason why children's typewriting skills are so different. Children in the class, of a teacher that often uses the computer room are generally more skillful in typewriting. On the other hand, children of teachers that do not use the computer room often are not as good at typewriting. And there is also appears to be a difference between boys and girls.

(3) A teacher's advice appears to work most effectively when talking to children individually (directly by face-to-face communication).

It is often difficult for a teacher to communicate individually with a child during a class. However, in the computer room the teacher is able to talk directly to each child face-to-face. It provides satisfaction to both the teacher and the children; it therefore works effectively from the point of view of an instructional methodology. **Example:** When children encountered unfamiliar material/procedures such as operations, messages or instructions from the computer, he/she asks questions to teacher, who is walking around the computer room. A teacher comments, "I was satisfied to communicate with children directly face-to face

(4) Children learn mainly by observing contents displayed on the other students' screen; it is interpreted as the modeling effect.

Children show their interests when they encounter content or information different from their own thinking. When they have an interest in the information on the screen, they observe it for a much longer period of time. Through peer observations, they appear to learn a lot from each other; a type of modeling learning environment is produced. **Example:** When children find the content or information different from their own, they observe the screen for a much longer period of time. Children say, " This mail is much longer than the one I sent, so I am reading the mail, and thinking how to write more sentences."

(5) Reciprocal teaching will naturally happen, when they encounter the unknown.

When children encounter the unknown or find some questions, they naturally begin to talk together in order to solve the problem. And they exchange their ideas and products; this is considered to be a type of reciprocal teaching. **Example:** When children encountered the unknown, they asked the teacher or their classroom peers. A girl asked another child how to make a report and learnt by observing another child's product and through the exchange of ideas.

(6) Children learn more by accessing the homepages made by older children.

Children learn more by accessing the products made by children in the upper grade than in the same grade. The lesson plans that were designed to connect children to different grade children worked effectively. It appears that in these situations learning is promoted through an effect known as the zone of proximal development (refs.[13],[14]). **Example:** Children accessed the homepages made by children in the upper grade, and they said "How wonderful this report is, I would like to know how to make it."

(7) On collaborative working in the classroom, the group leader's role and leadership skills including intelligence are important and crucial for leading the group through to success.

It is known that the leader's role is very important not only for group work in schools but also in general office

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work. Expert teachers, who are experienced users and instructors of ICT education, talked of the importance of the above-described findings. **Example:** Children producing a report through a group working activity. A child, the leader of the group, says "Be careful when saving, because we must make the file name easy to access and easily recognized by our members." A teacher remarks, " The outcome of group work often depends on the leader's power and character."

(8) Comparing and observing other group's work through a computer network brings competitive feelings to group members, and a competitive willingness promotes children's incentives towards producing a better performance.

The computer network enables children to access and observe other groups' work and performance; it leads to group members' exhibiting competitive feeling and willingness. Sometimes it is more effective to use group work to produce better products. Children learn a lot of techniques and superior design methods through group competition. **Example:** Through accessing and observing other group's work, children can compare and evaluate their own performance. Group members say, "Let's introduce more sophisticated techniques so that we can compete with the other groups."

(9) When group members combine the individual work made separately into one product at final stage, children show a lot of satisfaction.

Collaborative learning makes children produce a more superior product than individual learning. It also brings deep satisfaction to children especially when combining their individual pieces of work into one product at the final stage. It is also important from a pedagogical point of view. The computer network system enables to realize these learning activities. **Example:** Group members are combining individual work made separately into one product. They watch enthusiastically the screen displaying their product. They say "Oh, great. Let's revise here and add another picture"

(10) Technical support is needed especially when using synchronized telecommunication systems such as a videoconference system.

Most classroom teachers are not computer network experts; therefore technical problems that may occur may not be able to be dealt with by the teacher. Team-teaching such as the classroom teacher coupled with computer experts such as computer teacher or technical assistant is much more effective when conducting a class using complicated systems. To remove the classroom teacher's fear is essential. **Example:** A class using a videoconference system when a technical trouble occurred. Classroom teacher comments, "I cannot do any thing, because I'm not computer network expert. We don't have enough time to check as to how this problem occurred." When later asked about their feelings about working with technical equipment in the classroom one teacher remarked, "My fear disappears when team teaching together with the technical assistants".

(11) Accessing desirable sites using search engines with keyword inputs is not easy for childrenit takes time and requires domain knowledge.

Most children would like to retrieve desirable sites using search engine with keyword inputs, but in many cases they are unsuccessful with their attempts. In order to get desirable information, children must have domain knowledge related to the topics they are searching for, not only operational skills such as how to use a search engine. Without domain knowledge, they often failed to access desirable information. In addition, it is often not easy for children to remember suitable keywords for retrieving information, because these keywords are often closely connected to the domain knowledge. Scaffoldings by teacher or other students' having more domain knowledge are required. **Example:** From the observation of children's activities in retrieving a site using search engines the following was found. Children that had been attempting to access topic specific sites for a long period of time abandoned their attempts to try and retrieve information using a search engine.

(12) Using a variety of resources enables children to search out information more effectively.

There are many learning resources such as the Internet, CD-ROM, newspapers, books, videotapes and so on. When children search for topic related or make reports a variety of resources that holds relevant material should be made available to them. Information on the Internet is not always reliable as is well known. At present a combination approach is required which would allow children to use the Internet as well as other resources in order to ensure an effective learning environment. **Example:** When children are told to produce reports as their assignments, they often go to search for additional information. As resources for investigation they can use the

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Internet, CD-ROM, newspapers, books in the library, and construct a report according to their teachers' recommendations.

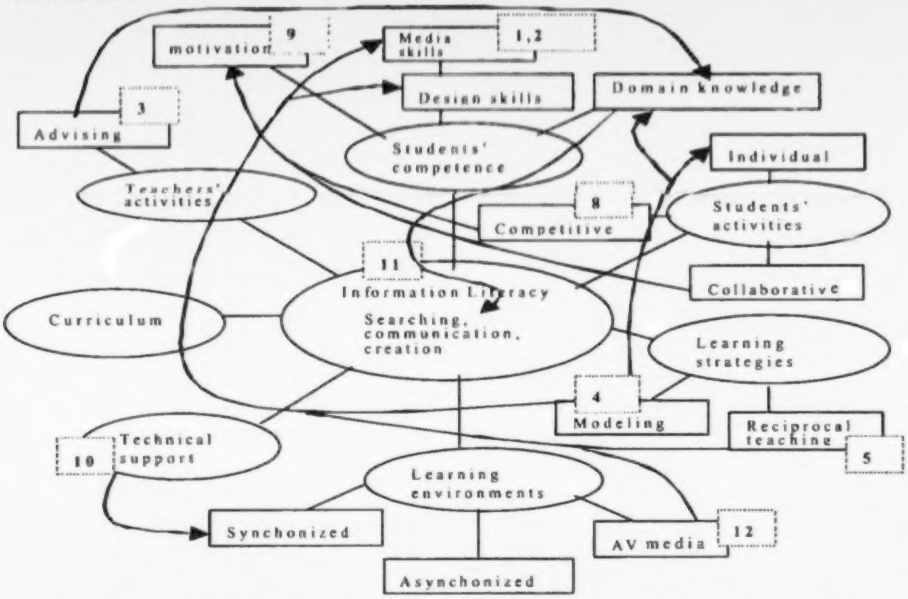
motivation
9
Media skills
1,2
Design skills
Domain knowledge
3
Advising
Students' competence
Individual
Teachers' activities
8
Competitive
Students' activities
11
Information Literacy
Searching, communication, creation
Collaborative
Curriculum
Learning strategies
4
Modeling
Reciprocal teaching
5
10
Technical support
Learning environments
Synchonized
AV media
12
Asynchonized

Figure 2. Causal relation graph based on qualitative data analysis
O val- assumed large-scale variables. rectangle- sub variables

Conclusion

The twelve findings described above are represented as a causal relation graph shown in Figure.2 The important findings from pedagogical view point can be summarized as the following statements.

(1) Basic computer operating skills such as type writing often depend on the classroom teacher's attitude and computer literacy level.

(2) Most computer operation skills such as file saving, and design skills such as homepage making are mastered through reciprocal teaching and modeling among children.

(3) Teacher's advice helps children to search and access information related to their topics, moreover it was found that the access of topic related effective information is closely tied to domain knowledge a child has rather than operational skills.

(4) Learning motivation is highly promoted by collaborative and competitive group activities.

(5) Integration of synchronized systems such as videoconferencing in classes needs professional technical support.

From the pedagogical view, reciprocal teaching and modeling among children (2), and teachers' advice (3) seems to be more important than other findings, as it effectively highlights the different roles of novice and expert users of ICT in classes. In order to integrate ICT into classes, ICT literacy such as type writing skills, file operation skills, design skills, and a competent understanding of the learning domain are required. Integration of ICT literacy and domain understanding is essential in promoting ICT education in schools. Traditional teaching methodology is mainly based on the teacher's knowledge and their teaching strategy regarding how to transmit their expert knowledge using authorized teaching materials. However, ICT literacy can be acquired by reciprocal teaching and modeling among children without the teachers' assistance. In the classroom, there are often some children that are competent computer users because they have access to and often use a computer in their own home. These children play an important role in the transmission of skills to other children through cooperative activities. Collaborative learning among children was found to be most effective in the domain of computer skills' acquisition. This finding can be interpreted by using the concept of Vygotsky 's zone of proximal development, a

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concept that has previously been noted as playing an important role inof ICT education (refs.[14],[15]). Most children do however fail to access suitable Web sites. This suggests that information literacy or the ability to search for information, utilization, representation and so on are closely related to the child's knowledge of the each specific information domain. The teacher as an expert of each domain can play the important role in cultivating the child's ability to strengthen their information gathering skills. It can be concluded that information literacy or capability cannot be separated from domain knowledge, and that information capability needs to be acquired through subject learning such as cross-curriculum through teacher guided assistance, while computer operation skills can be acquired through peer teaching and modeling from other children through collaborative work sessions.

References

[1] M. Tebbutt, "Information and Communications Technology in the Science Curriculum: an Australian case study", J. of Information Technology for Teacher Education, Vol.8, No.1, pp.25-39, 1999

[2] T. Lawson, C. Comber, "Superhighways Technology: personal factors leading to successful integration of information and communications technology in schools and colleges", J. of Information Technology for Teacher Education, Vol.8, No.1, pp.41-53, 1999

[3] Ertmer P. A., "Addressing First- and Second-Order Barriers to Change; Strategies for Technology Integration", Educational R & D, Vol.47, No.4, pp.47-61, 1999

[4] R.T.Clift, L.Mullen, J.Levin, A.Larson, "Technologies in contexts: implications for teacher education ", Teaching and Teacher Education, Vol.17, pp.33-50, 2001

[5] Willis J., Thompson A., Sadera W., "Research on Technology and Teacher Education: Current Status and Future Directions", Educational R & D, Vol.47, No.4, pp.29-45, 1999

[6] N.Selwyn, L.Dawes, N.Mercer, "Promoting Mr. Chips: the construction of the teacher/computer relationship in educational advertising", Teaching and Teacher Education, Vol.17, pp.3-17, 2001

[7] Collins, B., Peters, O. and Pals, N. "A model predicting the educational use of information and communication technologies ", Instructional Science (An International Journal of Learning and Cognition), Vol.29, No.2, pp.95-125, 2001.

[8] Akahori, K., "Effectiveness and some problems of the Internet: Utilization to education from overview of school practice research in Japan", proc. of SITE (Society fro Information Technology & Teacher Education), 98 International Conf. in Washington, DC, 1157-1156,1998

[9] Akahori, K. Horiguchi, H., Suzuki, K., Nambu, M.,"Development and Evaluation of Web-based In-Service Training System for Improving the ICT Leadership of Schoolteachers", Journal of Universal Computer Science, Vol.7, No.3, pp.211-225

[10] Akahor,K. "Features and Framework of Information Communication Technology Use in Classes", Proc. of Int'l Conference on Computer in Education 2001, pp.974-977,2001

[11] D. M. Marcovitz, "Support for Information Technology in Schools: the role of student teachers", J. of Information Technology for Teacher Education, Vol.8, No.3, pp.361-374, 1999

[12] S.A.Barab, K.D.Squire, W.Duber, "A Co-Evolutional Model for Supporting the Emergence of Authenticity", Educational Technology Research and Development, Vol.48, No.2, pp.37-62, 2000

[13] Miles, M. B., Huberman, A. M.(Ed.), "Qualitative Data Analysis, Second Edition", SAGE Publishers, Inc., London, 1994.

[14] Admiraal, W., Veen,W., Korthagen, F., Lochhorst,C., Wubbels, T., "Tele-Guidance to Develop Reflective Practice: experiences in four teacher education programmes across Europe", Journal of Information Technology for Teacher Education, Vol.8, No.1, pp.71-88, 1999

[15] Hoel,T., Gudmundsdottir, S.,"The REFLECT Project in Norway: interactive pedagogy using email ",Journal of Information Technology for Teacher Education, Vol.8, No.1, pp.89-110, 1999

Issues and Prospects of E-Learning in Oman

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Abstract

The paper describes the issues and prospects of e-learning in Oman educational system. Technology has transformed the practice of education in many countries and Oman is set to modernize her education to align with the rest of the world. Several issues are receiving attention as policies are formulated and the requisite foundations are being laid in preparation for the national distance education program in Oman.

Introduction

The Ministry of Education in the Sultanate of Oman has continued to put the education of both girls and boys high on her priority list. During the Five-Year Plan 1996-2000, a total of 107 new schools were built as the Ministry has a comprehensive plan to modernize the education system to meet with meet the needs of the 21st Century. By the year 2000 about 565,856 boys and girls, aged 6-18 years were in schools (Ministry of Information, 2000). In 1994, there were about 3,600 students, in the various specializations at the only university, Sultan Qaboos University (SQU) with 56% females and 44% males. Only a small fraction of high school graduates get admitted into SQU.

E-learning is of interest in Oman because of the apparent inability of the only public university to cope with the large number of students who qualify for higher education but cannot be offered places. Research and experience around the world have shown that e-learning can bridge this gap. Canning-Wilson (2000) reports experts' prediction that in the next few decades, over 50% of student population will be educated using on-line learning and/or technology. What then is e-learning?

The most important concerns at this point in Omani educational development are whether or not e-learning is the best alternative in order to increase University admissions of Omani high school graduates? To what extent can policy-makers and educators trust e-learning in producing high quality university graduates? What are the criteria for assessing the quality of e-learning to accord it the reasonable credibility for acceptance? What are the issues involved in e-learning security? These concerns are, in a sense universal. A survey entitled "*The States of E-Learning in the States*" found that the current challenges most frequently cited by the States are the costs of developing content and training instructors; the necessary enlargement of infrastructure capacity; the quality of courses and content; agreements on articulation and residency; the responsiveness of traditional institutions; and issues of privacy and intellectual property rights. The report shows that States rank quality issues as their highest concern (NGA, 2001).

IT Status and Prospects of E-Learning in Oman

The Sultanate of Oman recognized IT as an enormous untapped wealth and began to focus her efforts in setting up IT business parks and Information Technology institutions. Apart from IT adoption in Governmental and the private sectors, educational institutions have embraced IT on a large scale. In the last few years, there had been a proliferation of the Internet Cafes in major cities of Oman and IT literacy continues to improve with many citizens using the email facilities and surfing the Web for needed information on a daily basis.

It is important that Oman is able to keep pace with the rest of the world. Al Balooshi (2001) asserts that e-learning is the "now big thing" and not the "next big thing" and that e-learning must be viewed with some seriousness in the Gulf region. On-line learning is the future of education and it is certain that those teachers who are still trapped in the in the chalk and talk tradition will be left behind as education advances into the 21st century. Canning-Wilson (2000) Further states an assumption that "Educators in the Arabian Gulf and worldwide will need to be more proficient in Educational

Technology, more aware of the theoretical and practical aspects of foreign and second language teaching, as well as increase recognizing the need to build further awareness of how teaching methodologies, learning strategies, and learning may be altered based on this new medium of on-line education".

In Oman, the population is spread thinly over a wide geographic area. To ensure that the populace has access to the resources they need, two solutions exist which concern telecommunications. First, electronic storage and retrieval of information via the Internet will continue to erode the role, traditionally filled by books and printed media. Secondly, e-learning technologies will bring education to the Omanis by providing access to learning resources at a wide variety of locations, rather than making people travel to education. The World Wide Web offers a truly global library of a scale unimaginable and it is available equally to students studying at home or anywhere in Oman. Oman Telecommunication Company's Internet service has struggled from time to time as demands constantly outstripped capacity. There are about 40,000 registered Internet customers and over 90,000 users. It is understood that today SQU alone has over 15,000 users. Omani students get linked with their counterparts in any part of the world through the Internet. (Al Rawahy, 2001).

Internet instructional uses by SQU faculty members are however, mostly limited to obtaining information and rich resources available at all times. This suggests that they should be trained and encouraged to broaden their use beyond the present status (Abdel Rahim & Al Musawi, 2002). Currently, there are attempts at e-learning, using the WebCT by faculty at SQU and a study on the implementation and perspectives of the early adopters has been conducted (Akinyemi et al, 2002). Omani educational system needs to learn from other countries' experiences in her development.

Conclusions

While Oman is not oblivious of the advantages of e-learning many Omani educators will be better convinced with more research evidence on the quality, security and credibility issues of e-learning. The Omani concern for comparability of standards with the traditional system is a genuine one which must be attended to before e-learning can be developed, disseminated and diffused into higher education on a large scale. According to the call by Al Balooshi (2001) and Al Majdoub (2001), there is a need for e-learning strategic plan for the Arab world and Oman will be a fore-runner in the formulation of such e-learning strategies.

References

Abdel Rahim, A. & Al Musawi, A. (2002). Instructional Uses of Internet Services by SQU Faculty Members, Part 2, *International Journal of Instructional Media*, 30 (2). (In Press).

Akinyemi, A., Osman, M. T. and Al Kindi, M (2002) Implementation and Perspectives of WebCT at Sultan Qaboos University. Unpublished CET Research, Sultan Qaboos University, Sultanate of Oman.

Al Balooshi, F. (2001). Creating E-Learning Communities: Effective Strategies for the Arab World. In Educational Technology Symposium/Exhibition 2001 Proceedings, SQU.

Al Majdoub, S. (2001). A Strategy for E-Learning for the Arab World. Unpublished Workshop presentation at the Educational Technology Symposium/Exhibition 2001, SQU.

Al Rawahy, H. (2001). E-learning: A Telecommunications Perspective. In *Educational Technology Symposium/Exhibition 2001 Proceedings*, SQU. (under publication).

Canning-Wilson, C. (2001). E-learning with the E-teacher: Considerations for On-line Course Design. Available: http://www.eltnewsletter.com/back/December2000/art422000.htm

Ministry of Information (2000). Oman 2000. Muscat, Sultanate of Oman.

National Governors Association-NGA- "Center for Best Practices" (2001). The States of E-Learning in the States. Available:
http://www.nga.org/center/divisions/1,1188,C_ISSUE_BRIEF^D_2125,00.html

NDU Knowledge Net:
A Web-Enabled Just-In-Time Information Service for Continuing Education

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Abstract: This paper describes the development of a web-enabled information service for constituents of the Information Resources Management College. The constituents of the College, who include graduates, current students, and prospective students, typically work in the Chief Information Officer (CIO) office of United States federal agencies. The web-enabled information service, known as "Knowledge Net," is intended to tie the College constituents located throughout the world into a virtual community sharing technical information, emerging problems, and potential solutions. Knowledge Net has evolved over a three-year span from a skunk-works project of several faculty members to an institutionalized system supported by the University. The most significant lessons learned to date include the requirement for a web-enabled content management system to ease posting of information to the website and the need to adjust administrative policy to encourage faculty to take on and integrate Knowledge Net related activities into their ongoing academic responsibilities.

Introduction

The Information Resources Management (IRM) College of the National Defense University is, in a sense, a Corporate University for information technology executives in the Department of Defense (DOD) and other federal agencies. The IRM College, located in Washington D.C., offers several graduate-level programs dealing with policy, strategy, development, and management of information technology systems.

One of the major programs offered by the College is the Chief Information Officer (CIO) Certificate program. This program, attended by mid-to-senior level managers in the Department of Defense as well as all other federal agencies, leads to a CIO Certificate acknowledged by the Federal CIO Council. The certificate attests that graduates of the program have received education in the skill and knowledge required of federal Chief Information Officers. Also, students completing the program earn 15 graduate-level credit hours that can be applied towards Master's Degrees at several civilian institutions. The students earn the CIO Certificate by successfully completing eight of approximately 20 graduate-level courses from ten defined competency areas: *policy, strategic planning, leadership, process improvement, capital planning, performance measurement, technology assessment, systems architecture, security*, and *system acquisition*.

Like many other corporate universities, the IRM College conducts its courses face-to-face and via an asynchronous distributed education. However, in its continuing education role for our primary constituents, the College recognized that formal courses (residential and distributed) are only one way of meeting their ongoing information needs. There are perhaps twenty thousand people worldwide serving in the CIO organizations of DOD and other federal agencies. The IRM College has the capacity for handling a maximum of 2,000 students per year. How should the College support the other 18,000 individuals? How can it better serve the graduates of its program?

These twenty thousand people are also in need of continuing development and support. They work in the field of information technology that changes radically, not just in the superficial "bells and whistles" of the systems, but even more so in the requirements for management oversight. How will conversion to a wireless strategy change the fundamental way business is accomplished? How can the greater demand for information security be balanced with increasing concerns of information privacy? The people who work in federal CIO organizations worldwide are continually bombarded with new demands and challenges for which they were unprepared by educational programs taken just six months earlier. Curriculum development activities at the IRM College indicate that about half of the program content must be significantly revised each year. In addition, even though there is a commonality of issues through which all members of federal CIO staff must work – whether at an outpost in Korea or at a government research facility in North Carolina – each unit tends to do so individually, on its own. Historically, there has been no community by which federal CIO staff can share common problems and solutions. With the exception of the infrequent periods of time when some of them are jointly enrolled in courses at the IRM College, they are on their own – keeping up with the technology as best they can, testing out their own solutions until their next opportunity to occupy one of the limited slots for attendance at the IRM College.

The Information Service

The emergence of the World Wide Web, its growing accessibility, and rapidly developing functionality offer a supplemental approach for achieving the mission of continuing education. The model conceived to take advantage of the evolving capabilities of the Web - beyond conducting formal courses online - has been designated as the NDU Knowledge Net (http://www.nduknowledge.net/). The NDU Knowledge Net is a web-enabled service seen as an alternative Information Age strategy for the University to deliver just-in-time continuing education to its constituency. As originally conceived, it provided the following web-enabled services for each of the ten competencies identified by the Federal CIO Council:

- FAQs: Frequently Asked Questions and answers concerning fundamental concepts
- NEWS: Summary and links to recent developments concerning the competency
- GUIDES: Software tools, decision aids, and "How to" guidelines to do things.
- EVENTS: Links to training/educational programs and conferences related to the competency
- EXAMPLES: Success stories and sample products of real-world applications
- RESOURCES: Annotated links to related references on the Web

Two additional services were envisioned for the information service:

- FORUM: Threaded discussions on topical issues facilitated by faculty and users
- LIVE: Entry to scheduled real-time discussions and briefings on topical issues

The home page for the original Knowledge Net provided direct access to each of the ten competency areas (e.g., *policy, strategic planning, leadership,...*). Access was also provided to a search engine for searching all the Knowledge Net content, a statement of the web policy governing the Knowledge Net web site, a glossary of terms associated with the CIO position, and links to related sites.

When the user clicked on the name of a competency on the home page, the *NEWS* page for the selected competency area opened. From here, the users had a number of options. They could...

- scroll down the summaries of articles until they find one in which they are interested, and then click on the arrow icon to open that article in a separate window.

- open a different kind of page for the same competency (e.g., *EVENTS, GUIDES,...*) by clicking on one of the tabs near the top of the display.

- access the same kind of page in another competency area (e.g., *Policy, Strategic Planning, Leadership,..*) by clicking on one of the icons at the top of the page .

- access any of the general purpose pages (e.g., *search, glossary, contact us,...*) by clicking on an appropriate section of the image map in the upper left section of the display.

Each of the other kinds of pages has the same functionality as the *NEWS* page.

One Content Manager was responsible for each of the ten CIO competency areas. Volunteer faculty members with technical specialties in the associated competency accomplished these roles. They searched for relevant content, in part to support their normal course development and teaching duties, and in part to maintain the currency of the Knowledge Net competency web pages for which they are responsible. To assist them in this role, a pool of students doing independent study courses in related topics and research assistants was made available to them. They were also encouraged to establish special interest groups composed of other faculty, alumni, and practitioners in the field to feed them relevant sources of information. Content Manager are also provided with an account for a software agent under their control that continually crawls the web and reports back on a periodic basis with updates to its discovery of relevant content.

As the Content Managers identified items for their Knowledge Net area, they entered the required information into an electronic form designed for this purpose. Their submissions were entered into a database. At this time, items were uploaded from the database to the Knowledge Net server manually by a Webmaster, to allow for a quality control check.

The faculty member who conceived the idea of Knowledge Net served as its coordinator. His primary roles were to coordinate the activities of the Content Managers, provide quality control over the website, and serve as a catalyst for continual improvement and redesign of the site. He was supported by a Graduate Research Assistant who acted as the Knowledge Net Webmaster. Site statistics were made available from the external website hosting service, and mechanical checks on the site were conducted periodically by a subscription service looking for broken links, misspellings, and sources of excessive downloading times. Regular meetings were conducted with the Content Managers and typical users to help identify opportunities for improvement.

Lessons Learned

The initial phase of Knowledge Net development covered in this paper is restricted to the web publishing function – the posting of relevant information for users. The discussion and streaming capabilities will be introduced into Knowledge Net later this year.

In the earliest stage, Knowledge Net was hosted on a local University server. The Content Managers created and updated pages (*News, Events*, ...) associated with their assigned competency area using a web editor software package (i.e., Frontpage). Updated pages were sent to the University Webmaster who in turn would upload the pages to the server. This approach proved disastrous. Firstly, although IRM College faculty members are quite proficient in management concepts associated with information technology, their expertise with web editors varied considerably. The updating process required that the Content Managers first download the current page from the web server (to assure that the page being revised included all current changes), update it with the web editor, and then send it to the Webmaster for uploading back to the server. This did not always happen this way. Occasionally, a Content Manager would update the web page on his or her local drive and send it to the Webmaster without first downloading the most current page from the server. If the page on the server was a more recent version than the page on the Content Manager's local drive, this action would overwrite previous changes and corrections. In other words, configuration management of the website was a nightmare. Plus, the lack of capability with web editors by some Content Managers led to some very strange looking web pages uploaded to the server.

Another problem associated with this early stage in Knowledge Net development was its dependence on University assets – the University Webmaster and the hosting of the website on the University web server. As an experimental project of the IRM College, Knowledge Net was not high on the list of University priorities. The University Webmaster was managing multiple web projects, some of great concern to the University senior administration. It was not unusual for pages updated by the Content Managers to remain on the Webmaster's system for a week or more waiting to be uploaded to the web server while the Webmaster attended to more pressing University duties. Also, periodic weekend maintenance of the University's systems made Knowledge Net frequently inaccessible to users.

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Both these problems were solved fairly easily by hiring a part-time Graduate Research Assistant as the Knowledge Net Webmaster and outsourcing the hosting of Knowledge Net to an external organization at a cost of about $200 per year. The website is now available 24/7 with rare periods of inaccessibility. The new Knowledge Net Webmaster quickly created simple web-based transaction forms and scripts to elicit new content items from the Content Managers. In this situation, a Content Manager wishing to update a page with new information accesses a web-based form customized to the type of page being updated. After entering the requested data (e.g., *title, date, link, summary*), the Content Manager can preview the appearance of the new item and then click on the Submit button to send it to the Webmaster. Content management no longer required the use of web editors and configuration management was completely in the hands of the Webmaster. The Webmaster was asked to upload new items to the server within three days of receipt, a requirement that was generally met except during periods of illness, vacation, and competing academic pressures on the Research Assistant. More recently, the Webmaster created a new system in which new items submitted by the Content Managers are entered directly into a database that, in turn, generates the updated web pages on the fly. In other words, as soon as a Content Manager submits a new item, it is immediately displayed on the Knowledge Net website. Content Managers now also have the ability to edit and delete items from the database themselves. They are now, indeed, *content managers*.

Another problem led to a major overhaul of the Knowledge Net website this year. Up until recently, the Knowledge Net areas (e.g., *Strategic Planning, Capital Planning,...*) were based on the ten competencies originally specified for Department of Defense CIO's. As such, ten IRM faculty members were recruited to serve as Knowledge Net Content Managers, one for each competency. The selected faculty members undertook this new incremental task with varying degrees of enthusiasm. Some were highly excited about the prospect of managing a portion of a website devoted to a content area associated with their own intellectual pursuits. These faculty members saw their content management responsibility as an opportunity, spending several hours a week in the search for new relevant content, publishing new items almost every day, and integrating the website into their academic courses as a major information resource. However, other faculty members were more reluctant to embrace their content management responsibility. They seemed to see their role in Knowledge Net as a burden, almost a distraction to their ongoing academic duties. As a result, the content on web pages associated with these competency areas might not be updated for weeks on end. This is a serious problem for a web-based information service such as Knowledge Net. Websites of this sort must have fresh content in order to attract and bring visitors back. At the request of the Knowledge Net Coordinator, the College administration granted teaching load credit for Content Managers. It was hoped that the ability to reduce teaching hours in return for work done on Knowledge Net would both free up the necessary time and serve as an incentive. Moreover, the granting of contact hours gave recognition that Knowledge Net was a legitimate and important service of the College. Unfortunately, this management action had virtually no affect on the frequency with which web pages of the various competency areas were updated. The pace of activity on Knowledge Net by both groups of Content Managers – those who saw it as an opportunity and those who saw it as a problem – went on as it was.

The proposed solution to this issue led to a redesign of Knowledge Net. The number of competency areas has been collapsed from ten to six and these six areas are now aligned with the organizational structure of the College. The six areas are now *e-Government, Performance Management, Enterprise Architecture, Systems Acquisition, Technology Capabilities*, and *Information Assurance*. Each of the three academic departments in the College now has responsibility for two Knowledge Net areas, and two of the areas - *e-Government* and *Information Assurance* – are each aligned directly with a center of excellence at the College. Department Chairs at the IRM College have supervisory responsibility over faculty (i.e., they play a prominent role in hiring, contract renewal, work assignment, promotions, and bonuses). The redesign was based on the belief that a more consistent level of performance will be attained by reducing the number of required Knowledge Net Content Managers (i.e., it should be easier to find six personally motivated faculty members than ten such individuals) and by delegating their selection and management to the Department Chairs. This change was initiated about three months ago and, although performance has been more consistent, it is too early to declare a success. Everyone is still exploring the requirements and practices of his/her new responsibilities.

The redesign of Knowledge Net also involves the following changes that are expected to be completed by the end of 2002:

- Redesign of the pages for a common look & feel consistent with a new IRM College website.
- Reduction in the number of kinds of pages for each competency (*Basics, Articles, Events,*

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Documents, Websites), which are easier to distinguish among than the previous page types.

- Introduction of a more powerful search engine.
- Addition of a threaded discussion capability to be facilitated by the Knowledge Net Coordinator, with the voluntary assistance of other Content Managers, to enable users to share field problems and solutions with each other.
- Ability of users to suggest sources and items for inclusion into Knowledge Net.
- Presentation of scheduled lectures by faculty and guest speakers of the IRM College using streaming video.

Conclusions

The existence of Knowledge Net offers a number of benefits to the College and its constituents.

Benefits to the Constituents of the College

Knowledge Net enables the 20,000 thousand people working in federal CIO officers to continue their professional development, even when they are unable to enroll in formal College courses. They have access to current information about the field anytime and from anywhere – information that has been selected and filtered by faculty experts in the CIO competency. When the full functionality of Knowledge Net comes online in 2002 with streaming video and discussion boards, users will also be able to hear and see guest speakers at the College talk about advanced topics related to the field, and discuss issues with faculty, peers, and experts around the world.

Moreover, Knowledge Net benefits the College's constituents by helping improve their job performance – it serves as a kind of electronic performance support system. Users can stay abreast of late breaking news concerning CIO responsibilities. They can more easily find resources to help do their jobs, just when they need them. Using the discussion boards, they can note how things should be done and how others are actually doing them – noting what works and what does not. They can even collaborate with others doing the same kinds of things no matter where they are doing them.

Benefits to the Institution

The mission of the IRM College is to "prepare military and civilian leaders to direct the information component of national power by leveraging information and information technology for strategic advantage." Note that the mission says nothing about preparing these leaders by means of educational programs. Knowledge Net is an alternative means to accomplish the College's mission, one that is likely to play an even more prominent role in the future.

Knowledge Net also benefits the College by strengthening its relationship with its constituents. Certainly, the information available on Knowledge Net is a resource available to students currently enrolled in courses, both residential and online. It provides a searchable database of relevant information useful for papers required in the academic programs. As mentioned previously, Knowledge Net is also available to graduates of our programs for continuing education and development. Alumni thereby remain connected to the College long after graduation. Knowledge Net can even be used to promote the College programs. Many of the 20,000 people working in federal CIO organizations are unaware of the IRM College's existence and the availability of the CIO Certificate program. If Knowledge Net is perceived as a useful tool on the job, its association with the IRM College can continually attract new students.

Implications For Other Organizations

The Knowledge Net strategy being developed by the IRM College seems to have value for other corporate universities, provided they see their missions as developing and supporting the job performance of constituents, rather than just conducting training and education courses. In a similar vein, professional

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associations whose members share a common set of competencies can also apply the strategy. Even subject-specific centers of excellence resident in institutions of higher learning can implement a Knowledge Net-type website to benefit both their constituents and the center itself. In fact any organization seeking to support constituents with a common set of competencies and that possess a group of specialists who are willing to adapt web technology to serve their role can implement a Knowledge Net strategy.

References

Relevant Websites:

National Defense University - http://www.ndu.edu

Information Resources Management (IRM) College - http://www.ndu.edu/irmc

Information on CIO Certificate Program - http://www.ndu.edu/irmc/cio.html

"What is a CIO" - http://www.cio.com/executive/edit/description.html

NDU Knowledge Net - http://www.nduknowledge.net/

Articles:

Gilbert, L. S. (Summer 1998) Intranets for learning and performance support. *New Directions for Adult and Continuing Education* no.8 pp.15-23.

Hanka, R.; Fuka, K. (2000) Information overload and "just-in-time" knowledge. *The International Journal for Minicomputer, Microcomputer, and Software Applications in Libraries.* 18, Part 4: pp.279-284

Kester, L; Kirschner, P. A; Van Merrienboer, J. 0; and Baumer, A. (2001) Just-in-time information presentation and the acquisition of complex cognitive skills Computers. *Human Behavior.* 17, no. 4,: pp.373-393.

The views expressed in this article are those of the author and do not reflect the official policy or position of the national defense University, the Department of Defense, or the U.S. government.

Integrating Handheld Technology and Web-based Science Activities: New Educational Opportunities

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Abstract: We describe the integration of handheld computer technology into an existing web-based educational platform, the Web-based Inquiry Science Environment (WISE) and the synergy it produces. This solution facilitated a research program that explores how handheld computers (PDAs, palmtops, etc.) can expand the scope and functionality of inquiry activities in K-12 science and mathematics curriculum. We present the WISE software and curriculum and explain how combining it with handheld technology creates unique educational opportunities. We then describe the system we have developed and its future.

Introduction

This paper will present an innovative application of handheld technology for science education. For the past seven years, the Web-based Inquiry Science Environment (WISE) project, funded by the National Science Foundation, has explored the most effective designs for inquiry activities that draw upon the wealth of Web resources. We have designed an effective browser-based learning environment that scaffolds students as they work collaboratively on inquiry projects.

The designs of the WISE learning environment, inquiry curriculum and assessments are based on a pedagogical framework called Scaffolded Knowledge Integration. This framework, developed by Dr. Marcia Linn and her colleagues (Linn and Hsi, 2000), has been developed through twenty years of classroom research with technology and inquiry (Linn and Songer, 1982, Bell, Davis and Linn, 1995; Slotta and Linn, 2000).

Continuous improvement of the WISE technology has resulted in easy-to-use software that scaffolds students as they perform critique, design or debate projects. A growing library of such projects has been developed by "WISE Design Partnerships" that include scientists from agencies like NASA, NOAA, and The National Geographic Society. Over the past several years, both our curriculum library and user base have grown dramatically. Thousands of teachers and many thousands of their students now use WISE inquiry projects in their science courses.

We have begun to research the challenges faced by science teachers as they adopt the innovative technology and inquiry methods provided by WISE. To that end, we have formed partnerships with two large school districts -- Denver Public Schools (Colorado) and Desert Sands Unified School District (California). Working closely with administrators within these districts, we have helped science teachers integrate WISE activities into their courses, and developed networks of WISE mentors in the districts to support them.

Together with these school district partnerships, we were recently awarded a grant of 500 Palm IIIc handhelds from the SRI Palm Education Partnership to design effective uses for handheld technology in education. Our goal was to develop Palm activities that would complement our existing library of Web-based projects, benefiting from the scaffolding of the WISE technology and curriculum. We sought to integrate the use of handheld computers with WISE curriculum, enabling both data collection activities like surveys and field observations and further, reflection activities in analyzing the collected data.

In this paper we present an overview of the WISE environment, detail the goals of our handheld technology initiative, and describe it functionally. We then present our experiences with its use to date and look toward the future.

WISE: The Web-based Inquiry Science Environment

WISE offers a powerful browser-based learning environment for middle and high school inquiry science projects. Students work collaboratively in these projects, actively using materials and software from the World Wide Web. In one project, students evaluate the health of a local creek, modeling the factors that contribute to pollution. In another, they compare two competing theories about why deformed frogs are appearing in American waterways. Figure 1 shows a screenshot of the WISE learning environment and Figure 2 shows the growth of our user base. An *inquiry map* on the left-hand side of the browser window coordinates all student activities, resulting in Web materials, pop-up notes or hints (shown in the Figure), or any of a variety of other tools and features, such as online discussions, journals, causal maps, data visualizations, and an argument editor. Throughout the project, the inquiry map scaffolds students as they work collaboratively to perform carefully designed inquiry projects.

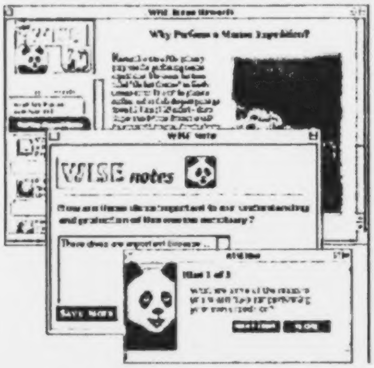

Figure 1 WISE user interface, notes, hints

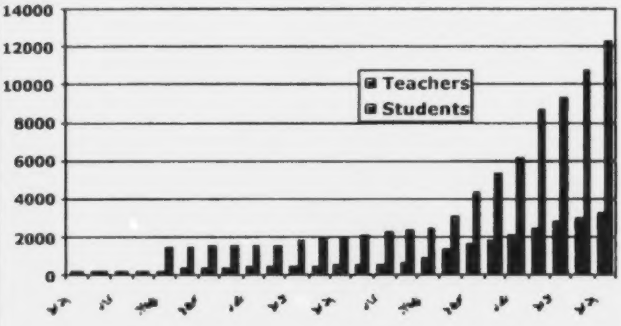

Figure 2 WISE user signups in past 2 years

WISE projects are designed to offer teachers a means of adding inquiry and technology to their existing curriculum. Teachers choose from a library of projects, each accompanied by a lesson plan, assessments, scoring rubrics, connections to standards, and opportunities to customize the project to local issues and curriculum topics. Teachers can monitor and grade student work, provide formative feedback during a project run, and manage their student accounts. The reader is invited to visit http://wise.berkeley.edu/ where she will find more than 30 different projects, in topics of physical, earth and life sciences at grade levels from 4 through 12.

We have researched the effectiveness of WISE activities for student understanding in a wide range of classroom studies, summarized in a recent book by Linn and Hsi (2000). All WISE activities are assessed by pre-post test items, as well as embedded assessments, which show that students develop a deep understanding of the science content, and gain important lifelong learning skills related to critique of evidence, debate of arguments, and design of personally relevant solutions. WISE research has demonstrated an impact on student understanding of science, fluency with technology, and literacy in the use of language and argumentation (Linn and Slotta, 2000).

Goal of project

We seek to leverage the strength of the WISE platform and curriculum to provide effective new applications for handheld technology. Our innovation focuses on two main affordances of handheld technology: 1) convenient and portable data creation, 2) portable dynamic content. Within the scaffolding and instructional context of the WISE learning environment, these become powerful pedagogical instruments.

For example, working in the *Genetically Modified Foods* project, students download a carefully designed survey into their handheld, and then interview their friends and family between classes or after school (e.g., collecting age, gender, dietary habits, and beliefs about GM Foods). Later, they put them in the syncing

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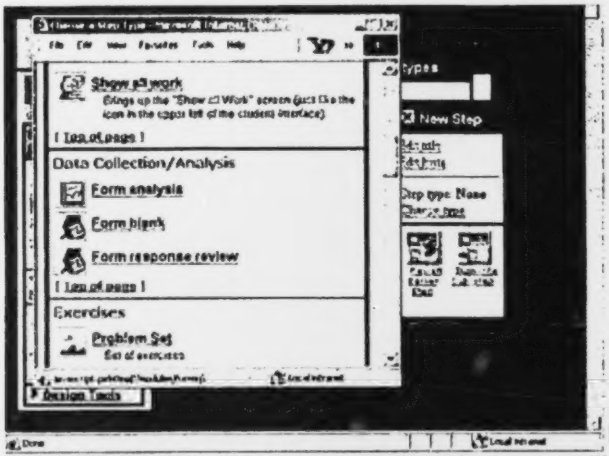
cradle and all their data is transferred to the WISE databases. This provides collaborative data for the students to draw upon as they continue to debate whether GM foods are dangerous.

By facilitating data collection, we enable useful analysis. For example, in the *Healthy Creeks* project, students take measurements of the chemistry of the creek and input it on-site automatically with probeware or manually with the stylus. In the classroom, they analyze the variance among their class and how it relates to other classes. Using the data analysis tools, the students can explore the data. For example, comparing the average pH of the creek each month for the past 2 years. (The Creeks project will be presented in detail below.) Such activities empower the handheld with the context of a broader curriculum.

System description

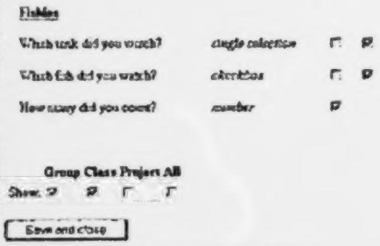
In the course of bringing our vision to handhelds, we have developed a versatile collaborative database that can be used to collect and analyze any sort of data in any context. To explain, we will describe a mock application from start to finish.

Remember that a WISE project consists of steps that the student navigates through using the inquiry map (far left of Fig 1). To bring collaborative data into a WISE project, the author adds a step from the Data Collection / Analysis family. We begin by selecting the "Form blank" step (Figure 3). A form blank is the empty form that is to be filled out.



Brings up the "Show All Work" screen (just like the icon in the upper left of the student interface)

Figure 3: Creating a new step in the project



Fishies

Which tank did you watch?	*single selection*	☐	☑
Which fish did you watch?	*checkbox*	☐	☑
How many did you count?	*number*	☑	

	Group	Class	Project	All
Show:	☑	☑	☐	☐

Figure 4: Authoring an analysis step

Within the form blank authoring window, we author the form blanks for this project. A form blank is comprised of a sequence of form fields. A form field is comprised of a prompt and a data input definition. Data input types include text, numbers, radio buttons, checkboxes, pop-up menus, lists, etc. To define a form field, the author chooses the type and then sets the parameters of that type. For instance, if it is a checkbox field they will define the choices and optionally include an image to represent each choice.

For the sake of explanation, let us author a form called "Fishies". It consists of three form fields. The first has a prompt of "Which tank did you watch?" and a pop-up menu to choose between Main, Tropical, and Arctic. The second, "Which fish did you watch?" lets the user choose images of a guppy, a tuna, and a shark. The third, "How many did you count?" lets the user input a number.

We also add a "Form analysis" step. Here we choose which fields to analyze. We also choose the scopes of data to include in the analysis: just the group's data, the whole class's data, data for all users of the project, data for all projects. (A form field, once defined, can be reused in any form blank even across different projects.) We also choose what data filters to offer to the student in order to guide their reflection. Filters can omit or include responses that meet certain criteria, such as temporal range or response to a field.

For our project, let us choose to analyze the fish count based on the tank and fish that the student watched (Figure 4). Now we have our collaborative data collection and reflection working in the web browser (Figure 5). This is all well and good, but we want the students to have Figure 5 on their handhelds. To do this,

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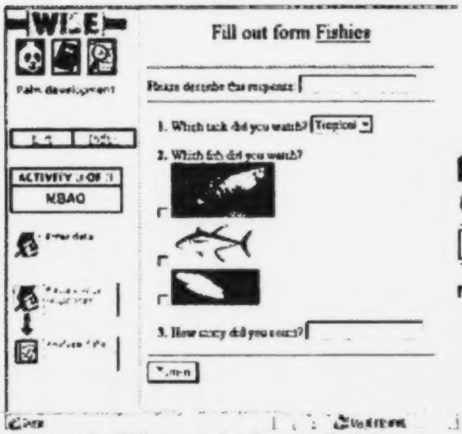
we go to the handheld setup page of the authoring environment and define channels to send to the handhelds. A channel is a selection of form blanks to fill out preceded by introductory text, much like a WISE project step. It is separate so that the author can differentiate the tasks to perform on the handheld from those to perform in the browser. (An in-class form may have the students make predictions and on-site collect the true data.)



Fill out form Fishies

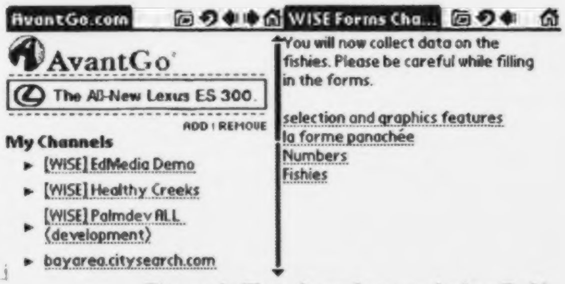
Please describe the response:

1. Which tank did you watch? Tropical

2. Which fish did you watch?

3. How many did you count?

Figure 5: Filling out the form in the browser



My Channels
- [WISE] EdMedia Demo
- [WISE] Healthy Creeks
- [WISE] Palmdev ALL (development)
- bayarea.citysearch.com

You will now collect data on the fishies. Please be careful while filling in the forms.

selection and graphics features
la forme panachée
Numbers
Fishies

Figure 6: Choosing a form on the handheld

Once we have defined the channels, we click to subscribe the handhelds to them. We currently make use of a service called AvantGo to transfer the data. (AvantGo is a commercial service and may not suit us in the long term, but because we have built our system on open standards we can easily shift to other services or create our own.)

Once this is done, the students put their handhelds in the cradle and let them sync with the WISE servers. This downloads the channels and form blanks for them to fill out. Each set of handhelds shares one AvantGo account. The account lists the channels that have been subscribed (left Figure 6). When the student picks up their handheld for a WISE project, they select its channel. In our example, "EdMedia Demo". They are then presented with the instructions and list of form blanks that the project author specified (right Figure 6).

In our example, they select the "Fishies" form blank. (Figure 7 shows how this form blank appears on an actual Palm IIIc, in contrast to the web browser in Figure 5.) The students then fill out the form wherever they may be. Since the handhelds are shared by the whole class, each student signs their form with their name in order to receive credit. (Any illegible or no-name work is sent to the teacher's management window to reattribute.)

When they return to the classroom, the students drop their handhelds in the cradle to submit their responses to the WISE server. Then they return to their web browsers to explore the data and reflect. The inquiry map guides them through this exploration. Within a Form analysis step they experiment with the parameters of the filters. The system then renders the data for the subset they have defined. (Figure 8) This is how the students mine the meaning out of their data.

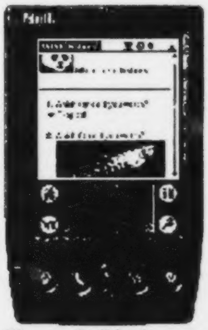
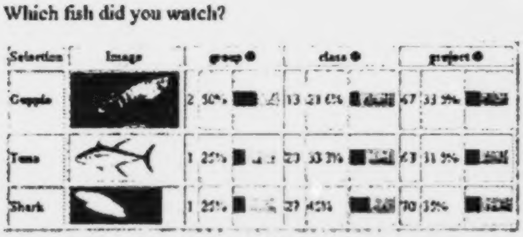


Figure 7: Display on actual Palm IIIc



Which fish did you watch?

Selection	Image	group	class	project
Guppie		2 50%	13 [illegible]	67 33.5%
Tuna		1 25%	23 [illegible]	63 31.5%
Shark		1 25%	27 [illegible]	70 35%

Figure 8: Graph in browser of collected data

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First Trip: Aquarium

But how does the technology work in the real world? Our first trial with students confirms that it does work in real classrooms. In partnership with the Monterey Bay Aquarium, we developed an inquiry project to help "extend the visit." (Figure 9) Before the trip, the project led students to ask themselves questions that helped their investigations during the aquarium visit. During the trip the handheld forms prompted the student for data to collect. After the trip, the students worked through the analysis steps of their WISE project to help make sense of their observations and integrate their field experience with the classroom curriculum.

Figure 9: Student recording observations at aquarium

Educators from the aquarium wanted to help students focus on marine science concepts, including the factors relating to fisheries decline. We co-designed an activity where students explore the fish in Monterey Bay, reflecting on why some fish are placed on a "Seafood Watch List " while others are not. Students chose one fish for specialization, which they investigated at the aquarium. The forms prompted them to record observations about the fish and other features of the aquarium. We designed an observation form that would help students reflect on the habitat and adaptations of "their fish," as well as a checklist of aquarium activities that was beamed to students by aquarium docents. These observations provided a focus for student activities at the aquarium while enabling the collection of student data for use in later stages of the project.

When we ran the project with students from an oceanography club at North Salinas High School, they embraced the handhelds even more quickly and easily than we had expected. After a few minutes, they had no difficulties navigating the forms. They became adept quickly at inputting text using Palm's special system, Graffiti. But most importantly, we came away with new ideas to improve the system. In their next trip to the aquarium, students could refer to on-line guidance while using the Palm. If they did not understand a term, they could click next to it to view a glossary. If they did not know where to find what they were looking for, they could click another button to pull up a "field guide." In this way, handheld technology can bring the aquarium to the classroom *and* the classroom to the aquarium.

Second Trip: Creeks

Our second major run was using the *Healthy Creeks* project, mentioned earlier. In this project, students visit their local creek and use chemical tests to take real measurements. They collect data from several sites and then upload them all back at the classroom.

These students were from Foothill Middle School. Even these 6th grade students had little or no difficulty navigating the forms and entering data. Furthermore, they were visibly excited to learn that they would be using the handheld computers. "Do we get to use those?!" We discovered that the cool factor of the technology motivates many students like nothing else could.

Future

Our future research is to further explore the pedagogical value of the technology. One experiment in development is to study several classrooms of students at the Monterey Bay Aquarium, only some of which will use the handheld computers. To evaluate the impact of the technology, we will observe how the activities at the museum and the take-home learning differ between the groups.

We also plan to bring a handheld component to our longstanding Genetically Modified Foods Debate project. Currently, eighth-grade students engage in a two-week inquiry based curriculum on genetically modified foods. Students learn to weigh the tradeoffs involved in using one method of agriculture or another, as well as to support their position with appropriate evidence. Students are given many opportunities to express their ideas, and learn from each other while debating the controversy over whether GM foods are safe for human consumption. With handheld forms, students will be able to extend their own investigations beyond the classrooms and into their social networks. Back in the classroom, they can visualize the data and compare based on criteria they choose. Additionally, they will be able to incorporate and compare responses from their teacher's other classes, or from classes in another district, state, or even country.

We also seek to understand the effects of bringing learning into a social context. In the process of surveying, we expect students to learn to evaluate information sources, to synthesize from observations, to interview effectively, and to reflect on their role. We believe that they can develop a coherent understanding by first asking people what they know, discussing the issues with them, and then researching the relevant facts and concepts independently using WISE. We want to know how the use of handheld technology can improve students' general inquiry skills.

From the technical side, we plan to research the data representation component itself. We are developing many different visualizations and comparison schemata for the data and in the process of evaluating their relative effectiveness. And more specifically, what representations are most effective for what pedagogical goals. The challenge is to develop software that is 1) flexible, 2) intuitive, and 3) works well on the computers found in most classrooms. Even further down the road, we plan to streamline the technology and make it even easier to administer. We envision a turn-key solution that a school can place in the computer lab. This box would track and mange each handheld device and help the teachers focus on teaching.

Conclusion

The WISE learning environment and handheld computing are synergistic. The handheld provides the mobility necessary to collect real-world data and observations and to bring dynamic content outside the classroom. WISE provides the scaffolding to give these data pedagogical value. By integrating them, we have created the exciting education opportunities described and certainly even more opportunities that we have not yet imagined.

References

Bell, P., Davis, E. A., & Linn, M. C. (1995). The Knowledge Integration Environment: Theory and design. In J. L. Schnase & E. L. Cunnius (Eds.), *Proceedings of the Computer Supported Collaborative Learning Conference, CSCL '95, Bloomington, IN* (pp. 14–21). Mahwah: Erlbaum.

Linn, M. C., & Hsi, S. (2000). Computers, Teachers, Peers: Science Learning Partners. Mahwah: Erlbaum.

Linn, M.C. & Slotta, J.D. (2000). WISE science. *Educational Leadership*, Alexandria: Association for Supervision and Curriculum Development.

Slotta, J.D. (2000). Toward a WISE Professional Development Model": Case studies from a whole-school study of teacher adoption. Paper presented at the National Association for Research in Science Teaching (NARST) annual meeting. April 28 - May 1,. New Orleans, LA.

MusicImprovAnEdTechTool

Douglas B. Allen
Dwight W. Allen
Carl Hoagland
Gwendolyn Watson

Musical Improvisation: A Model For Infusing New Technologies Into The Design Of Instruction

Panel Position (shared by the four panelists):

In an age of rapid change and almost unlimited opportunity for continuous technological innovation in schools, traditional communication and decision-making systems characterized by structure and linear process must be made more responsive. Lessons from jazz and other forms of musical improvisation can help schools develop new approaches to discussion, decision-making and experimentation which will allow schools to more fully engage technology and new educational practices, thus better meeting the often complex expectations of a diverse range of stakeholders.

Each panelist brings a unique perspective to this topic:

Dwight Allen, is Eminent Professor of Education Reform at Old Dominion University and former Dean of the University of Massachusetts School of Education. A recognized thought leader in the field of education innovation for more than four decades, his latest book on education reform, co-authored with Bill Cosby, was published as one of Time-Warner's first e-books. The book was a finalist in the Frankfurt Global E-book Awards, sponsored by the International E-Book Award Foundation this past Fall.

Carl Hoagland, holds the Emerson Electric Endowed Professor of Technology and Learning at the University of Missouri, St Louis. He is also the director of the E. Desmond Lee Technology and Learning Center. With over 35 years of experience in all levels of education as teacher, consultant and professor, he specializes in the application of new technologies as learning support tools.

Douglas Allen is Associate Professor of Management at the University of Denver. Former MBA Course Coordinator for the Daniels College of Business High Performance Management course, he has participated in a wide range of educational innovations at the University of Denver. A frequent consultant to Fortune Global 500 companies in the US and overseas, he has written and conducted research on a variety of topics related to change in domestic and global companies.

Gwendolyn Watson is concert cellist, composer, improviser and teacher. Described in a *New York Times* review as a "zany but serious musician," she has performed in some of the great concert venues of the world and continues a life-long ambition to extend musical appreciation to the general public.

More complete bios are attached at back of proposal.

Description of the Panel Topic

In the current age of technological frenzy with its promises of new potential, enhanced options, vastly increased choices (and occasional cacophony), educational practitioners are bombarded with so many opportunities for innovation, that it is very difficult for them to know how to respond. Adding to the confusion, equally impressive developments in both cognitive and neurological learning sciences suggest that the very processes of education can be restructured to improve effectiveness. Further complicating this instructional melee is increased public and policy-maker demand for accountability.

In this turbulent environment, traditional organizing and decision-making systems are being taxed to their limit. Perhaps we are in need of some new organizing principles -- a new approach to sorting out the complicated opportunities and demands imposed upon educators by a diverse range of stakeholders.

What we will demonstrate

Dwight Allen, Eminent Professor of Education Reform at Old Dominion University, and Carl Hoagland, Emerson Electric Endowed Professor of Technology and Learning will join participants in an exploration of the power of musical improvisation as a metaphor for decision-making and experimentation with the infusion of technology into educational processes. Specifically the use of improvisation will be examined as a tool from the perspectives and for the use of: educators, students, parents, technologists, as well as software and materials developers.

The panel will identify four roles in improvisation: to lead, to follow, to reflect (wait out), and to redirect. In this session, we argue that members of an education system (whether elementary, high school or university) can become individually and collectively more effective by building capacity in each of these four skill areas. Through impromptu musical participation (utilizing a variety of hand-held musical instruments from around the world) by the audience - led by world-famous cellist Gwendolyn Watson - the session will explore how technology can shape and be shaped by each of these roles.

Referencing the work of Kao (1996) and others, Douglas Allen, associate professor of management at the University of Denver, will show how traditionally emphasized *economies of scale* in organizations including schools may need to be supplemented with an emphasis on *economies of discovery*. The theory of scale economies has emphasized efficiency through standardization – often achieved through high degrees of linear structure. While these are certainly still important, they are no longer sufficient. To fully prepare students to be effective participants in the new, information and technology rich environment, an emphasis on creativity, innovation and spontaneity is required as well. By adopting improvisational behaviors, schools may become more open to the approaches that can effectively prepare students for life in an information-rich society and model the very capacity for change and openness that our students must learn.

Throughout the session, we will demonstrate how the principles of jazz and other forms of musical improvisation help us find "the sweet spot" between precise scripting of learning and the chaos of random response, and what this means for the adoption, development and use of technology in schools.

Context

We will faciliate our session as an emergent mix of content-oriented discussion and experiential exercise involving session participants in musical improvisation– taking time as we go, to discuss the takeaways of each improvisational experience. The exercises will provide a metaphor for the discourse that could effectively take place in schools, helping them to become more open to technological change. Through the experience offered in this panel, session participants will discuss and explore first-hand, how having a multitude of resources available - sometimes without coordination, but with the awareness of the availability and utility of each - can enrich the instructional environment by facilitating and encouraging impromptu experimentation, trial and adoption of new technologies and the new pedagogical approaches they may allow.

Relevant URLs and references

Bransford (1998) How People Learn, National Academy of Science URL

Jackson, Paul Z (1995) Improvisation in Training: Freedom Within Corporate Structures," *Journal of European Industrial Training*, v19n4.

Jensen, E. (1998). *Teaching With the Brain in Mind*. Alexandra: ASCD.

Jones, Michael (1997) "Getting Creativity Back into Corporate Decision Making," *Journal of Quality and Participation*, v20n1, January-February.

Kao, John (1996*) Jamming, The Art and Discipline of Corporate Creativity*, Harper Business

Kao, John (1997) *The Art and Discipline of Business Creativity*, Strategy and Leadership, v25n4 July-August.

Tushman, Michael L; O Reilly, Charles A III (1999) "Building Ambidextrous Organizations: Forming Your Own "Skunk Works," *Health Forum Journal*, v42n2.

Weick, Karl (1996) "Prepare Your Organization to Fight Fires," *Harvard Business Review*, May-June.

Weiss, R. P. (2000). Emotion and learning. *Training and Development, 54* (11 November), 44-48

WQ: An Environment for Teaching Information Access Skills

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Abstract

WQ is a Web-based system which reflects some of the ideas found in WebQuests. We intend to analyze the characteristics that make the WebQuests so popular and determine which of their components give them the greatest educational value. The WQ system which we have implemented presents sites to be browsed and searched, it allows students to make notes on those sites, and it lets the students manage those notes to respond to the Quest. Ultimately, we hope that the WQ system will incorporate collaboration, integrate digital libraries, be scalable, and support a wide variety of content areas.

1 WebQuests

WebQuests are Web-based learning activities that have become very popular with both teachers and students [6]. Students are given questions to investigate and Web-based resources to use in answering them. The students produce answers to the questions that include references to the resources. WebQuests are closely related to other systems for inquiry-based learning such as ThinkQuests [18] and Internet Quests [5]. In a larger view, they are related to e-books [9] and digital libraries.

1.1 Variety of WebQuests

WebQuests are not a single, simple educational approach but a collection of related approaches. The essence is that students synthesize answers to questions based on Web resources. These resources may be either public Web sites or sites custom-designed for the Quests. Types of resources may vary greatly depending on the educational goals and the resource familiarity of both teachers and students. Some WebQuests also require cooperation among teams of students.

1.2 Underlying Skills

WebQuests are a type of inquiry-based learning [2, 7, 10, 19]. WebQuests combine many layers of skills. At a low level, the student must pick out material that is relevant to the question. This is similar to the challenge of reading comprehension [13, 14]. There is also the challenge of navigating the text on the page via cognitive organizers [8]. At a still-higher level, the student must engage in problem solving to determine where to find the best material. There are aspects of "active reading" in note taking (e.g., [12]) and in the management of the notes.

1.3 Digital Libraries and WebQuests

A WebQuest may be thought of as a very simple digital library which the student has to search. We take that analogy literally and attempt to combine digital library technologies (e.g., [3]) and educational strategies. Digital libraries can support teachers in creating a collection of works for the students quest. The student then navigates within the colection. Various different strategies can be applied in scoping the collection, such as appropriate levels of scaffolding.

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2 The WQ System

While current WebQuests generally require the student to write essays either by hand or with a word processor, it is useful to develop a completely integrated framework. In this case, rather than writing essays, we simply ask the students to make notes on a selection of articles. These notes can then be arranged to present a response to the question. WQ provides a single interface for the associated activities of searching, reading, and writing.

The main control for the WQ system is via a tree widget which is presented in the left frame. This widget lists several Web Quests and for each Quest it presents background information and separate questions. In the present version, the basic paradigm for student interaction is creation of notes on the texts provided. The collection of notes taken together represents the student's response to the questions. Later, we propose models for extending this interactivity.

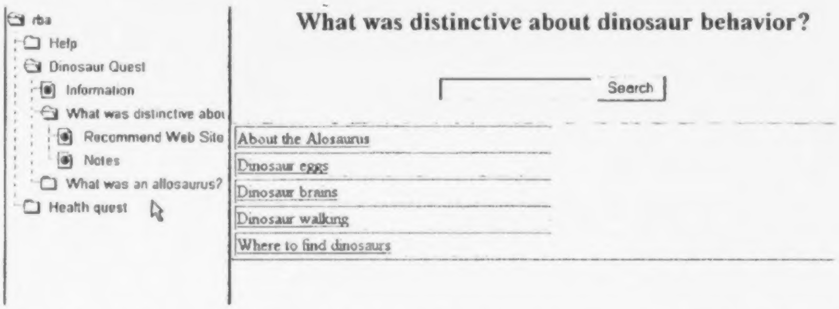

Figure 1: The Quest Manager (left) allows selection of Quests and questions within those Quests. Recommended Web pages (right) can be accessed either by browsing or via search.

2.1 Selecting Web Pages

The right side of Figure 1 shows the screen for presenting the list of web pages that have been recommended by the teacher for a particular WebQuest. While the current five articles are small enough to be browsed, we have also implemented a search feature that will be useful for larger collections which may be more properly thought of as digital library collections. The search utility allows teachers to provide a controlled domain of material, supporting the student by narrowing the field of resources but still providing an environment of exploration.

2.2 Making Notes

The students interact with the Web sites by selecting relevant sentences. Specifially, the students click on sentences to annotate them and to add those annotations to the list of notes. This is illustrated in Figure 2 which shows the highlighted text and a box for adding the note title and body. The main paradigm we wish to explore with this first version is linking into the text of documents. However, the current implementation allows access to any Web page in addition to formatted documents. For these Web pages, the notes can be posted only at the top of the page. In the future it may be possible to attach notes to particular passages as with the formatted docs.

2.3 Notes Manager

All of the student notes are collected into a single list as shown in Figure 3. The student can arrange the order of the notes to respond to the questions. In particular, notes are managed by selection of the note with a radio button and the selection can then be moved up/down or right/left in an indented hierarchic list. Integration of the notes manager with the browsing utility allows the student to respond to questions in the quest with out leaving the browsing environment.

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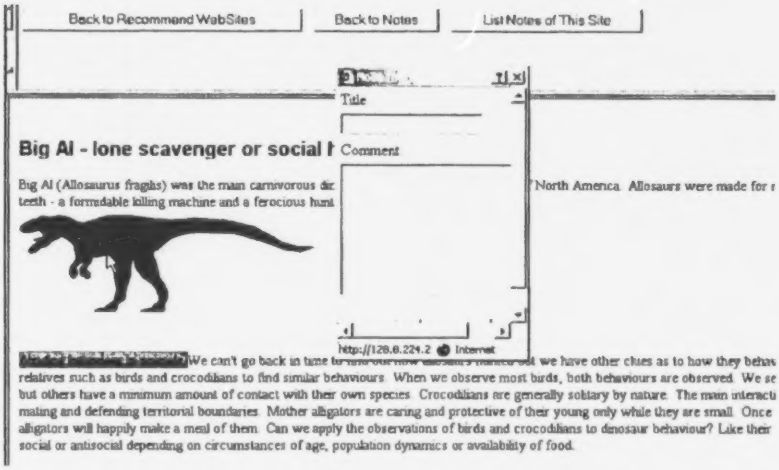

Big Al - lone scavenger or social

Big Al (Allosaurus fragilis) was the main carnivorous di North America. Allosaurs were made for
teeth - a formidable killing machine and a ferocious hunt

We can't go back in time t we have other clues as to how they beha
relatives such as birds and crocodilians to find similar behaviours. When we observe most birds, both behaviours are observed. We se
but others have a minimum amount of contact with their own species. Crocodilians are generally solitary by nature. The main interacti
mating and defending territorial boundaries. Mother alligators are caring and protective of their young only while they are small. Once
alligators will happily make a meal of them. Can we apply the observations of birds and crocodilians to dinosaur behaviour? Like their
social or antisocial depending on circumstances of age, population dynamics or availability of food.

Figure 2: The student can create a note by clicking on a sentence from the text. This screen shows a frame with control buttons, a text with a highlighted (selected) sentence, and a note-entry box.

2.4 Implementation

This implementation uses a frameset which includes HTML, Javascript, and Java. In order to be able to add notes by clicking the text, we built a Java applet for the presentation of the text. This also meant that specialized Web pages had to be constructed. This is in the spirit of WebQuests that have tailored Web pages. The text of five Web pages from [4] was selected and reformatted for presentation via the Java applet. A future implementation may be adapted to automate reformatting either in batches or on the fly. The login control, recommended site listings, and notes are all managed with Perl scripts which connect to a Postgres database.

3 Digital Library Resources for WebQuests

WebQuests depend on high-quality content for the students to access. This information resource may range from a single Web page to a large collection of Web resources. We treat the Web resources as a scalable digital library. We have recently completed work on a digital library for The Maryland Electronic Learning Community (MELC), a part of the Baltimore Learning Community (BLC), has focused on the creation, maintenance, and cultivation of a digital library for teachers in five middle schools in the Baltimore area [16].

OAI, the Open Archives Initiative, has developed an open protocol supporting free sharing of metadata among diverse digital libraries. Using the OAI open protocol and an XML interface provides navigable access of the metadata from the MELC digital library as well as other digital collections. The OAI protocol [11] was initially developed within the e-print community with very task specific feature sets. Early directions evolved to open the standard and lower the barrier to entry for non-e-print collections. Thise opens the door to a great many potential resources for Web Quests. With further development, WQ could be expanded to take advantage of any OAI compliant resource. Here we see a different balance being struck between specificity and generality. Building on that foundation, information providers have a great deal of freedom to develop specific enhancements. The approach has great strength in that it offers one of the first structured protocols for metadata sharing. Our system uses XML to provide a minimal foundation of interoperability.

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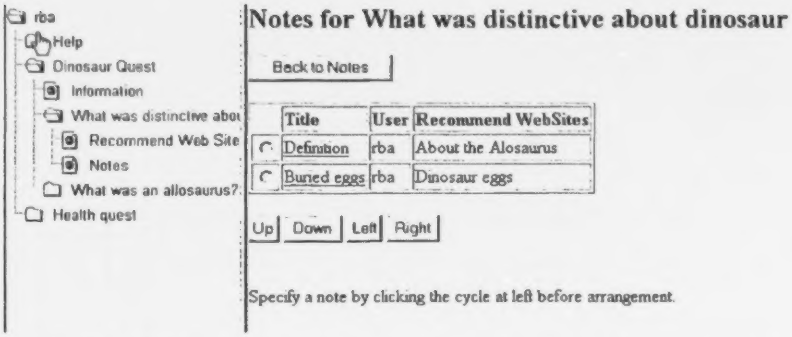

Notes for What was distinctive about dinosaur

	Title	User	Recommend WebSites
○	Definition	rba	About the Alosaurus
○	Buried eggs	rba	Dinosaur eggs

Specify a note by clicking the cycle at left before arrangement.

Figure 3: The entire set of notes for a Quest can be viewed. In addition, the order and nesting of notes on the list can be be controlled.

4 Future Directions

We will extend the initial work to incorporate additional features including (1) access to video and other multimedia resources, (2) support for collaboration, and (3) the ability for the teacher to harvest resources and evaluate student work in progress. We will also systematically examine the use of Web-based online resources in inquiry based-learning. Ultimately, students could have flexible resource management desktops (e.g., extending the ideas in [1]) and the underlying model could allow flexible interaction among the components.

4.1 Multimedia and Collaboration

We will incorporate videos as information resources, add the ability to jump to specific frames of the video, and we will develop simple summaries and indexes for those videos. The WebQuests of students with different multimedia indexing and access tools will be contrasted. Some existing WebQuests include multimedia, but that multimedia is not seamlessly integrated with the Quest. Because XML is rapidly being extended to encompass multimedia, our XML-based framework should be able to leverage that work. Similarly, simulation may be added.

Collaboration often makes learning more engaging [17]. Our existing annotation facility can be extended for use by several students at one time. We will extend the current model by adding features to give each student the ability to have distinct annotations and resources while also being able to read and comment on the work of the other student(s).

4.2 Teacher's Interface

While we have focused on the student's environment for completing WebQuests, it is also possible to support the teacher while they build the WebQuests and while they interact with the students who are completing the WebQuests. The teacher's needs in many ways mirror those of the student interfaces.

The teachers in the Baltimore Learning Community have found WebQuests to be highly effective. Building a WebQuest, as well as many lesson plans, requires identification of useful and appropriate Web materials. Selection criteria for inclusion in a lesson plan generally hinge on readability. Many teachers report that the challenge is to find the right digital collections. There has to be enough text, at the appropriate reading level, but not too much to be digested. When teachers find these resources, it would be helpful if they could manage them in personalized collections with annotation capabilities.

Moreover, teachers are looking not just for evidence in support of lesson objectives, they must simultaneously screen for appropriate presentation. In building a WebQuest, the teacher plays the role of collection builder for the student. A collection that covers the topic being studied but presents it at an inappropriate level is of limited use.

The materials in an OAI compliant collection can be a resource of great value to teachers. The Open Archives Initiative also provides open access for "harvesting" collections, but the protocol alone is not enough to make the data useful. We have explored metadata sharing via the OAI in light of teachers' needs in the BLC. We find a need for a system that allows users to integrate collections of annotations of, and associations between, Web resources. For instance, tools built on top of the OAI architecture could allow teachers to add value to the metadata or resources they find.

We find in usage analysis that many of the same materials within a very diverse collection are reused, not necessarily because of their content but because of "word of mouth" [15] and the barriers to easily finding alternative materials. One of the greatest obstacles teachers face is the ability to obtain and interpret organized collection data. Teachers find an overwhelming amount of resources on the Web. But the transition from collection to collection can be a somewhat nomadic process. Teachers use words like "hunting" and "searching" when describing the process of obtaining task-appropriate materials from multi-media sources and digital libraries.

Finally, teachers could also monitor the progress of the students and, eventually, could even provide interactive suggestions to the students while they worked, using the WQ interface. We envision the computer as a support for the teachers to track the progress of individual students. WQ could be extended to help teachers identify which students need the most help with a particular Quest.

5 Conclusion

Although Web Quests are very popular, their educational value is not well understood. We have developed the first stage in a unified environment for managing WebQuests. The current system allows the students to attach notes directly to texts. The collection of the notes allows the students to respond to the questions. This is not the final version of this system; we are close to completing access to multimedia and support for collaboration in note taking. We anticipate that WQ will become a successful model for an integrated WebQuest interface.

6 Acknowledgement

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References

[1] R. B. Allen and W. Puntai. A digital library-based recommender service for multimedia development in a learning community. In *European Conference on Computer Supported Cooperative Learning*, pages 37–42, 2001: Maastricht, The Netherlands.

[2] American Library Association. *Information Power: Building Partnerships for Learning*. ALA, Chicago, 1998.

[3] M. Q. W. Baldonado. A user-centered interface for information exploration in a heterogeneous digital library. *Journal of the American Society for Information Science*, 51(3):297–310, 2000.

[4] BBC. Dino Fact File. http://www.bbc.co.uk/dinosaurs/fact_files/scrub/allosaurus.shtml.

[5] B. Burgess. *Internet Quests: Web Activities Across the Curriculum*. Teacher Created Materials Inc.

[6] B.J. Dodge. Some thoughts about WebQuests. 1995. http://edweb.sdsu.edu/courses/edtec596/about_webquests.html.

[7] M. B. Eisenberg and R. E. Berkowitz. *Information Problem Solving: The Big Six Skills Approach to Library and Information Skills Instruction*. Ablex, 1990.

[8] J. J. Franks and J. D. Bransford. The acquisition of abstract ideas. *Journal of Verbal Learning and Verbal Behavior*, 11:451–454, 1972.

[9] G. Golovchinsky, M. N. Price, and B. N. Schilit. From reading to retrieval: Freeform ink annotations as queries. In *Proceedings of the ACM SIGIR Conference*, pages 19–25, 1999: Berkeley.

[10] B. R. Joyce and E. A. Joyce. The creation of information systems for children. *Interchange*, 1:1–12, 1970.

[11] C. Lagoze and H. Van de Sompel. The Open Archives Initiative: Building a low-barrier interoperability framework. In *Proceedings Joint ACM/IEEE Digital Libraries Conference*, pages 54–62, 2001.

[12] C. C. Marshall. Toward an ecology of hypertext annotation. In *Proceedings ACM Hypertext*, pages 40–49, 1998: Pttsburgh.

[13] National Reading Panel. *Report of the National Reading Panel: Teaching Children to Read*. National Institutes of Child Development, Bethesda MA, 2001.

[14] M. Pressley and P. Afflerbach. *Verbal Protocols of Reading: The Nature of Constructively Responsive Reading*. Lawrence Erlbaum Associates, Hillsdale NJ, 1995.

[15] A. Rose, R. B. Allen, and K. Fulton. Multiple channels of electronic communication for building a distributed learning community. In *Conference on Computer Supported Cooperative Learning*, pages 495–502, 1999: Palo Alto.

[16] P. P. Semple, R. B. Allen, and A. Rose. Developing a multimedia video library: Content preparation, indexing, and usage. In *Proceedings of EdMedia*, 2000: Montreal.

[17] N. Streitz, J. Haake, J. Hannemann, A. Lemke, W. Schuler, H. Schutt, and M. Thuring. SEPIA: A cooperative hypermedia authoring environment. In *Proceedings ACM Hypertext*, pages 11–22, 1992: Milan.

[18] ThinkQuests. http://www.thinkquest.com/.

[19] R. Wallace, E. Soloway, J. Krajcik, N. Bos, J. Hoffman, H. E. Hunter, D. Kiskis, E. Klann, G. Peters, D. Richardson, and O. Ronen. ARTEMIS: Learning-centered design of an information seeking environment for K-12 education. In *Proceedings ACM SIGCHI: Human Factors in Computing Systems*, pages 195–202, 1998: Los Angeles.

How are Learning Objects Used in Learning Processes?
Instructional Roles of Learning Objects in LOM

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Abstract: In order to reuse and exchange learning objects we need information about these learning objects. The LOM draft standard defines a set of more than 70 attributes, which specify learning object properties like author, title, subject, and many others. Even though the LOM draft includes a category educational, no information is included in the standard to specify, which instructional roles are played by a learning object in a course. We show how to include this important didactic information using the concept of instructional roles and relations in a way, which is extensible and flexible enough to specify not only general didactic criteria, but rather specific criteria, as prescribed by different instructional theories.

Motivation

To allow the reuse of learning objects (LO), various standards have been developed to describe learning objects, their relationships, etc. The IEEE LOM Draft Standard for Learning Object Metadata (LOM2001) specifies a variety of bibliographic and technical properties of LOs, as well as different relationships between LOs, and make exchange, reuse, and search of LOs based on these metadata possible. Even though the LOM draft includes a category educational, no information is included in the standard to specify, which instructional roles are or can be played by a LO within a course. As curriculum programs do, LOM concentrates on what should be taught and when, rather than how to teach. Obviously, a standard for learning objects metadata should not tell how to teach, but it should definitively be able to provide information on how to specify pedagogical aspects of LOs. This difficulty is caused by the fact, that LOM attributes specify properties only at a very basic abstraction level. LOM specifies annotations for content and activities but does not support metadata about instructional models and theory, even though authors are implicitly or explicitly using specific instructional theories. LOM does not support information about the use of LOs in learning processes, which are a central concern in instructional design. The current paper introduces additional abstraction layers to the LOM specification which explicitly takes different instructional theories into account.

The Current LOM Model: The Learning Object Metadata Standard (LOM for short) defines a structure for interoperable descriptions of LOs. It aims at facilitating search, management and (re)use of LOs by authors of online-courses, teachers and learners. A LO is defined in the LOM specification as "*any entity, digital or non-digital, that may be used for learning, education or training*" (LOM 2001). The LOM basic schema consists of nine categories and simply of two types/classes: the LOM resource and the LOM type, linked by LOM attributes (LOM data elements). In the model layer we have only the LO itself, the attributes describing the LO and the datatypes for those attributes. The descriptions of LOM are context-independent and static classifications. This is not appropriate for many instructional aspects: To characterize "collaborative learning" the type resp. the vocabulary "collaborative" can hardly be added to a single category, as "collaborative learning" is an instructional principle which affects and shifts the entire environment: the role of teacher and learner (Intended End User Role (LOM 5.5)), activities, interactivity type (LOM 5.1), Typical Learning Time (LOM5.9), purpose, organizational framework, and many more. The current LOM model does neither provide concepts for modelling instructional models, instructional principles, nor to specify epistemological approaches.

Basic Instructional Framework

Pedagogical Dimensions – Abstraction Layers: We start by defining what we consider as pedagogical dimensions in this context. We choose a top-down-model in which pedagogical dimensions are embedded in different layers of abstraction - according to educational and cognitive sciences. In this model, LOM only addresses the bottom layer which is the most basic. *4th (highest) layer of abstraction: epistemology, paradigm:* The highest level of abstraction addresses (whether implicitly or explicitly) broad orientation concerning epistemology resp. theory of cognition. *3rd layer of abstraction: (instructional) principles:* Merrill refers to this layer as "set of underlying principles". In literature as well as in practice we often find fixed terms comprising some well-agreed principles: Problem Based Learning (PBL); Case Based Learning e.g. *2nd layer of abstraction: instructional models, learning theories* as well as communication theories and sets of strategies. Models often

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structure and organize learning processes in several phases. *1^{st} (basic) layer of abstraction: content, practices, activities,* sets of activities and scenarios. Curriculum programs assembling content are located at this layer. This layer tells which resources are actually used. The current LOM Metadata Schema only addresses this layer.

The top-down-model presented in this paper is derived from German tradition of education. But there is obviously an urgent need for implementing a model in LOM that reflects both, American as well as European thought, and hopefully also other tradition in the field of instructional design. Analogies between these different traditions can be stated: Merrills approach of abstraction layers in instructional design (Merrill 2001) seems to be comparable to our perspective which is presented by German authors (Kösel 1993; Klafki 1993). A decision made on a higher layer of abstraction shifts the entire setting at the level of the basic layer: the 'Typical Learning Time' spend with one and the same LO may be different in a PBL scenario from an expository scenario e.g.. In order to solve the need for dynamic classification, we suggest to include the concept of *roles* in the meta-model. *Instructional Roles – Instructional Aptitude*: Using LOM metadata we cannot specify the instructional aptitude of a LO. Is a LO suitable to be used in a scenario of collaborative learning or in a scenario enabling problem solving? *Learning Sequences – Learning Processes*: In separating content from structure, LOs are decontextualized. In our meta-model, LOs are integrated into different learning cycles supporting processes which are derived from different instructional models. In the role-concept of our meta-model learning theories and instructional models represent context. Merrill stresses the importance of phases in learning cycles (Merrill 2001). One and the same LO (types) may fill different instructional roles within learning processes set up by different learning theories. Our concept of roles stringently and clearly distinguishes the natural types of LOs (media type, tools e.g.) from their instructional role/purpose (Guarino 1992; Steimann 2000). The top-down-model can be mapped to the concept of types (class) and roles (figure 1).

Roles for Modelling

There is a wide choice and diversity of definitions of the role concept in literature (in semantics e.g.). The concept of Roles in Modelling has been elaborated in (Steimann 2000a). Role expectations include both actions and qualities. Steimann distinguishes definition of characeristics from the player itself: „(...) „a role is a kind of protocol specificification specifying behaviour and characteristics, but not the role player itself" (Steimann 2000b). As opposed to natural types or classes, roles have strong dynamic aspects. Types/classes, which are the fundamental concepts in the object oriented modelling are inherently static: an instance of a class once and forever belongs to that class – it cannot change it without loosing its identity. A LO may fill different insructional roles. Learning Models are used as context of roles and determine relationships between entities.

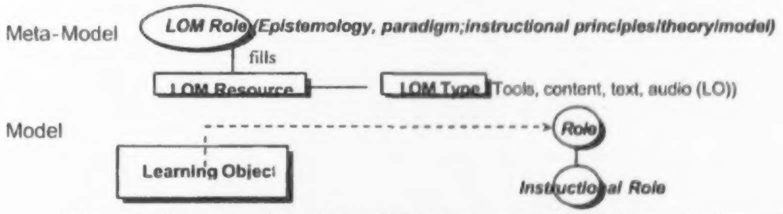
Meta-Model
LOM Role (Epistemology, paradigm;instructional principles/theory/model)
fills
LOM Resource
LOM Type (Tools, content, text, audio (LO))
Model
Role
Learning Object
Instructional Role

Figure 1: The extended LOM Meta-Model (The model distinguishes roles from types/classes)

The instructional role is compatible with the idea of the role concept: a type must have certain characterising predicates (Guarino 1994), qualities, attribute, or requirements in order to be able to fill a certain role. Characterising predicates, attributes and requirements are matchable with the concept of instructional aptitude.. We suggest to name instructional aptitutes 'instructional qualities'. The important advantage of the approach of instructional roles is its ability to deal with dynamic modelling and instantiation, in contrast to a standard class-oriented approach which is suitable for the static attributes currently included in LOM.

References

Guarino, N., & Carrara, M., & Giaretta, P. (1994). An Ontology of Meta-Level Categories. *Principles of Knowledge Representation and Reasoning, 1994*, Fourth International Conference KR94, San Mateo, CA. 270-280.

Klafki, W. (1993). Neue Studien zur Bildungstheorie und Didaktik. Weinheim.

Kösel, E. (1993). Die Modellierung von Lernwelten. Elztal-Dallau.

LOM (2001). Draft Standard for Learning Object Metadata. IEEE P1484.12/D6.1. 18. April 2001

Merrill, D. (2001). First Principles of Instruction. Educational Technology Research & Development.

Steimann, F. (2000a). Modellierung mit Rollen. Habilitationsschrift, University of Hanover, Germany.

Steimann, F. (2000b). On the representation of roles in object-oriented and conceptual modelling. *Data & Knowledge Engineering* 35 (1), 83–106.

Dual Coding Theory and Computer Education: Some Media Experiments to Examine the Effects of Different Media on Learning

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Abstract: Dual Coding Theory has quite specific predictions about how information in different media is stored, manipulated and recalled. Different combinations of media are expected to have significant effects upon the recall and retention of information. This obviously may have important consequences in the design of computer-based programmes. The paper describes an experimental approach which has been developed using the Statistical domain in which the presentation media have been varied (Text only, Text and Diagrams and Diagrams with Voice-over). The results are compared with Dual Coding theory predictions and the effects of Student Learning Style explored.

1. An Early Attempt at Using the Web to Communicate Statistics Knowledge

Our interest in this work arose out of a desire to measure the effectiveness of Distance Learning compared with Face-to-face presentations. An opportunity arose in a second year HCI module which included two lectures on the use of the Null Hypothesis and Statistical Inference in HCI evaluation. We decided to divide the class into two groups, one of which would be taught face-to-face and the others over the Web. Presentation was mainly textual but some animations created using Visual Basic were also included. Students were first given a test to ascertain their knowledge of the material to be presented. There were some students with detailed knowledge, but most knew little about the domain. Throughout both presentations, questions were asked to enable students to check if they had understood the material. The Face-to-face class was taught the material on the last day of term, and the Distance Learners were given access to the material once they arrived home in the vacation. Access was protected by password and, becausethe student homes were widely dispersed it is unlikely that any of the "lecture" students could gain access to the material. On their return to the University in the next semester, the students were tested for knowledge of the material through a series of questions. We marked the test with a simple scoring system – one point for a correct answer.

The results, as one might expect, were inconclusive. Overall, the performance of subjects on the post-test was similar for both groups. It was interesting that the Distance Learners did no worse overall that the Face-to-face Learners, though a number of them did report that they found working at home, alone, not very motivating.

Scores varied widely (from 13 to 60). It was clear that some students in both groups had not taken the exercise seriously. It was also clear that previous knowledge had an effect (though students who professed previous knowledge did not always do well). Previous Mathematics expertise also had a positive effect on the score as might be expected. We had asked the Distance Learners to keep a log of their access to the system. Most did this and total access times reported varied from 1 hour to 6 hours. Some students also made comments on the way in which the material was presented. The material was heavily text -based and most comments suggested that more "interesting" media should have been used (whatever that meant).

Although this was only an exercise partly to illustrate to the students the problems involved in such experimentation, it did raise some major design issues for any future experiment:

1. By how far do different media affect the learning process?
2. At what level should the learning material for the experiment be pitched and how extensive should it be?
3. How can the students be m otivated so that they make a serious attempt at learning?
4. How is the amount of material learned measured? Clearly correct answers to questions do give an indication, but how should the questions be phrased?
5. How is previous knowledge allowed for? Aremarks only given for improvements in knowledge transfer? Does someone who knows it all before get zero!

6. Should we be considering different learning styles?

2. Effect of Different Media on Learning and Performance

2.1 Some Process Control Results

We have previously studied the effects of using different media on the performance of operators carrying out a laboratory task. The task chosen was that of Crossman's Water Bath [Crossman & Cooke, 1974]. The task is closely related to the process domain [Sanderson et Al., 1989].

There was a marked difference in performance across media. For example, the performance results differed when using Text and Graphics. At low task complexity the performance was very similar, but as complexity increased the differences start to show. In the more complex tasks the results are significant ($p<0.03$) with Graphical interfaces giving the best performance. After each sequence of tests, the understanding of subjects was tested with a questionnaire. The comprehension results showed significant differences in the performance between the use of Verbal and Spatial Coding in the interface.

Interestingly, spatial coding improved comprehension of the two least understood variables and this was a significant result ($p<0.01$). There is not space to report all the findings but the other variables showed similar trends (Alty, 1999).

Thus the choice of medium used does seem to have an effect on comprehension and this could be important in learning situations.

2.2 Dual Coding Theory

Dual Coding Theory (Paivio, 1986) assumes an orthogonal relationship between symbolic systems and sensory motor systems. The theory suggests that there are clear distinctions between the internal representations of Symbolic and Sensory-motor events. The stored versions of visual, verbal, and haptic events retain the modalities of these events. For example, in the visual modality there are printed words and images. In the auditory modality there are spoken words and sound events. *Lion* can be stored as an image of a lion, the word "lion", or both but within distinct systems. Of major importance is the verbal/nonverbal distinction. The verbal and non-verbal processing systems are assumed to be functionally independent though there are cross linkages between the two. If the Dual Coding theory is relevant then the recall of material will be affected by the way it is presented.

3. Choice of Learning Domain and Subject Motivation

Many experiments that have examined the effects of different media on learning have been constructed over relatively simple subject domains. The material being communicated to learners is often limited in scope and usually not complex in nature. There are, of course, good reasons for this. A complex domain necessarily requires a specialised user base, and an extensive set of learning material will impose serious time requirements on the subjects taking part. Yet it is important to really challenge subjects both with domain complexity and the extent of the material in order to obtain results which will scale-up for real situations.

One possible solution to this problem is to choose a domain that is acknowledged to be inherently difficult, is difficult to teach, and yet for many people, constitutes a most desirable skill to attain. Within a University context (the population from we from which we are most likely to draw subjects) there was an obvious candidate – Statistics.

Most Masters and PhD. students require statistical knowledge for analysing their experiments, and yet it is a subject most feared by many of them. Thus the Statisitical Domain fulfils our requirements of being complex, of being not easy to teach, and yet would be regarded by subjects as a required and desirable skill. There should therefore be a strong motivation to take such a course and to take it seriously. Furthermore, at Loughborough University, we have a Masters course on Multimedia Interface Design, and an important aspect of the course is the design and evaluation of HCI experiments using Statistics. The material is typically taught in four one-hour lectures on the course and covers basic information about the Null Hypothesis, the Binomial Distribution, the Sign Test, the Wilcoxon Ranking Non-parametric Test and Normal distributions and their use. We therefore decided to develop Web-based material to teach the subject matter on the course and to additionally make the exercise an example of HCI experimentation and its evaluation.

We constructed four separate computer-based modules in FLASH to teach this basic statistical knowledge:

1. The Null Hypothesis and the relevance of Statistics
2. The Binomial Distribution
3. Non-parametric distributions - i.e. Ranking (Wilcoxon)
4. The Normal Distribution and the Central Limit Theorem

The presentations were constructed using three different media combinations of voice, text and diagrams/pictures. The material and timing was identical in each presentation. In other words, the text and the voice-over content were identical. Each of these media could be disabled so that a number of different presentation formats was possible. We actually used:

1. Text only
2. Text + Diagrams
3. Voice + Diagrams

These formats were preserved over a complete module presentation session.

4. Proposed Experimental Approach

Each developed presentation had an elapse time of about 10-15 minutes and each was presented in a serial non-interactive fashion. We planned to place subjects in a room and present the material on a screen using a computer projector. At the commencement of the first session all subjects were to be given a short questionnaire to determine their previous knowledge of the subject and would be told to write nothing down during the experiment, but that at the conclusion of the experiment they would be required to answer a series of questions on the material. If students were subjects, they would be assured that the results did not form any part of the evaluation process for their module

The subjects would be tested for immediate recall of the material presented at the conclusion of the presentation. The post experimental test would consist of a series of questions about the presented material. In order to allow for the effect of previous knowledge, subjects would be able to indicate alongside their answer whether they already knew the answer before the session, whether the session had reminded them of the answer, or whether the material in the question was completely new to them.

5. The Construction of the Material

Because all the three different media presentations had to be based upon identical material, the construction of the different sessions was an interesting exercise in itself. When constructing the Voice-over + Diagrams presentation we had to be mindful of the fact that the Voice-over (as text) had also to work when presented as a Text-only session. This exercise in itself provides useful insights into the nature of multimedia presentations, how media are implicitly allocated for communicating particular types of material and the limitations some media have for communicating particular types of material. For example, communicating the idea that the results of an experiment might be caused by a set of independent random events is quite straightforward in text, but is not easy to do in a diagram. On the other hand some material (describing the shape of a normal distribution) is easy with a diagram but laborious using text. The Null Hypothesis concept is relatively straightforward to communicate using text but more difficult using a diagram. All the material was constructed in FLASH and each module was divided into a number of FLASH scenes. The scenes were transparent to the subjects, but we used this approach so that later the material could be adapted so that it could be presented in a more parallel, interactive manner at a future date.

6. An Initial Experiment

The first module was actually constructed in Australia whilst the author was a Visiting Research Fellow at Melbourne University Department of Information Systems. Towards the end of the Fellowship the author gave a commercial course on Multimedia Interface Design to a class of about 50 commercial, industrial and academic participants, which lasted two days. It was decided that this would be a good opportunity to run a pilot study of the first module during the course to give the participants an insight into evaluation techniques and to demonstrate the effects of different media on learning. From the point of view of the experiment, it would

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provide an exercise in creating the material, a test of the suitability of the material and provide experience in setting the post-experiment test. The participants (most of whom in the pre-test claimed not to have significant knowledge in the Statistics area) were divided into three groups and presented with the three different presentation styles – Text-only, Text + Diagrams and Voice-over + Diagrams.

All presentations were given in separate room areas using a computer projector. At the end of the test all subjects answered the same test to check recall of material. No learning style classification of users was attempted in this pilot run. The test administered at the conclusion of the experiment consisted of a series of questions, some of which were multiple-choice questions.

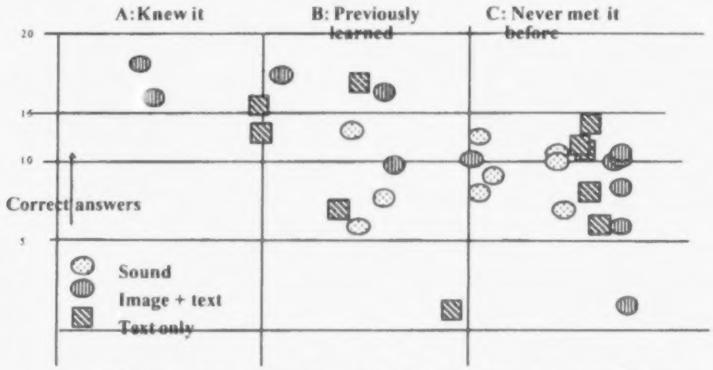

Figure 1: Raw results from the Australian Experiment on Recall.

The results are shown in (Fig 1). The three vertical columns refer to whether the subject had met the domain or concepts before (A: *Knew it*, B: *Previously learned and forgotten, but reminded*, C: *Did not know it*). One can clearly see the effect of previous knowledge. The marks decrease as subject knowledge decreases. This experiment was only carried out as a pilot, to guide future experimental design (for example, we did not expect to carry out any statistical analysis on the result) the results seemed initially to contradict Dual Coding Theory predictions. For example, the Text Only group (A) had a tendency to do better than the Voice-over-Diagrams group (B), whereas we might have expected the results to be in the opposite direction. However, a replay of the experimental material discovered an error. We had met with some trouble in starting the three presentations and, in the confusion, had actually presented Voice-Over+Text (not Voice Over+Diagrams) to Group (B). Thus in retrospect it was not surprising that the Group (B) performed badly. Previous experiments have shown that the redundancy of Text and Voice-over can worsen performance. Other interesting features were noted. Subjects who professed to know the material often still made recall errors. Finally we had great difficulty in analyzing the questionnaires in giving marks for recall and realized that the questions needed to be more carefully designed and related more carefully to the material.

7. The First Student Class Experiment

We reorganized the material so that each scene had clear learning objectives and the resulting questions were derived from these objectives. Some questions were carefully chosen such that even previous knowledge in itself would not enable a student to answer it. We also decided to test the students Learning Style using the Felder and Soloman Test (Felder 1993). The test identifies preferences on the axes Active/Reflective, Sensing/Intuitive, Visual/Verbal and Sequential/Global.

We asked students on a first year HCI course to take the learning style test. The spread of learning styles indicated that there were similar sized groups of Sensing Learners and Intuitive Learners in the class, and the rest of the students had Learning Styles balanced between the two. The class was then divided into three groups each group having an equal number of Sensing Learners, Intuitive Learners and Balanced subjects. A further regrouping improved the gender balance without disturbing the Learning Style balance.

The first module (Null Hypothesis) was then presented to the three groups of students – Text-only, Text and Diagrams, and Diagrams with Voice over. The results of this exercise are reported elsewhere in this conference (Beacham, Elliott, Alty and Al-Sharrah, 2002). The media combination used was significant with respect to recalled material and it was shown that Learning style played an important part in the accuracy of recall.

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8. The Extended Student Class Experiment

As a result of the success of the first experiment we completed all four modules and tested them on the students attending a postgraduate Multimedia Interface Design course (59 students, though all did not take part in all sessions). The students answered a questionnaire to determine their learning style. The test administered was again that of Felder and Soloman. They were then again divided into three groups (A, B and C) according to their learning style SENSING / INTUITIVE / BALANCED.

As far as possible, each group was balanced for gender and learning styles. Groups were given the four modules (in the different presentation formats) as detailed below in (Tab. 1).

	Text	Text + Diagrams	Voice + Diagrams
Null Hypothesis	Group A	Group B	Group C
Binomial Distribution	Group B	Group C	Group D
Ranking	Group C	Group A	Group B
Normal Distribution	Group A	Group B	Group C

Table 1: Groups and Presentation Formats

Since learning about Statistics was part of the course as well as the experiment, we did not want to disadvantage any students who might do less well on a particular presentation technique. We also did not want succeeding modules to be affected by any lack of knowledge gained in previous modules (though generally this was not a problem because most of the material was quite different). All students were therefore given a normal lecture on the material of a module after the presentation. They were able to interact and ask questions to ensure they fully understood the material. Any students who did not complete all sessions were removed from the sample. This left 37 students.

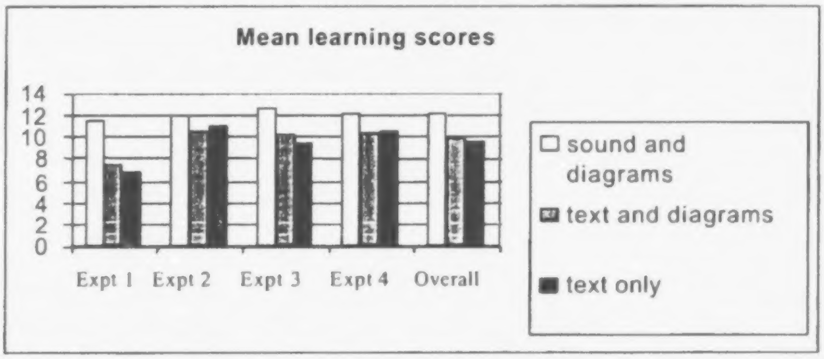

Figure 2: Preliminary Experimental Results

The results for the different media can be seen in (Fig. 2). In all cases the predictions of Dual Coding theory are borne out

Our sample included some dyslexic learners. Although the sample was too small to be significant (6 subjects), the results did suggest that such learners might react differently see (Fig. 3), and this looks like an interesting area for more experimentation. The dyslexic subjects do not seem to follow the predictions of Dual Coding Theory (or at least there seems to be more complex interactions taking place). The results also indicated that the material based upon real world objects were recalled more accurately than more abstract visual material.

Certain learning styles were influenced more (or less) by different media (Fig. 4). For example, Intuitive Learners tended to out-perform Sensing Learners in all presentations, although in certain experiments, Sensing Learners using Voice/Diagrams outperformed Intuitive Learners using Text-only.

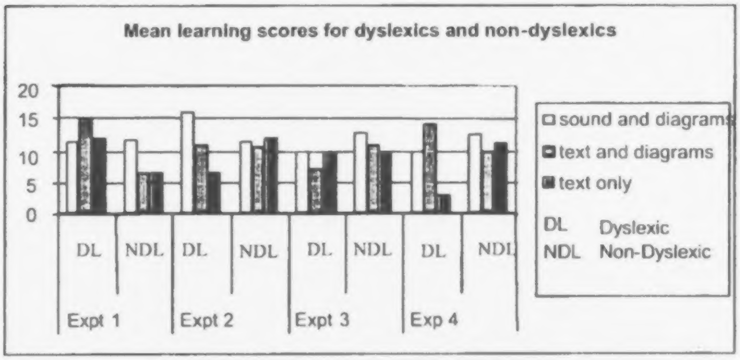

Figure 3: The Preliminary results for Dyslexia

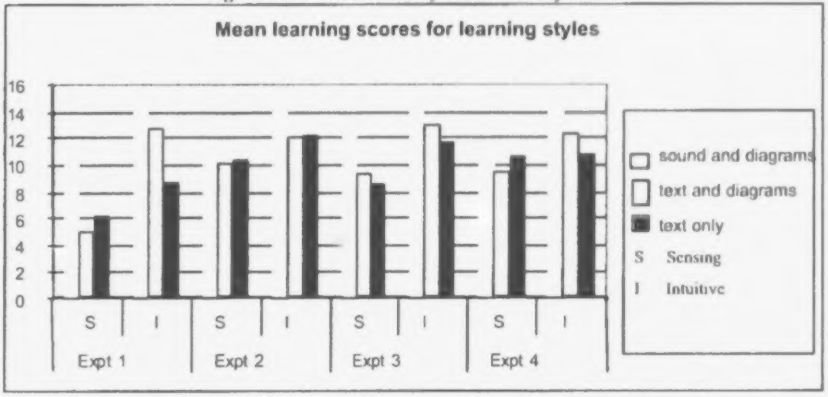

Figure 4: Performance for Different Learning Styles

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References

Alty, J.L., (1999). Multimedia and Process Control Interfaces: Signals or Noise? *Trans. Institute of Measurement and Control*, Vol. 21, No. 4/5, pp 181 - 190

Alty, J., Beacham, N., and Al-Sharrah, A. (2002). This Volume.

Crossman, E.R., and Cooke, F.W. (1974). Manual Control of Slow Response Systems, In *The Human Operator in Process Control* (Edwards, E., and Lees, F., eds.), Taylor and Francis, London, 51 – 64.

Felder, R., (1993). Reaching the Second Tier: Learning and Teaching Styles in College Science Education, *Journal of College Science Teaching* 23, 5, 286 – 290.

Paivio, A., (1986). Mental Representations. New York: Oxford University Press.

Sanderson, P.M., Verhage, A.G., and Fuld, R.B. (1989). State Space and Verbal Protocol Methods for Studying the Human Operator in Process Control, *Ergonomics*, 32, 11, 1343 – 1372.

Using Critical Components of Communicative to Measure the Distance Learning Experience

Distance delivery of educational material and adult-learning are not new concepts. From Paul's letters to the Corinthians, to books from printing presses, to the mass media approach of film, radio, TV, and today the Internet, distance education has a long tradition of making use of available communication technology to store, transport, and disseminate information. But the storage, transportation, and dissemination of information do not constitute higher-level learning according to Bloom's Taxonomy. Whether engaged in formal or informal higher-level learning, humans incorporate new information into their prior experience base (Mezirow, 1991). Humans ascribe value and meaning to their experiences and operationalize their knowledge according to their interactions with others (Mead, 1917).

Limited interaction, student to faculty and student to student, has always been one of the rationale for distance education's struggled to gain equal prestige with traditional classroom settings. Major universities administer distance education programs as part of their extension services. Experienced educators' perceive face-to-face communication as an essential part of the learning process. However, the advent of multimedia, hypermedia, and telecommunications for educational purposes has created a new opportunity to overcome not only the geographic barriers which have separated DE students in the past, but to provide all students the leaming advantages of interactive communication. The ever-growing ability of computing and telecommunications to support interactive learning allows educators new opportunities to construct communities of learners to assist students in higher-level leaming (Palloff & Pratt, 1999).

As the twenty-first century begins traditional educational institutions face several challenges:

- Mounting economic pressure (Increasing costs & reduced funding)
- The need to produce college graduates with the ability to function well in a knowledge society (Palloff & Pratt, 1999).
- Enrollment in post-secondary institutions reached 15.3 million students by the Fall of 2002, (http://chronicle.com/daily/2001/08/2001081701n.htm).
- Enrollment in post-secondary institutions is expected to reach 17.5 million by 2010, (U. S. Department of Education, 1996).
- As few as 1 in 4 college students fit the description of the traditional full time student, (Twigg, 1994).

Statement of the Problem

These non-traditional and part-time students are turning with increasing frequency to distance delivery to address their educational needs (Palloff & Pratt, 1999). Educational institutions are turning more frequently to the use of the Internet to deliver courses to nontraditional students, (Palloff & Pratt, 1999). The advent of the personal computer and access to the Internet has increased the opportunity for universities to offer on-line courses to DE students. The University of South Dakota began using a PC delivery platform in 1997. Within five years the number of courses archived in the system had grown to 338 courses. While researchers have examined the design and implementation aspects of on-line instruction, few studies have documented the experience from an online student's perspective, (Turkle, 1995).

The purpose of this study is to examine the relationship between graduate student satisfaction with the on-line learning experience and four criteria. The four criteria were established by Junger Habermas in his work, "The Theory of Communicative Action", 1984. This study will attempt to ascertain by what degree graduate student satisfaction with the on-line learning experience is related to the interactive communication facilitated by multi-media and computer mediated learning situations.

Habermas states that all human communication is judged by the receiver using four critical components of interactive communication; coherence, relevance, accuracy, and honesty. Each message received is critiqued according to the receiver's ability to understand the message, the perceived usefulness of the information transferred, the receiver's perception of the correctness of the information, and the receiver's perceptions of the motives of the sender. The student's perceptions are key to developing understanding and trust for the other members of the group. Through interactive communication the group modified and re-enforced understanding and incorporation of information.

Significance of the Study

> Many are the conditions, which must be fulfilled if the Great Society is to become a Great Community.... The highest and most difficult kind of inquiry and a subtle, delicate, vivid and responsive art of communication must take possession of the physical machinery of transmission and circulation and breathe life into it. When the machine age has thus perfected its machinery, it will be a means of life and not its despotic master.
>
> John Dewey (1938, p. 38)

Dewey's choice of words reflects the pessimistic view of the human/machine relationship of many during the Industrial Age. And his words are nearly prophetic as to the focus and accomplishments of the Information Age. The Industrial Age was defined by rules and calculations, while the Information Age is defined by communication and collaboration. "Today, the lessons of computing have little to do with calculation and rules; instead they concern simulation, navigation, and interaction", (Turkle, 1995, p. 19).

This study explores the communication phenomenon of the internet learning experience from the graduate student's perspective and seeks to increase educator awareness of the theories guiding interactive communication. While there is a need for quantitative measurements to insure system functionality and course content, there is an equal need to make qualitative measurements of the DE communication experience. Addressing the communication experience of the graduate and professional level students is essential for DE's evolving mission and desire to maximize student learning opportunities.

The general purpose of this study is to analyze the relationships between the critical components of interactive communication and graduate student perceptions of the on-line learning experience. Specifically this study will ask graduate students taking DE courses through South Dakota's DDN and computer-mediated communication network. Students will be asked questioned concerning administrative, technical, and interactive communication issues. Questions dealing with interactive communication issues will be constructed and critiqued according to the critical components of interactive communication theorized in "Communicative Action Theory", Hubermas (1984).

Population and Sample Selection

The population for this study was limited to graduate students studying at three public universities located in South Dakota. Participants in the study have all recently completed a graduate level course delivered primarily by remote means or containing remote components through South Dakota's DDN and computer-mediated communication network

Instrumentation

A narrative approach will be utilized to achieve the purposes of this study. A select group of graduate students participating in CMC distance delivery courses will be ask to share their experiences with and observation of the CMC classroom. A narrative approach to research allows people to voice their values and preferences, increasing our collective knowledge of the human experience (Bakan, 1996). The scale for this study will have six components: frequency, honesty, relevance, openness, affiliation, and student satisfaction. The student satisfaction component will draw from questions (p. 158) and issues concerning online learning communities posed by Pratt and Palloff (1999). Issues to be explored will include: frequency and mode of communication, student perceptions of the honesty, relevance, and openness of the online classroom environment, and student perception of the effectiveness of CMC communication.

This study will primarily use interviews to obtain data. Interviews will be conducted in person, by phone, or over the Internet. Participants will be asked to disclose basic demographic information.

Literature references;

Habermas, J. The Theory of Communicative Action. Boston, MA: Beacon Press. 1984.

Mead, G. H. (1917). Lectures notes: Philosophy 327 – Social Psycology. University of Chicago. Chicago, IL.

Mezirow, J. Transformative Dimensions of Adult Learning. San Francisco, CA: Jossey-Bass Publishers. 1991.

Palloff, R. M. and Pratt, K. Building Learning Communities in Cyberspace: effective strategies for the on-line classroom. San Francisco, CA: Jossey-Bass Publishers. 1999.

Turkle, S. Life on the Screen: Identity in the age of the Internet. New York: Simon & Schuster. 1995.

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Digital Disconnect:
Students' Perceptions and Experiences with the Internet and Education

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Abstract: In close collaboration with the staff of the Pew Internet & American Life Project (www.pewinternet.org), the American Institutes for Research (AIR) is conducting a qualitative study on the impact of the Internet on schooling and education from the perspective of middle and high school students. Primarily through the conduct of multiple in-person focus groups that are being held across the country, we focus on the behaviors, beliefs, and attitudes of middle and high school students about access to and use of the Internet for schooling, including (intended and unintended) outcomes of those uses. Among the questions we are most interested in pursuing: Is the Internet helping students learn and why? What activities do students consider and pursue as "educational" on the Internet? What are the other outcomes (intended and unintended) of educational Internet use (e.g., social interaction, interest and motivation, writing skills, post-secondary goals, etc.)? Based on this knowledge, how could the Internet be better used by schools? Other data collection strategies include the surveying of focus group participants (to better describe our sample), as well as the online solicitation of stories about the use of the Internet for education directly from students.

Introduction

> "Overall, I really think that the Internet has a great impact on how much I learn at school and without it I don't think that I would have the opportunities to learn as much as I do."
> – Midwestern female HS student, online storyteller

Given the relatively high levels of Internet access in schools and homes, it stands to reason that youth are increasingly online. In fact, this is the case. By the age of 10, youth are more likely to use the Internet than anyone at any age beyond 25. As of September 2001, about two-thirds of 10 to 13 year olds—and more than three-quarters of 14 to 17 year olds—reported using the Internet at any location. We know, then, that youth are online more and more. However, we know less about what they do online – especially for school.

To date, most research on the use of the Internet in schools and for school—as distinguished from research on the use of computers and other technologies—has focused on access. This has consisted of measuring the extent of connectedness to the Internet and supports for Internet use in schools (i.e., the amount and adequacy of teacher professional development and technical support). A few large-scale surveys, most now several years old, provide some modest insights into the extent and types of Internet use in schools, though typically from teachers' or school technology coordinators' perspectives. Unfortunately, the current knowledge base is exceedingly limited in its ability to describe the rich details of educational student Internet use and outcomes, particularly when this use is occurring outside of schools and classrooms.

The Study

To provide insight into the rapidly evolving influence of the Internet on schooling, the American Institutes for Research was commissioned by the Pew Internet & American Life Project to conduct a study to describe the rich

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and varied ways that middle and high school students use the Internet for school and learning, their attitudes toward the Internet, and what they would like from their education. Data for this study were collected primarily through three mechanisms:

- The conduct of 12 focus groups of a total of [136] diverse middle and high school students drawn from across the country who characterized themselves as heavy Internet users, coupled with 2 focus groups of light Internet users (comprised of one middle and one high school group);
- The administration of questionnaires to each focus group participant in order to help characterize their school-related Internet use both in- and out-of-school; and,
- The online solicitation of student-written stories detailing how they use the Internet for school. Nearly 200 middle and high school students from across the country wrote and submitted their stories to AIR through the study's Website.

Findings

Preliminary findings show that students who use the Internet a great deal use it for communication, entertainment, and learning purposes – including gathering and synthesizing information for school. There seems to be a disconnect, however, with the high Internet skill and knowledge that these students have, and the access and uses that that schools and teachers provide for them. A final report with these and numerous other findings and implications will be available at http://www.pewinternet.org/reports in the summer of 2002.

Literature References

Cattagni, A. and Farris, E. *Internet Access in U.S. Public Schools and Classrooms: 1994-2000.* U.S. Department of Education, National Center for Education Statistics (2000)., NCES 2001-071. Washington, DC. Available at: http://nces.ed.gov/pubs2001/2001071.pdf

Learning, and Computing Study: 1998. Center for Research on Information Technology and Organizations (CRITO). National Science Foundation's Division of Education and Human Resources, and the U.S. Department of Education's Office of Educational Research and Improvement. (NSF Grant #: REC-9600614), Washington, D.C. Available at: http://www.crito.uci.edu/tlc/html/tlc_home.html

Lenhart, A., Rainie, L., and Lewis, O. (June 2001). *Teenage Life Online: The Rise of the Instant-Message Generation and the Internet's Impact on Friendships and Family Relationships.* The Pew Internet & American Life Project, Washington, DC. Available at: http://www.pewinternet.org/reports/toc.asp?Report=36

Lenhart, A., Simon, M., and Graziano, M. (September 2001). *The Internet & Education: Findings of the Pew Internet & American Life Project*: The Pew Internet & American Life Project , Washington, DC. Available at: http://www.pewinternet.org/reports/toc.asp?Report=39.

Smerdon, B., Cronen, S., Lanahan, L., Anderson, J., Iannotti, N., and Angeles, J. (2000) *Teacher's Tools for the 21st Century: A Report of Teachers' Use of Technology.* U.S. Department of Education, National Center for Education Statistics NCES 2000-102, Washington, DC.
Available at: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000102

U.S. Department of Commerce, Economics and Statistics Administration, National Telecommunications and Information Administration (February 2002). *A Nation Online: How Americans Are Expanding Their Use of the Internet.* Washington, DC. Available at: http://www.ntia.doc.gov/ntiahome/dn/nationonline_020502.htm

THE SCULPTUREQUEST MICROWORLD PROTOTYPE

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Abstract: This presentation demonstrates the SculptureQuest Microworld Prototype, designed to allow sculpture students to implement rapid prototyping in their production process. The Microworld's purpose is to promote metacognitive learning outcomes and enhance domain-specific skills and knowledge related to the art of sculpture. The Microworld's programmed environment delivers customizable, constructivist strategies that drive the effective use of technology within a classroom context. Teachers and students are encouraged to add, delete, or reprogram features as necessary to adapt the tool to their particular needs.

Introduction

The SculptureQuest Microworld (SQMW) is a learning environment in which the student uses interface and display capabilities of a contemporary 3D computer modeling GUI to perform functions which rapidly prototype sculptural pieces. In addition, analytical features output the physical parameters of prototyped sculptures and installations as if actually built. This allows recognition of the strengths and weaknesses, or logical outcomes, of decision points encountered throughout the creative process of sculpture. SQMW is meant for use in a classroom setting with emphasis on examining relationships between the artist's mental models and artistic processes.

In a non-traditional environment, where knowledge is assumed to be constructed and experiential, learning objectives must reside within the learner and her cognitive/metacognitive abilities (Lin, 2001). One major outcome of employing SQMW in a pedagogical setting is the integration of metacognitive and domain-specific activities, scaffolding student self-knowledge and domain knowledge simultaneously. The output data directly relates actual material outcomes with specific design decisions and promotes transfer of knowledge to the larger physical world.

The Microworld Model

The use of the microworld model to represent the technology piece of this course is a good fit. Strohecker (2000) identifies microworlds as inquiry-based learning environments, inherently constructivist in nature, simple in principle but rich in possibilities for playful, thoughtful activity. Land and Hannafin (1996) add that students rely on the open-ended nature of microworlds to support experiences necessary to identify, question, and test the limits of their intuitive beliefs.

Battista (1998) provides the most concise criteria for what constitutes a microworld by stating that this environment should: 1. Support problem-centered inquiry 2. Be based on research of students' domain-specific learning 3. Cultivate mental models of abstract ideas and 4. Induce reflection and abstraction. SQMW supports each of these criteria using programmable features including the Diary tool, the Self Assess tool, the Playback tool and the Video Assistant.

The Course

College students who possess familiarity with 3D computer drawing programs comprise the target audience for this course. It is likely that these students will initially possess only a beginner's awareness of metacognitive techniques. Despite the fact that this Microworld exists as a computer environment, its real context is the social milieu of the classroom. Students and teacher must together navigate techniques for developing metacognition, using sculpture as a focus. It is necessary for all to meet in the spirit of collaboration to develop a mutually agreed upon approach for the semester. It is at this time that SculptureQuest is programmed for specific needs that the class has developed. Next, all parties agree to follow through with the agenda, using the Microworld features to record and sequence events, observations and insights that arise.

How the Microworld Works

There are two worlds found in SQMW: Explore and Prototype. Explore provides 2D and 3D objects as building blocks that can be assembled into complicated three-dimensional arrangements that may be assigned material characteristics. This is the environment most attractive to the novice learner who is examining basic shape relationships, physical/ structural properties and sculptural concepts. Constructions may be exported to "Prototype" for further study. The Video Assistant (V/A), Playback and Diary tools are also available in Explore.

Prototype provides a more demanding-for-mastery set of tools and an environment in which construction and analysis take place. This area is the primary strength of the Microworld. All material and structural analysis takes place here and a sculpture may be continuously modified through design iterations. It is within the Prototype environment that the metacognitive activities incorporated in the Video Assistant (V/A), the Diary, the Playback, and the Self-Assess tools (combined with the social environment of the classroom) come into full play.

The Microworld Tools

The Tool designs are based on findings from cognitive research. The Diary Tool has its roots in Lesh's Construct Documentation Principle (2001) that requires activities to contribute to both learning and documentation of learning, thereby fostering self-reflection. Lesh claims that thinking about thinking does not come easily without scaffolding. His work recommends thought-revealing activities that encourage students to externalize their thought processes in order to facilitate reflection (Lesh, et al. 2001).

The goal of the Self Assess Tool is to stimulate self-explanation through prompts that serve to guide student attention to conflicting thoughts and build coherent understanding of the domain tasks. Findings by Chi, et. al (1994) show prompts lead to extensive inference.

Lin and Lehman (1999) also use prompts in a computer-simulation developed to aid students in designing biology experiments. Monitoring how and why certain decisions were made is effective because students are able to pin down specifically where and what they did not understand. Instead of self-assessing at a general level as expressed in the statements "I don't understand" or "I am confused", the students are able to explain specifically what they did not understand and where the difficulty occurred (Lin and Lehman, 1999).

Conclusions

The SculptureQuest Microworld has been integrated into a course on sculpture studio practice to demonstrate that technology may effectively support Lin's findings that the best approach for optimal learning outcomes is to practice metacognition within a domain-specific context (Lin, 2001). Hence, while the design of the computer piece is significant, it is the design of the course in which it is used that will determine the effectiveness of SQMW for cognitive and metacognitive learning outcomes.

References

Battista, M. T. (1998). Computer environments that engender students construction of mathematical ideas and reasoning: A constructivist perspective. Paper presented at the ENC Technology and NCTM Standards 2000 Conference. Arlington VA, June 5-6, 1998.

Chi, M.T.H., deLeeuw, N., Chiu, M.H., & LaVancher, C. (1994). Eliciting self-explanations improves understanding. Cognitive Science, 18, 439-477.

Land, S. M., & Hannafin, M. J. (1996). A conceptual framework for the development of theories-in-action with open-ended learning environments. Educational Technology Research and Development, 44(3), 37-53.

Lesh, R., Hoover, M., Hole, B., Kelly, A., & Post, Thomas (2000). Teaching experiment methodology: underlying principles and essential elements. In R. Lesh & A. E. Kelly (Eds.), Research Design in Mathematics and Science Education (pp. 591-640). Hillsdale, NJ: Erlbaum.

Lin, Ziaodong. (2001). Designing metacognitive activities. Educational Technology Research and Development, 49(2), 23-40.

Lin, X.D., & Lehman, J. (1999). Supporting learning of variable control in a computer-based biology environment: Effects of prompting college students to reflect on their own thinking. *Journal of Research In Science Teaching, 36*(7), 1–22.

Strohecker, Carol , & Slaughter, Adrienne H.(2000). *A Framework for Microworld-style Construction Kits*. Retrieved December 20, 2001 from http://www.merl.com/papers/TR2000-19/.

POLICIES For CONTENT FILTERING In EDUCATIONAL NETWORKS: The CASE Of GREECE

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Abstract : An increasing number of nations connect their schools on the Internet as an acknowledgment to its extreme importance in the education area. Our study specifies the perils that arise from its use when the users are minors and evaluates the technologies that are currently available to address the filtering issues. The thoughts presented in this paper outline our proposed solution for the Greek School Network. By no means the thoughts that are presented here, apply for adults or people who pay to establish access to the Internet.

INTRODUCTION

As the number of computers in schools and the number of children accessing the Internet from the classroom have grown exponentially over the past few years, so too have the challenges facing educators trying to ensure that children have a positive experience when they go online. The educational community cannot ignore the problem, as it will be like it accepts the use of the school network resources for purposes irrelevant to every possible educational goal.

A related debate rages over what percentage of Web sites would truly be considered objectionable. Some advocates argue that sites that would be considered harmful to minors represent only a very small proportion of the Web. What is of greater concern, they say, is that perfectly benign and possibly very useful information could be blocked when software is used to screen inappropriate material. The actual extent to which adult-oriented materials are available on the Internet is irrelevant according to those who support content controls. They believe that any amount of inappropriate content is too much, when children are concerned. Some experts argue that the Web is expanding so fast that it is virtually impossible to track every site that could be objectionable. The flip side of that argument is that it is better to minimize access to objectionable content as best we can, even if the occasional site slips through the cracks.

Although pornography on the Internet has captured the greatest attention on the part of policy-makers, it is not the only area of potential concern for parents and educators. Many adults are concerned about Web sites that are created by hate groups or devoted to topics such as bomb making and weaponry, gambling or alcohol and smoking. The World Wide Web, however, is not the only source of concern. Children can receive email messages with pornographic file attachments. Of special concern, too, are Internet chat rooms and so-called Instant Messaging, where children can communicate online in real-time with adult strangers who may not have their best interests at heart.

A wealth of information is available on the Internet. White papers [4,5] are opposed to the use of censor ware programs (they call it) in the American libraries and schools, and there are some interesting links that are indicative of the ongoing debate [2,6,9,10].

The Internet truly is like a vast library including millions of readily available and indexed publications, containing content as diverse as human thought. Throughout the past decade, policy makers, industry advocates, parents and teachers have tried to address these concerns especially in the more technologically advanced areas of the earth. This decade may well be the decade of decisions in a much broader spectrum than ever before.

From our point of view it is an unarguable fact that Internet offers a vast mass of information, some of which is suitable for schools whilst some is not. Without meaning that we should implement extreme measures of censorship or suffocative limitations to the content we allow our users to access, we should be alert and monitor the things that happen while students are online. The problem with Internet content seems to have social, cultural, pedagogic and scientific viewpoints: Schools' trustworthiness is endangered if the school network is used (systematically or occasionally) for other purposes than those for which it was designed and implemented. The parents and the public believe that their children and students proportionately, should be protected from illegal, offensive and inappropriate content. Whilst some may argue that it is a means for censorship and nothing more, others believe it is the only way societies have to inform and protect the children from the potential danger the Internet poses.

Every country should establish its own policies to deal with it without raising public concern regarding human rights and individual's freedoms. This document will try to group all potential dangers the Internet can pose and some possible solutions to those dangers. For us the best solution is the one that combines the right guidance of the students from the educational authority, the informing of parents and the training of educators together with the technical solution. No solitary technical working-out can resolve such a problem and whichever policies put forth should take in mind all the above parameters.

Status in the other Countries

Each of the countries presented here, establishes it's own policies and methods. However, their perception of the problem presents some surprisingly common characteristics. In our survey we browsed some interesting and concise pages regarding the pronounced decisions on the Internet content issue in Australia [12], Canada [7], United States of America [3] and the European Union [11].

Internet is being used in Australian schools with highly increasing rates, as a learning driving force in education. 43% of the children asked in Australia said that Internet improved their perception about school. The federal government of Australia responded to the issues posed by the entrance of Internet in the everyday and school life, with the Broadcasting Services Amendment Act (1999). A hot line was created to allow people report what they think is illegal and express their worries about the content that can be accessed on the Internet. The industry plays important role by establishing policies for the improvement of the information exchange regarding the content of the web pages. In some cases schools store pages certified as 'safe quality pages' in their cache, ensuring by that way that their students have quick access to them. While these pages are available for the benefit of students reducing the bandwidth consumption, the costs for schools remain low because of the quicker access time achieved for stored sites. In Australia the decisions are made on the school level (in some states there is a trend for more obligatory policies decided on a higher level of authority). Education authorities stress the importance of accessing pages of high quality. Educators in national level do the evaluation of pages selected to meet certain specifications. Recent studies point out that almost 98% of public schools connected to the Internet have established Acceptable Use Policies. 74% of schools with AUP use software to block or filter pages of certain content, 64% uses rules of conduct and 28% uses an intranet in their effort to control access.

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To date, Canadians have established a wide range of partnerships to deal with the issues of the Internet content. The strategy of Canada's Government is to make Canada the most connected country in the world. Illegal content — content that violates Canada's laws — is of key concern to Canadians. Child pornography and hate propaganda are particularly troubling, because they pose the greatest and most immediate risk to the safety and well being of Canadians. Enforcing the law in cyberspace, however, presents significant challenges, particularly in view of rapid technological change. For Canadians it is important to distinguish between Internet content that is illegal, and content that is offensive to some, but is not illegal. The control and management of offensive content, however, calls for different approaches, such as empowering users, educating consumers to make informed choices, and establishing responsible industry practices. The *Canadian Charter of Rights and Freedoms* guarantees all persons in Canada "freedom of thought, belief, opinion and expression, including freedom of the press and other media of communication". The federal government's approach is to involve a broad spectrum of Canadians in addressing the issues. Its priorities include supporting initiatives that educate and empower users, promoting effective industry self-regulation, strengthening the enforcement of laws in cyberspace, implementing hotlines and complaint reporting systems and fostering consultation between the public and private sectors, and their counterparts in other countries. A considerable number of important initiatives, studies and discussion have taken place or are in progress in Canada. In 1994, the Government of Canada established the private sector Information Highway Advisory Council (IHAC) to provide advice on the best way to develop Canada's Information Highway. According to its recommendations the federal government should a. fine-tune existing laws to make them more applicable and enforceable in the changing world of global networks and b. encourage research and the development of technical tools that can protect users against offensive content on the Internet, and assist in law enforcement.

The United States of America Congress passed legislation requiring Internet blocking technology to block pornographic materials in all public schools and libraries funded through certain federal programs. The *Children's Internet Protection Act – CIPA* passed the senate and the congress on December 2000 as part of a big government budget for the year 2001. To date the issue of content control in the United States of America is in a critical point: while the congress decided the mandatory implementation of filtering in schools and libraries, parents, organizations and politicians are steadily opposed to the legislation passed. Influential organizations are hostile to it and government bills mandating filtering in schools and libraries face legal challenges on constitutional issues. Some libraries have already been sued for installing filtering software onto their computers. Parents, schools and libraries face difficulties to decide whether, and how, to filter Internet content [8]. Still nobody denies the fact that the World Wide Web is not content zoned, which means that kids can access anything on it very fast and very easily. As for the libraries, while school libraries have special characteristics, public libraries are intended for free willing inquiry and access control is a more complicated issue.

The European Union has published an Action Plan on promoting safer use of the Internet [4]. While it recognises the positive benefits of Internet (particularly in education) it states that the amount of harmful and illegal content carried over the Internet, while limited, could adversely affect the establishment of the necessary favourable environment for initiatives and undertakings to flourish. A safer environment should be provided by combating illegal use of the technical possibilities of the Internet, in particular for offences against children and trafficking in human beings or for the dissemination of racist and xenophobic ideas, ensuring that consumers make full use of the Internet. Europe should promote industry self-regulation and content-monitoring schemes, the development of filtering tools and rating systems by the industry and of course international cooperation. While any hot-line reporting mechanisms should support and promote measures taken by the Member States, duplication of work should be avoided. The responsibility for prosecuting and punishing those responsible for illegal content should remain with the national law-enforcement authorities.

Techniques and Solutions

The techniques that can be used to achieve content filtering are keyword blocking, negative and positive lists and content labeling and rating systems. Keyword blocking prohibits access to pages that contain the specified words (words can be tobacco, wine, drug, sex etc). Unless this is a 'clever' software (rarely this is the case) this technique cannot successfully address the modern issues. It can be easily bypassed as it has been reported that web developers add additional characters to the words they suspect that can be searched for. The use of negative and positive lists is easy from filters or browsers. The positive lists contain URLs and domains to which access is allowed to and negative lists contain the URLs that access is prohibited to. Use of white lists will be very restricting regarding the amount of available pages on the net. Labeling and rating systems provide a way to categorize pages according to their content and provide that categorization to the user. That technique can proved to be inefficient if nobody offers to undertake the task of labeling. The main problem is the size of the Internet and the rate of its daily expansion (there is some indication that Internet growth today has gone from exponential to linear).

Access control can be achieved using Commercial Software, Freeware Programs, Rating Systems or Hardware Solutions (all of them are mainly structured on the use of lists).

Many commercial filtering programs advertise that can block access to the harmful or improper pages on the Internet (in fact they claim they can do much more). There are programs that can be installed at the server side, some are for clients only, while other offer versions for home and for education. The problem with commercial software is that the companies usually do not reveal the pages they block access to [4]. This solution is not favorable for a school environment for one more reason: The filtering is done by a third and not by the government or an educational authority. This gives to the company that implements the filtering, access to sensitive data. The use of proxies has a policy problem: proxy servers keep log files. These files contain all the requests a proxy receives, causing complaints and worries regarding the people that gain access to that data and the processes that can be put in place to monitor individual users' behavior. Although it seems that today there is a some development under way on rating systems everyone should remember that this method might proved to be of little efficiency if there is not someone who will undertake the task of labeling and rating of sites in Internet in a continual basis. Hardware solutions appear to be more complete, with specialized systems of black box type. They are intended as big scale solutions for huge users' databases and lines of high capacity. They require minimal efforts to be installed, configured and operate while full support is offered from their company. Along with that comes the usually high cost to obtain such a system.

Policies

Currently in Greece there is no government decision regarding the policies mentioned here. The policies' part of our suggestions -it could also serve to initiate a public discussion regarding content filtering and content blocking in Greece- is:

1. Creation of Acceptable Use Policies for the Greek School Network to inform users for the purposes of the creation of the technological infrastructure of the school network and the actions or behaviors that are considered acceptable. Most such policies include: Description of the underlying philosophy and strategy implemented into the school network for the access to Internet, Report of the educational uses and advantages of Internet, List with the catalogue of the duties teachers and students have on the issues involved by the use of Internet, Description of what is considered acceptable and what not acceptable use of the school network and of the Internet, Reminder that the access to the school network and to the Internet is a privilege, Specification of the pages considered as 'improper', 'harmful', 'illegal', or 'void of educational content'. 2. A critical point is the responsible, with no exaggerations informing of the teachers. Without their sincere participation success will prove hard. 3. Control of the time and opportunities students will have access to the computers (when in lesson hour, they will be supervised from their teachers). 4. Control of installation of software on school computers. The common problems are license issues, installation of 'Trojan horse' programs (programs with malicious or harmful code), worms, etc. 5. Availability of educational material to constitute the positive counteroffer. The network itself is not the main objective: The main intension of schools is the use of all possible ways and new technologies for educational purposes, and therefore the use of the school network and equipment for specific cognitive purpose. 6. The age of students should be taken in consideration(ages from 6 to 11 are the most vulnerable). 7. Provision of the cachemaster's mail address for communication between him and the school community. 8. Extra security considerations and policies if the school provides email accounts for students and teachers (not true currently in Greece but visible in the very near future).

Architecture

The Greek School Network's topology is illustrated in the next figure.

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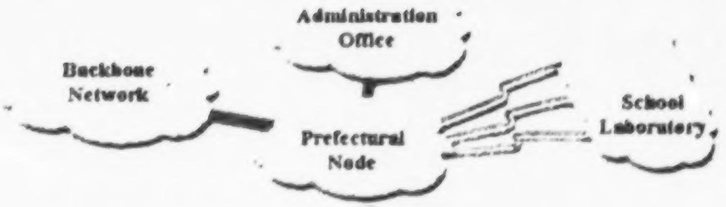

Fig1 : The Greek School Network topology

The backbone network is the Greek Research and Technology Network (GRNET), which provides Internet Services to the Greek Academic and Research community. The distribution network is the part of the network that interconnects points of presence (nodes) with the backbone network. The topology has such design in order to preserve the operational cost in low levels, which is particularly critical in large geographical region networks. The proposed architecture is in favor of the use of a proxy-cache server for the school network because the proxy server on a network -especially when it is configured as transparent- is the ideal point for the implementation of control on the requested objects.

The extent of Squid's usage in educational networks all over the world and the level of acceptance it enjoys from the global networking community (especially researchers, scholars and educators), is obvious from the number of networks implemented on: the JANET network (a private, government funded network for education and research in England with 90 to 120 million hits per day), the italian GARR network, the german DFN network, the Swiss network SWITCH, the Dutch network SURFnet and the USA academic network the NLANR. We are going to use Squidguard as the redirector of our choice because it is faster and opens less redirectors than it's competitor programs.

Implementation Issues

Squid is free software, licensed under the terms of the GNU (General Public License). The most important resource for squid's performance is physical memory, so fast disks are important for high-volume caches. Some new options were added to squid's configuration file after its last release. All new parameters intend to improve the performance, the security or the flexibility of the program. Available options are selective logging and the use of time spaces, ip ranges or users ids in order to grant or deny access at certain hours of day, at certain ips or at certain users.

Conclusions

The rapidly evolving nature of the Internet virtually ensures that no filtering technology can be a hundred percent perfect. Certain kinds of network management products may provide basic information on how students and staff are using the network but the parental and school guidance will remain the basic factor to the solution of the problem.

If a school district employs monitoring or filtering, its Acceptable Use Policy should explain what it would be doing, and the procedures a student should follow if he or she encounters a site that would be considered inappropriate.

The practices are quite the same across the different nations. This happens because the filtering problem is relatively new and those who started first to deal with it lead the way. The content filtering issue we discuss herein has never caused a central debate either from parents for their kids or from school teachers or even from the government in Greece. We work on that issue because we believe that every country should be aware of the possible dangers and be as prepared as possible to deal with them. If we know and understand what happens in the rest of the world and in countries that have a lead over Greece in technological issues we will save ourselfs time and trouble.

The biggest percentage of the pages on the net is written in English which is nowadays an international language. Therefore the most interesting sites and definitely those which get read from the biggest audience are

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the same even for the countries whose language is other than english. That means that the problems are the same since their source is the same. This is why many countries seem to adopt the same strategies despite their natural differences.

A convenient solution for the most educational institutions has been the installation of filtering software on the proxy server. This is the ideal place to do filtering for a network because it is the one point through which all network communications pass. Filtering on a proxy server can have an impact on network performance because of the need to match a URL against what may be a long list of blocked sites. The use of a caching server can help speed access and reduce the bandwidth that would otherwise be needed.

Web server surveys have shown there were more than 27 million web servers in operation as of January 2001 [15]. One study estimated the Web to have approximated 800 million pages in February 1999 [13]. While the above results are not accurate for 2001, they are indicative of the order of magnitude of the sites on the Internet. If this is to change, obviously it won't shrink. The lists every software uses to block access to sites will probably include controversial entries. As these lists cannot be human reviewed the common way to cope with problems that might arise is the creation of an environment which allow the modification of the lists and provide the required information to the users.

Even if we find the ideal solution and implement it in our school networks, no one can guarantee that this will be the ideal solution or even an appropriate one, in one or two years time. People with wide knowledge of the Internet and the emerging technologies should monitor the developments that take place and adjust their policies to the new era.

Implementation of content/access control doesn't solve radically the problem of students using the school networks to gain access to objectionable or illegal material. There is a number of ways that can be used to exchange that material and email and ICQ are only the two most common programs to do that. While solutions for that issues do exist (there are programs that allow only the execution of authorized programs, while the rest are locked out), the governments and the school communities should decide if they wish to implement so hard constraints.

Future Work

Our future plans include the improvement of the current design and architecture to best fit the continually emerging technologies and to therefore address successfully the new problems that almost certainly will come up. The listing of the blocked sites (everybody could see it) and the ability to add or remove sites to the squidquard database (administrators only) through a web interface is a big priority already on discussion.

References

[1] CIPA - http://www.cdt.org/legislation/106th/speech/001218cipa.pdf
[2] Communications White Paper –
http://www.communicationswhitepaper.gov.uk/by_chapter/ch6/6_10.htm
[3] Congress Passes Filtering Mandates - http://www.cdt.org/publications/pp_6.22.shtml
[4] EFF NRC Censorware White Paper #1
http://www.eff.org/Censorship/Censorware/20010306_eff_nrc_paper1.html
[5] EFF NRC Censorware White Paper #2 -
http://www.eff.org/Censorship/Censorware/20010306_eff_nrc_paper2.html
[6] How Filtering Tools Enable Responsible Parents to Protect Their Children Online -
http://www.cdt.org/speech/970716summary.html
[7] Illegal and Offensive Content on the Internet - http://www.connect.gc.ca/cyberwise/
[8] Internet Content Filtering - http://www.safetyed.org/help/filtering.html
[9] Is Cyberspace Burning? - http://www.aclu.org/issues/cyber/burning.html
[10]Joint Statement for the Record on "Kids and the Internet: The Promise and the Perils" -
http://www.eff.org/Censorship/Censorware/19981214_ifea_nclis.statement
[11]Promoting safer use of the Internet - http://europa.eu.int/ISPO/iap/decision/en.html
[12]Using the Internet: a Positive Learning Experience - EdNA Schools Advisory Group) -
http://www.edna.edu.au/publications/use_internet/report.html
[13]Web Server Survey - http://www.netcraft.com/survey/Reports/0101/
[14]What's happening across Europe? - http://www.netaware.org/gb/website.html
[15]Worldwide Domain Statistics - http://www.domainstats.com/

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An investigation of collaborative problem solving using different communications modes in Distance Education

Abstract: This paper reports results of a mixed method, multiple case study of collaborative problem solving by distance education students. Four groups of students were assigned to solve a multifaceted task and write a comprehensive solution report using the following net-based technologies: synchronous audiographics, synchronous text chat, asynchronous voice conferencing and asynchronous text conferencing. Time on task logs and reflections on group process as well as final assignment marks are compared among the four groups.

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Research Rationale: An increasingly large number of technologies can be used to support collaborative learning and teaching at a distance. Generally these technologies can be divided into those that support synchronous vs. asynchronous collaboration and those that support voice vs. text interaction. Instructors and course developers are forced to make decisions about which medium or which combination of media to use when assigning collaborative activities. There is little empirical work with actual students, in natural conditions, that informs this decision making process. This study will provide insights based upon analysis of a variety of triangulated data as a first step in developing guidelines and theory relevant to this decision making process.

A long history of media comparison studies has provided little evidence that any particular media has inherent education advantage over any other (Clark, 2000; Clark, 1994), however it is likely that particular media attributes are more or less congruent with particular learning activity and instructional designs (Kozma, 1994) and perhaps with different types of learners (Lara, Howell, Dominguez, & Navarro, 2001). Many of these media comparison studies have been conducted in laboratory settings and lack ecological validity and authenticity. This study uses groups of students who have some prior knowledge and relationship with each other (they are program students in a large Masters of Distance Education Program), the collaborative project is meaningful in that it relates directly to the course requirements, and is relevant to problems they face in their own workplaces and finally the study takes place in the context of a real distance education program. Finally, the type of collaborative problem solving and report generation is an activity very common to actual workplace tasks assigned to distributed teams in business and public sector employment.

Each of the technologies used is web based and commercially available at relatively low cost – at least as compared to the costs of face-to-face interaction.

Research Question: What is the efficacy and the participants' perceptions of synchronous/asynchronous and text/oral modes of interaction in distributed teams engaged in collaborative problem solving and report generation?

Study Design:

The study is based on mixed method, multiple case study design using each of the four media groups as separate cases (Yin, 1994). Four to five students will be randomly assigned to each case. The technologies used will be:

1. Asynchronous text based conferencing - Bazar
2. Asynchronous voice based conferencing using - Wimba
3. Synchronous audio graphics – Tutor's Edge
4. Synchronous chats –Chat using WebCT

The groups will work over a two-week period to research and produce a final report addressing the following problem.

> The Board of SaveMore College has just developed a strategic plan calling for an increase of 50% in enrollment using distance education technologies. The Faculty Association has threatened to strike if this new policy has any adverse effect on Faculty work loads. The Vice President has asked your team to prepare a 8-10 page report for both the Board and the Association that alleviates the Faculty concerns and provides a set of Action Recommendations that allows implementation of the new strategic plan. The report should recommend a technology platform and discuss the effect on the college budget of your recommendations.

Subjects will be asked to refrain from using other technologies to support collaboration except private email (the extent of email used will be logged).

Data Collection and Analysis

The following data will be collected, analyzed and results triangulated:

- Time on task spent by each individual (aggregated to obtain group totals) group gathered from time logs of individual and group work.
- Data on perceptions of ease, understandability and confidence in the media (Steinfield et al., 1997) obtained from 3 Likert like scales included with the time logs.
- Perceptions of efficacy of process and output gathered from summary reflection memo's from each participant and analyzed qualitatively for themes using constant comparative methodologies (Strauss and Corbin, 1990). A guide identifying issues to be addressed will be given to each participant and serve roughly the same function as a semi-structured interview guide.
- Final team mark awarded for each group
- Audio conference focus groups with each group conducted at the end of the experiment to develop collaborative understanding of process and gain understanding of divergent views of media effect on that process (McNamara, 1999).
- Thematic qualitative analysis of transcripts and logs derived from group interactions captured by the system software(s). Particular attention will be paid to

appearance and frequency of group process questions, communications breakdowns and other indicators of the quality of the mediated interaction.

These data sources will be analyzed to calculate the efficacy of each system by determining objectively the mean time spent on the project by each team and dividing this by the final mark to get a measure of efficiency of each media in supporting the team and its work task.

Results: As the study will not be run until March 2002, results are not available at this time. It is likely that there will be little significant differences between the groups based on teacher assessment of final product, however the time on task and participants perceptions of learning curve, ease with which organizational tasks were supported, reports of communications breakdowns and related organizational issues and perceptions of efficacy of the four media types will be rich in insights for both researchers and practitioners.

Reference List

Clark, R. (1994). Media will never influence learning. Educational Technology Research & Development, 42(3), 21-29.

Clark, R. (2000). Evaluating distance education: Strategies and cautions. Quarterly Review of Distance Education, 1(1), 3-16.

Kozma, R. (1994). Will media influence learning? Reframing the debate. Educational Technology Research & Development, 42(2), 7-19.

Lara, L., Howell, R., Dominguez, J., & Navarro, J. (2001). Synchronous and asynchronous interactions of bi-lingual pre and in-service teachers in distance education. American Journal of Distance Education, 15(3), 50-69.

McNamara, C. (1999). Conducting focus groups. Available WWW www.mapnp.org/library/grp_skll/focusgrp/focusgrp.htm

Steinfield, C., Goodman, E., Maitland, C., Hinds, T., Jang, C., & Krikorian, D. (1997). Global engineering methodology study. Michigan State University: Available online http://cscw.msu.edu/legacy/gemsrpt97.htm

Strauss, A., & Corbin, J. (1990). Basics of qualitative research: Grounded theory procedures and techniques. Newbury Park: Sage.

Yin, R. (1994). Case study research: Design and methods. (2 ed.). Thousand Oaks Ca.: Sage.

Technology Lesson Plans Based on the Sunshine State Standards and the ISTE Standards

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Abstract

Ninety-eight technology-enhanced lessons are now available on-line. Teams of professors, K-6 teachers, and pre-service teachers in South Florida have worked together to write, refine, and field test lessons based on the ISTE and Sunshine State Standards. These tried and true technology lessons are complete with downloadable resources and assessment rubrics for each standard taught. Math, Science, Social Studies, General Methods, Curriculum and Reading/Language Arts lessons round out the subject areas addressed in the lessons. There are also specific lessons that address special needs populations including English as a Second Language and Exceptional Education students. The lessons have been field tested in classrooms with urban high-need students, limited English proficient students, and suburban students. An overview of the resources available will be presented with opportunities for interaction. Elementary Education Teacher Education Professors, Curriculum Developers, and K-6 Teachers can make use of these well developed, peer reviewed resources.

Contribution to the Field of Educational Technology

1. The research involved in the creation of these technology enhanced lesson plans reflects the cooperative effort of pre-service teachers, professors, and in-service teachers. Thus, the product is well balanced with a combination of sound research and field-based experiences.

2. The recent development of the ISTE standards has opened up a new area of curriculum development based on those standards. This research project provides materials that address the need for high quality field-tested and peer reviewed lessons based on the new standards.
3. The lessons developed reflect the up-to-date availability of resources in the college and K-6 classrooms.
4. The lessons are based on curriculum standards as well as ISTE standards.
5. Professors from several institutions of higher education have worked together to create the lessons.

Objectives and Outcomes:

1. This session will address the need for high quality technology enhanced lessons based on both State and National Standards by providing on-line resources to attendees.
2. This session will supply assessment instruments to evaluate the use of technology for all lessons that address the State and National Standards.
3. Technology enhanced lessons at the K-6 level will be shown for Math, Science, Social Studies, Reading/Language Arts, Curriculum, General Methods, ESE and ESOL.

Importance:

1. As professors in schools of education seek to integrate technology into their teacher education classes, they can use these resources to assist them.
2. As K-6 teachers seek to utilize technology in their classes, they will be able to find resources on the curriculum area of choice by using the search engine presented based on the Sunshine State Curriculum Standards.

Associated Web Resources:

The lesson plans produced by this group can be found at www.beaconlc.org

Adaptive Hypermedia Educational System based on XML Technologies

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Abstract : In this paper we propose adaptive hypermedia educational system using XML technologies such as XML, XSL, XSLT, and XLink. Adaptive systems are capable of altering the presentation of the content of the hypermedia on the basis of a dynamic understanding of the individual user. The user profile can be collected in a user model, while the knowledge about the domain can be represented in the form of a concept based domain model. So we have defined two different markup languages using XML. And for adaptivity of system, adaptive presentation of the data comes using XSL and adaptive navigation of link comes using XLink.

Introduction

With the rapid advances in WWW interactive technologies, the use of Internet-based distance learning tools is rapidly growing. Most of these products are nothing more than a network of static hypermedia pages. In fact the domain knowledge implicit in traditional educational hypermedia is well defined and carefully structured and provides an only learning path optimal for a generic average student [Ekl1997]. Otherwise, a Web application, which is designed with a particular class of users in mind may not suit other users. Moreover, "static" hypermedia assume that the users can make sensible decisions about when to use navigation tools, about when to proceed in the learning process, about when they need an explanation, etc. [Bru1998]. This could be a problem for those users who access the hypermedia through the Internet and that can't have a teacher at their disposal.

Adaptivity is the feature of hypertext and hypermedia that allows one to adapt the contents to the user needs[Ada2001]. Adaptive hypermedia systems modify the presentation of the domain knowledge according to the user profile. This mechanism permits to personalize the Hypermedia in terms of contents and of navigation tools for each user.

The focus of this paper is on the general architecture and the implementation issues of a adaptive educational hypermedia system. This system has been implemented by using the functionalities provided by XML(XSL,XLink) in order to stress the separation of the information content from presentation. The basic idea is to define a general hypertext structure in order to create pages dynamically using a structured description of the domain knowledge and a model of the current user.

Adaptive hypermedia technologies and XML techniques

Adaptive hypermedia systems build a model of the goals, preference, and knowledge of each individual user, and use this model throughout the interaction with the user, in order to adapt to the needs of that user[Bru 2001]. In adaptive hypermedia literature they are referred respectively as adaptive presentation and adaptive navigation support

XML is designed to be the data format for the web, and at the time of writing is being used by many thousands of web-based applications. XML is a bit like HTML, the format used for web documents, but it's focused on representing data, rather than describing the presentation of data. Presentation of the data comes using XSL and navigation of hyperlink comes later, using XLink. Also XML is independent from a specific platform and operating system and provides the DOM(Document Object Model) as a platform- and programming language-independent API for the development of the necessary tools. XML grammars can be constructured in a way that they easily can be extended by new or alternate elements. There already exists a metadata scheme for teaching resource – IMS projects[IMS2001].

Design of adaptive educational hypermedia system

The adaptive hypermedia system architecture (see Figure 1) consists of three main components. Such as a student model that represents the student knowledge, a domain model that contains the domain knowledge information structured in topics and relationships, and a adaptation model that is responsible for creating pages dynamically by using the information contained both in the domain and in the user modules.

XML is a meta-language that allows us to create specialized markup languages for specific purposes [XML1999]. For example, it is possible to create a tag <TOPIC> (and the closure tag </TOPIC>) that identifies a particular knowledge element.

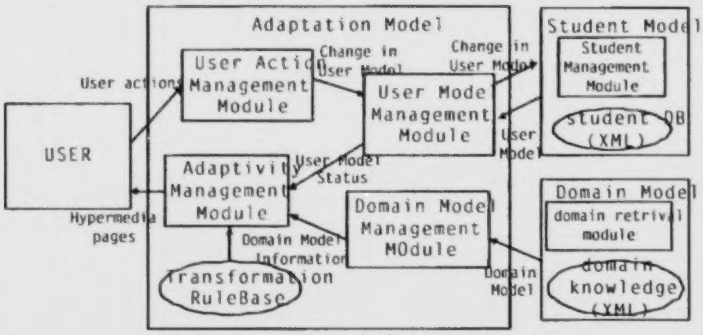
Adaptation Model
User Action Management Module
Change in User Model
Change in User Model
Student Model
Student Management Module
User actions
User Mode Management Module
student DB (XML)
User Model
USER
Adaptivity Management Module
User Model Status
Domain Model
domain retrival module
Domain Model Management MOdule
Hypermedia pages
Domain Model Information
Transformation RuleBase
Domain Model
domain knowledge (XML)

Figure 1: System architecture

For implementing our adaptive hypermedia system we have implemented two languages:

- the Domain Structure Markup Language(DSML) in order to describe the knowledge general structure,
- the Student Model Markup Language(SMML) used by the system in order to describe the student model status.

In particular we have implemented two different Document Type Definitions (DTDs) that define the fixed structure of the two above mentioned markup languages. In the following two subsections we will give some examples of the new tags that we have introduced. Finally in the last subsection we describe the Adaptation Model.

Domain Model

To be dynamically processed, the domain knowledge has been structured into topics and each topic is associated to a page. Each topic is characterized by: 1) a title, 2) a set of main keywords, called concepts, 3) a set of conditioned relationships, 4) a set of explanations, 5) a set of possible examples, exercises, etc.

Therefore a link from a page to another one represents a relationship between the two topics. We have considered six different types of relationships between topics.

- super/sub that is a bi-directional relationship between a topic and all its sub-topics
- next that is a relationship between a topic and the next topic to learn
- contrary that is a bi-directional relationship between a topic and the "opposite" one. example that is a relationship between a topic and an example that explains it
- widening that is a relationship between a topic and a study in depth of it
- exception that is a relationship between a topic and an exception or a particular case

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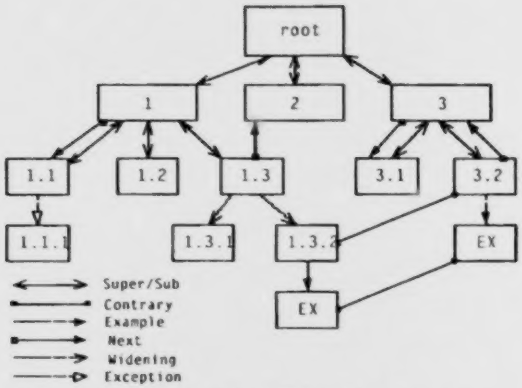

Figure 2: example of domain knowledge structure

The first relationship defines the hierarchical structure of the knowledge domain. Knowledge is represented as a tree in which each node identifies a topic and a root topic is defined. The next relationship represents the sequence of topics suggested by the teacher. All the other relationships create irregular connections between topics that transform the original tree-scheme in a graph. The student can navigate the graph following all the different types of relationships and defining a personal learning path.

Each relationship is associated to a cluster of conditions that defines which kind of requirements the student needs to follow the link. If the student model satisfies all the conditions the link is displayed. The link associated to the super/sub relation always appears without requirements. All the other links can be conditioned, and in particular the teacher links can have different arriving pages in function of the student model status. In this way each node is associated to a set of next links, each one valid under a different set of conditions. The condition scheme is organized as follows.

Each condition is divided in different condition terms composed with and and/or operators. We have considered that students are classified in three stereotypes and we have associated to each argument that needs to be known a stereotype and a certain minimum knowledge level. So that a condition term can be read as: "if the student of a level X have got a knowledge level Y on the argument A, then the condition term is true". By composing condition terms with and/or operators we can obtain complex didactical requirements.

The DTD that describes DSML contains the definition the following tags:

<ADAT></ADAT> is the root of the adaptive hypertext. The <ADAT> tag can contain different <TOPIC> tags. By using <ADAT> attributes the author can also define the TITLE, the AUTHOR name and other proprieties of the hypermedia. <TOPIC></TOPIC> represents a topic and is identified by using the attributes TITLE and ID; each <TOPIC> can contain different relational tags (<PARENT> and <SUBTOPIC> described below), different conditioned elements (introduced by using the <CONDITION> tag) and different <CONCEPT> tags.

<CONDITION></CONDITION> defines the requirement needed to follow a certain link or to give a certain explanation. Nested <CONDITION> tags can be used to realize and between different conditions; an attribute OR associated to a <CONDITION> tag is used to realize an or between this condition and the following one. Each set of nested conditions contains an <EXPLANATION> or a relational tag. <EXPLANATION></EXPLANATION> contains the real explanation of the topic. The <EXPLANATION> tag can contain any HTML tags. This choice lets one use different media to give the explanation to the student.

<CONCEPT></CONCEPT> defines a keyword associated to the <TOPIC> tag that contains the <CONCEPT>. <EXAMPLE></EXAMPLE> defines a particular kind of topic that can be used as an example of a certain <TOPIC>; a <EX-LINK> relationship links this <TOPIC> to the <EXAMPLE>. <EXERCISE></EXERCISE> defines an exercise. The <EXERCISE> tag contains a <TEXT> a <SOLUTION> and an <HELP> tag.

The following code fragment represents a simple example of the DSML tags.

```
<TOPIC> Topic Title
    <CONCEPT> Keyword</CONCEPT>
```

```
            <CONDITION USER_LEVEL="3">
                <EXPLANATION>
                       ...
                    HTML Explanation description
                       ...
                 </EXPLANATION>
              </CONDITION>
              ...
        </TOPIC>
```

Three different type of tags are used:

<CONCEPT>: that includes the keyword related to the topic.

<CONDITION>: this tag indicates a didactical requirement. In this case there is a very simple condition based on the student's knowledge level. Here an expert level (USER_LEVEL=3) is required. The student model, illustrated in the next section, manages values of the USER_LEVEL variable.

<EXPLANATION>: this tag includes the real explanation of the topic. Text between this tag and its closure can be written in HTML.

Other tags are defined in order to describe relationships between the topics and in particular:

<SUPERTOPIC> and <SUBTOPIC> are used torepresent the super/sub relationship. We have used two tags to describe the relation, one for each direction. <NEXT> is used to define the next relationship and represents the path suggested by the teacher; the previous topic is dynamically computed. <WIDENING> defines a widening relationship. <EX-LINK> represents the relationship between a <TOPIC> and an <EXAMPLE> related to it. <CONTRARY> defines a contrary relationship. <EXCEPTION> represents an exception relationship.

Student Model

The student model is a structure maintained by the system with the aim of being able to respond to the individual student's learning style and deliver customized instruction. There are different ways to approach the student model problem. The most commonly used student modeling technique in adaptive hypermedia systems is the overlay model[Ekl1997]. In this model, the student knowledge is considered an overlay of the domain knowledge and is frequently represented as a set of concept/value pairs. For each domain model concept the student model stores some values that estimate the student knowledge level of this concept. This model assumes that the student knowledge is a subset of the knowledge domain described by the teacher and cannot capture different knowledge conception. In spite of this, the overlay model is commonly used in the adaptive hypertext field because the content of the adaptive hypertext itself can be considered as a description of the entire domain knowledge. This involves that the student can be represented simply overlaying the hypertext structure.

Other adaptive hypermedia systems use simple stereotype model [Ekl1997]. Student knowledge is represented as a set of concept/value pairs (as in overlay model), but the values are not completely independent. The student can be assigned to one or more class (called stereotypes) and each class is identified by a fixed set of concept/value pairs.

On the other hand the most part of the Intelligent Tutoring System[And1995] are developed using a representation of the student's knowledge based on student bugs and misconception. The buggy model represent the student's knowledge in terms of deviations from an expert's knowledge. The system classifies each student error and then uses this information to predict the student's behavior in future situations. The buggy model is really useful in learning-by-doing systems in which the system needs to monitor a student activity (as for example, exercises solving procedure).

To implement the student model we have used a mix of the overlay model and of the stereotype model.

The overlay model has been implemented associating to each topic a value that weights the level of the student knowledge of that topic. This evaluation is given measuring the time spent reading the topic and the number of visits. Each time the student requests a page, then the associated value is updated.

We have also classified possible students into three different stereotypes: expert user, medium-level user and beginner user. This evaluation refers to all the arguments of the domain model and is a general assessment of the student ability. We have used a scheme based on three stereotypes referring to different system described in well-known literature [Wen1987, Ekl1997]. Anyway our system can recognize each set of integer values as a stereotype scheme.

The student model is realized using two DTDs: the former defines a structure that contains the user's logins and the related passwords, the latter defines the structure for the SMML in order to describe the personal student model file. The DTD that describes SMML contains the definition of the following tags: <MODEL></MODEL> defines all the visited topics described by using different <VISIT> tags and a <LEVEL> tag. <VISIT> is used to represent a visited topic; the argument is specified using the TOPIC attribute. <LEVEL> </LEVEL> and <LEVELT> </LEVELT> define respectively the general level of the student knowledge using the DEGREE attribute and the level of knowledge specific of the topic. <LAST> defines the last visited topic. <NUMVISIT> </NUMVISIT> defines the number of times that the student has visited this topic page

A simple example of student model is the following:

```
<MODEL>
    <LAST topic="1">
    <LEVEL degree="0">
    <VISIT topic="1">
            <LEVELT>0</LEVELT>
       <NUMVISIT>1</NUMVISIT>
    </VISIT>
</MODEL>
```

The example shows the student model of a beginner level user (LEVEL DEGREE=0). In the <MODEL> structure there is only one VISIT tag meaning that the student has just run the hypermedia and has visited only the first page identified by the topic="1".The LAST visited topic is obviously the number "1". The example shows the student model of a beginner level user (LEVEL degree="0"). The nested tags <LEVELT> and <NUMVISIT> identify respectively the level of knowledge of the topic and that the student visits this topic page for the first time.

It is worth to note that the student models are automatically created and managed by the system so that the SMML is used only by the system to store relevant information.

Adaptation Model

The Adaptation Model(AM) creates the pages of adaptive hypermedia on the basis of the Knowledge Domain Model and the Student Model. The general architecture of AM consists of four main components: the User Action Management Module(UAMM), the Adaptivity Management Module (AMM), the Domain Model Management Module(DMMM) and the User Model Management Module (UMMM).

The UAMM interprets the student's behaviors sending information to the other modules (e.g. possible changes to Student model status to the UMMM; student's request of a page to the AMM).

The DMMM retrieves topics from the knowledge domain model on the basis of the student's requests and interactions. The UMMM updates the student model sending the related information to the other modules. The AMM adapts the presentation of the domain knowledge to the user; creating hypermedia pages dynamically. In particular each time a condition is found, the AMM asks the UMMM the Student Module status in order to solve the condition and create the new page on the basis of the topics already known by the student (provided by the DMMM) and of his knowledge level.

Implementation and Results

We have described the developing of two new markup languages that allow us to describe complex knowledge structures. It's worth to note that the system is designed in order to realize adaptive educational hypermedia, but it can be used for every kind of adaptive hypermedia thanks to the flexibility of the used structures.

Our adaptive hypermedia system has been implemented using a client-server scheme based on HTTP. The server application that automatically produces personalized XML pages has been described in the previous sections. The client is a common used browser, Netscape and Internet Explorer that can evaluate and display XML pages. Before starting the navigation in the adaptive hypermedia system, the user has to identify himself with a username and a password. The server uses this information to store the appropriate student model (or to create a new student model for a new user). Then, each time the student asks for a new page, the browser asks for it to the server side application that compute the content of the page dynamically on the basis of the student model. A Java applet, which communicates to the server application all the events generated by the browser, updates the student model status.

We are currently testing an adaptive hypermedia system on programming, created with XML dynamic support, that is developed for a university undergraduate program course. This test has underlined different aspects of the system that need to be improved

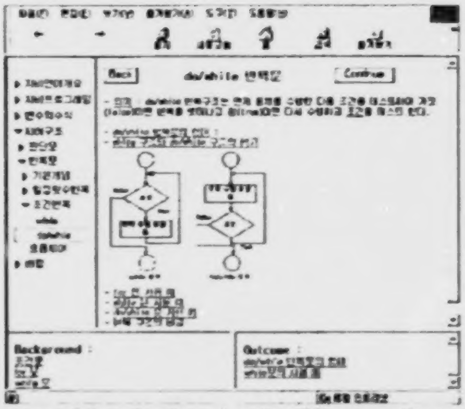

Figure 3: A screen of the adaptive educational hypermedia on programming

In particular we are working in order to improve the student model and the user interface.
We are working on the student model to insert: an entry test in order to evaluate the initial level of knowledge of the student. This feature can improve the value of the DEGREE attribute to the LEVEL tag that implements the stereotype student model. A set of tests related to each main topic in order to modify the LEVEL tag associated to each topic. This feature can improve the overlay student model.
Evaluation tests can be closed answer tests, exercises that need to be solved, every different type of evaluation procedure that can give back an integer evaluation. The solving procedure associated to the exercises of the evaluation test can be monitored using every type of user model. Moreover we are working on new user interface features to improve the navigation tools in the adaptive hypermedia system[Pas1992].
Further works will consider the implementation of an authoring tool that will allow teachers to structure the domain knowledge without introducing the tags directly. This tool should be a graphic editor for developing adaptive hypermedia courseware.

References

[Ada2001] Adaptive Hypertext & Hypermedia Home Page, http://wwwis.win.tue.nl/ah/

[And1995] Anderson J.R., Corbett A.T., Koedinger K., & Pelletier R., (1995). Cognitive tutors: Lessons learned. The Journal of Learning Sciences, 4,167-207.

[Bru1998] Brusilovsky P., 1998,"Adaptive Educational Systems on the World-Wide-Web: A Review of Available Technologies". In: Proceedings of Workshop "WWW-Based Tutoring" at 4th International Conference on Intelligent Tutoring Systems (ITS'98), San Antonio, TX, August 1998.

[Bru2001] Brusilovsky P., 2001,"Adaptive hypermedia" User Modeling and User Adapted Interation 11 (1/2), 87-110.

[Ekl1997] Eklund J, Brusilovsky P., Schwarz E., 1997, "Adaptive Textbooks on the WWW, in: Proceedings of AUSWEB97 - The Third Australian Conference on the World Wide Web, 186–192, Queensland, Australia.

[Ims2001] http://www.imsproject.org/

[Pas1992] de La Passardiere B., Dufresne A., 1992, "Adaptive navigational tools for educational Hypermedia", I. Tomek (Ed), Computer Assisted Learning (pp. 555-567), Spinger-Verlag.

[XML1999] W3C Recommendation, Extensible Markup Language (XML), http://www.w3.org/XML/, 1999.

[Wen1987] Wenger E., 1987, Artificial Intelligence and Tutoring Systems, Morgan Kaufmann Publishers, Los Altos, CA.

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Collaborative Teachback with a Statistical Cognitive Tool: A Formative Evaluation

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Abstract: A learning environment is described in which students collaborate in small groups to develop screen movies in which they use a statistical cognitive tool to interpret published research and to demonstrate their understanding of least squares statistical concepts. Evaluation data are reported which indicate that, although some groups thrive in this environment, other struggle to cope. Enhancements are proposed based on the outcome of the evaluation.

The teaching of applied statistics to social science undergraduates is a much discussed topic (Becker, 1996), no doubt because it presents a disproportionate challenge to students, many of whom do not have extensive mathematical preparation. Although various teaching methods have been adopted, many use prepared data sets in which relationships between variables are to be revealed (and tested for significance) through analyses undertaken by the student (****). In recent years the data sets have been related to research-based scenarios (e.g., Derry et al., 1995; Fischer, 1996; Thompson, 1994), and the analyses are performed with one of a growing number of computer packages which have user-friendly interfaces and powerful graphing capabilities (e.g., *DataDesk, SAS/JMP, SPSS, Statistica, Models'n'Data, Statview*).

The approach upon which the present work is centred shares several of these features (exercises anchored to published research, use of a computer program in the learning process, heavy emphasis on graphical representation), but it differs in several important respects:

- the data are created and altered by the student using a graphical rather than spreadsheet interface
- the emphasis is upon modelling—and playing 'what if' with—the relationships between the variables represented in the program
- the students' task is to demonstrate an understanding of statistical and research concepts by recording a screen movie, with voice-over, in which they 'teachback' what the statistical and research concepts mean and why they are relevant to the research scenario
- the students work in small groups (2–4) to develop and record their teachback movies.

This paper provides details of the teaching/ learning arrangements for this approach to statistics, and reports a formative evaluation of the learning process and outcome.

The Computer Program

The program upon which the learning process is centred is *BivarDescribe*, a Macintosh program designed by the first author. This program enables users to explore the least squares properties of correlation, regression and one-way analysis of variance (anova). Consistent with calls for regression and anova to be taught as variants of the general linear model (Thompson, 1993), anova is treated as a special case of multiple regression, and the focus is upon how the relational structure of the data is modelled by the least squares approach, not on sampling distributions and statistical significance. Thus the program is intended to redress some pervasive misconceptions, namely: that anova and correlation are different procedures (Keppel & Zedeck, 1989; Thompson, 1993); that the concept of 'explained variance' (or 'predictable variance') only applies to correlational data (Hays, 1981; Huberty, 1987); that statistical significance is more important to research interpretation than effect size (Rosenthal & Rosnow, 1985; Thompson, 1993; Wilkinson et al., 1999); and that omnibus anova adequately models relational structure in a one-way design (Rosnow & Rosenthal 1989; Thompson, 1993).

As already noted, this program differs from statistical analysis programs because it facilitates the creation of data (by clicking the 'dot' cursor on the data plot) and the alteration of data (by dragging data points to new locations, or altering variances with a 'variance change' tool). An example of the main plot window in which a data point has been dragged to an outlying position is provided in Figure 1.

Figure 1. The main plot window of *BivarDescribe* depicting a positive linear relationship between two variables, *Severity of Eating Problem* and *Neuroticism*, but with one data point dragged to an outlying position.

Some of the additional features of this program are:

- the strength of the relationship or effect size (the Proportion of Predictable Variance) is represented by a vertical meter that changes dynamically as points are added or altered
- users may access additional information about applicable statistics by opening mini-windows in which the statistics are defined algebraically and illustrated numerically
- there is a dynamic coupling between the graphical and numerical states of the program (points selected or changed in one are selected or changed in the other)
- users may use the Enquiry Tool to see how scores are predicted or to view the deviations with which predicted and residual variances are calculated
- the user can specify a linear prediction and compare it with the least squares regression line
- a correlational design can be converted to an anova design
- contrasts between the conditions of an anova design can be specified graphically and turned on and off to see how they contribute to the predictable variance
- anova as a special cases of regression can be seen in additional window which shows the prediction of scores from the weights defining each contrast.

The Course Context

The course in which the present project is embedded is a one semester second year course in research methods for psychology students at The University of Southern Queensland. The content includes a wide range of research design and methods concepts, for which the supporting text is Shaughnessy, Zechmeister, & Zechmeister, (2000), as well as the statistical concepts involved in bivariate regression, multiple regression and analysis of variance, for which the supporting text is Keppel & Zedeck (1989). In addition, there are extensive course notes (the course is also offered in external mode) and lectures and tutorials. The exercises with which *BivarDescribe* is used comprise 25% of the assessment for the course. Students are prepared for the exercises during several tutorials in one of which they develop and rehearse a simple teachback movie. Students also have access to demonstration movies made with *BivarDescribe* by the authors (about 8 hours in total duration). These movies are based on a research study not included in the exercises, and their topic structures differ from those required by the exercises (to avoid direct modelling).

The Learning Process

The intended learning process consists of several interdependent activities:

- The 'priming' of relevant statistical and research concepts by viewing the demonstration movies and using them as analogues, not direct models, for the exercise movies.
- The construction of statistical understanding using *BivarDescribe* as a cognitive tool with which "[l]earners themselves function as designers using technologies as tools for analysing the world, accessing information, interpreting and organizing their personal knowledge, and representing what they know to others." (Jonassen & Reeves, 1996, p. 694).
- The mapping back and forth between real research variables and relationships and their representations in the statistical domain (Derry, Levin & Schauble, 1995; Laurillard, 1993)
- Collaboration in small groups to encourage the development and refinement of understanding (Roschelle, 1992)

The Intended Learning Outcomes

The learning outcomes of most relevance here are focused on the ability of students to understand and use least squares statistical methods to interpret data within a realistic research setting, as manifested in the teachback movies created by each group. 'Understanding' in this context has several aspects: (a) the ability to map a research question into a statistical framework and vice versa; (b) the ability to translate flexibly between the graphical, algebraic and arithmetical representations of statistical relationships with a clear sense of why they correspond and what they mean (i.e., the understanding should be 'relational' rather than 'instrumental' —Skemp, 1976); (c) the ability to explain how basic least squares concepts apply to correlation and anova (Thompson, 1993); and (d) the ability to 'perform' understanding rather than to reproduce it (Perkins & Blythe, 1994) as a consequence of the 'teachback' format (Pask, 1976).

Evaluation

The aim of the evaluation reported here was not to determine whether the learning model outlined above is better than others reported in the literature, but rather to determine whether it is functioning much as intended and to suggest improvements (Bain, 1999). Accordingly, data were collected about the learning process (by video-recording the discussions of participating groups and coding for key features of the process) and about the learning outcome (by coding the teachback movies submitted by each group).

Participants

Eighteen groups (54 students) completed the assessment for the course, of which 10 groups agreed to take part in the evaluation (i.e., agreed to have their discussions video-taped). Four of the ten participating groups dropped out of the evaluation early, leaving 6 groups from which the present data were obtained. Most groups comprised 3 students, the range being from 2 to 4.

Teachback Exercise

Two substantial exercises comprised the assessment for the teachback component of the course, for each of which several teachback movies were to be produced. The data reported here are for the first of four movies in the first exercise for which the research scenario was based on the article by McFarland (1989). The scenario asked students to contemplate a study examining the relationship between religious orientation (as measured by the *Quest* self-report scale) and a scale measuring a general tendency to discriminate (*Discrimination*) consisting of attitudes toward several minority groups. The expected relationship was inverse, given the findings reported by McFarland—i.e., the higher the score on *Quest*, the lower the *Discrimination* score—but this was not stated in the scenario outline. The first movie was specified as follows:

Use BivarDescribe to model the data pattern (relationship) predicted in the scenario, showing the appropriate variable labels and scales. Initially assume a fairly weak relationship, and show what that might look like. Then:

- *refer to the Proportion of Predictable Variance (PPV) indicator to describe and explain the strength of the relationship that you have created*
- *open the PPV window and explain what the predicted scores are and what the proportion of predictable variance means*
- *apply the Variance Change tool to the grand mean (using increasing as well as decreasing modes) and describe and explain (a) the changes in the data and (b) what happens to the Least Squares Coefficient (LSC) and PPV indicators*
- *make sure you tie all your explanations back to the scenario study and discuss the meaning of the data patterns in terms of the scenario variables.*

Procedure

Our intention was to record two learning sessions, one early and one late in each group's preparations for an exercise so that improvements during learning could be documented. However, for logistical reasons this proved impossible to arrange, so the data reported below are for one session conducted part way through the preparation for the exercise. The session was recorded with a split screen format that enabled the group members to be seen as well as the details of activity on the computer screen. The teachback movies comprising an exercise were recorded when the group indicated that it was ready to do so, typically 2-3 weeks after preparations began. The recording was managed by a tutor who operated the recording software (*Snapz Pro 2*), leaving the group free to concentrate on producing its teachback movies. The video recordings and teachback movies were coded by a project assistant using a 5 point scale ranging from 'not at all' through 'poor', 'limited' and 'adequate' to 'excellent', where the descriptors for each point on the scale were contextualised to the characteristic being rated. The coding process involved repeated checks with the senior author about the codes assigned to each case.

Findings

The means reported in the 2nd last column of Table 1 indicate that the groups were better able to effect the intended social aspects of the learning process (discussion and collaboration) than they were able to use the resources to *construct* their understanding of statistical concepts (building understanding with *BivarDescribe* and correcting misunderstandings being rather limited). However, these general trends are qualified by substantial differences between the groups, two (F, G) being conspicuously sound, two adequate (E, J) and two others obviously struggling to cope (D, K). Similar patterns were evident when general and specific aspects of understanding were coded (Table 2). In this case it was possible to use the same scales to code understanding during the learning processes as well as in the teachback movies, and the mean data and ranges are reported in Table 2. Although the mean values on both sets of scales were mostly in the 'limited' to 'adequate' range, this pattern masks the fact that there were marked differences between the groups much as was evident in the process scales: the ranges provide some idea of the performance differences involved, although not the consistent patterns of group performance (space limitations prevent reporting of the group data).

Another aspect of the consistency of group performance is the degree of correspondence between the understanding 'profiles' (pattern of scores on the understanding scales) obtained during the learning process and evident in the learning outcome. An index of profile similarity is provided by the Euclidean Distance measure (Table 3) which varies from zero when the profiles are identical to an empirical maximum when the profiles are most dissimilar. As is evident from Table 3, the understanding profiles of the groups were relatively similar between the preparation sessions and the teachback movies. In other words, the level of understanding reached about mid-way through group discussion was similar to the understanding evident in the final product. This suggests that further assistance is needed to ensure that knowledge construction continues to grow as groups discuss their approaches to the teachback movies.

Future development

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The evaluation data reported here (and supported by the other data collected) indicate that some groups were able to construct their understanding in the intended manner, two groups in particular being conspicuously capable, but at least two groups (and maybe also those groups which withdrew early in the semester) were not able to perform to a satisfactory standard. Three enhancements may assist such groups in the next offering of the course:

- there will be more extensive lead-up work in the lab to encourage greater fluency with the software and statistical concepts before the teachback exercises begin in earnest;
- a more useful retrieval and playback interface for the demonstration movies will be available: statistical and research concepts and associated movies will be accessible with a zooming concept map built with TheBrain technology (http://www.thebrain.com), and the movies will be indexed with subheads in a synchronised text window to allow ready access to relevant subtopics;
- students will be able to seek the advice of a tutor when they reach an impasse in their exercise discussions, an option not provided in the present implementation.

	Group							
Social and cognitive processes	D	E	F	G	J	K	M	SD
Nature of discussion and ownership of ideas	4	3	3	4	4	1	3.17	1.07
Amount of collaboration evident during session	4	3	3	4	4	1	3.17	1.07
Organisation of time during session	3	1	4	4	1	1	2.33	1.37
Building of understanding with BivarDescribe	1	2	3	3	2	1	2.00	0.82
Correction of statistical misunderstanding	0	1	4	2	2	0	1.50	1.38
Reference to demonstration movies	1	0	3	1	0	1	1.00	1.00
Mean	2.17	1.67	3.33	3.00	2.17	0.83		
Standard deviation	1.57	1.11	0.47	1.15	1.46	0.37		

Table 1: Ratings on six general social and cognitive process variables for groups participating in the video recording of the preparation session

	Process		Outcome	
	Mean	Range	Mean	Range
General understanding scales				
Level of understanding of statistical concepts	3.17	1 – 4	2.67	1 – 4
Integration of statistical concepts	2.33	0 – 4	2.33	1 – 4
Integration of levels of representation (graphical, conceptual, algebraic, computational)	2.50	0 – 4	2.33	1 – 4
Extent to which statistical concepts were related back to scenario	2.00	0 – 4	2.00	0 – 4
Sense of intended audience	2.17	0 – 4	2.17	0 – 4
Specific understanding scales				
Label and explain the variables correctly	2.33	0 – 4	2.83	1 – 4
Comment on the measurement scale of the variables	2.17	0 – 4	2.17	0 – 4
Note and explain the negative relationship between the Quest and Discrimination variables	1.83	0 – 4	1.83	0 – 4
Explain the strength of relationship using the PPV indicator and discuss why this relationship is strong or weak	2.67	1 – 4	2.83	2 – 4
Apply the variance change tool to the grand mean	1.83	1 – 4	2.67	0 – 4
Explain the changes to the data when applying the VCT the grand mean	1.67	0 – 3	2.33	0 – 4
Note and explain why LSC and PPV do not move when points move around grand mean with VC tool	2.17	0 – 4	2.17	0 – 4
Explain how variance change relative to grand mean influences interpretation of the scales	1.50	0 – 4	1.83	0 – 4

Table 2: Mean ratings (and obtained ranges) on six general and eight specific understanding scales for the preparation sessions (process) and teachback movies (outcome)

	Group							
Social and cognitive processes	D	E	F	G	J	K	M	**Range**
General understanding profiles	2.65	2.24	1.00	1.41	1.73	1.41	1.74	0 – 8.94
Specific understanding profiles	3.87	1.73	2.00	5.29	2.65	1.41	2.83	0 – 11.31

Table 3: Euclidean distances (dissimilarities) between the process and outcome profiles defined on the six general and eight specific understanding scales

References

Bain, J. D. (1999). Introduction: *Higher Education Research and Development, 18*, 165-172.

Becker, B. J. (1996). A look at the literature (and other resources) on teaching statistics. *Journal of Educational and Behavioral Statistics, 21*, 71-90.

Derry, S., Levin, J. R., & Schauble, L. (1995). Stimulating statistical thinking through situated simulations. *Teaching of Psychology, 22*, 51-57.

Fischer III, H. W. (1996). Teaching statistics from the user's perspective. *Teaching Sociology; 24* (2), 225-30.

Hays, W. L. (1981). *Statistics* (3rd Edition). NY: Holt, Rinehart and Winston.

Huberty, C. J. (1987). On statistical testing. *Educational Researcher, 16* (8), 4-9.

Jonassen, D. H., & Reeves, T. C. (1996). Learning with technology: Using computers as cognitive tools. In D. H. Jonassen, (Ed.), *Handbook of research on educational communications and technology* (pp. 693-719). NY: Macmillan.

Keppel, G., & Zedeck, S. (1989). *Data analysis for research designs: Analysis of variance and multiple regression/correlation approaches*. NY: Freeman.

Laurillard, D. (1993). *Rethinking university teaching: A framework for the effective use of educational technology*. London: Routledge.

McFarland, S. G., (1989). Religious orientation and targets of discrimination. *Journal for the Scientific Study of Religion, 28*, 324-336..

Pask, G. (1976). Conversational techniques in the study and practice of education. *British Journal of Educational Psychology, 46*, 12-25.

Perkins, D., & Blythe, T. (1994). Putting understanding up front. *Educational Leadership, 51*, 4-7.

Rosenthal, R., & Rosnow, R. L. (1985). *Contrast analysis: Focused comparisons in the Analysis of Variance*. NY: Cambridge University Press.

Roschelle, J. (1992). Learning by collaborating: Convergent conceptual change. *Journal of the Learning Sciences, 2*, 235-276.

Rosnow, R. L., & Rosenthal, R. (1989). Statistical procedures and the justification of knowledge in psychological science. *American Psychologist, 44*, 1276-1284.

Shaughnessy J. J., Zechmeister, E. B., & Zechmeister, J. S. (2000). *Research methods in psychology*. (5th Edn.) McGraw Hill: Boston.

Skemp, R. R. (1976). Relational understanding and instrumental understanding. *Mathematics Teaching, 77*, 20-26.

Thompson, B. (1993). *The general linear model (as opposed to the classical ordinary sums of squares) approach to analysis of variance should be taught to introductory statistical methods classes*. Paper presented at the annual meeting of the American Educational Research Association, Atlanta Georgia, April 12-16. ERIC Document ED 358 134.

Thompson, W. B. (1994). Making data analysis realistic: Incorporating research into statistics courses. *Teaching of Psychology, 21*, 41-43.

Wilkinson, L., & Task Force on Statistical Inference. (1999). Statistical methods in psychology journals. *American Psychologist, 54*, 594-604.

The Catalyst Initiative: Integrating Support and Development through Collaboration

Background

In 1994, the Provost charged three top-level administrators at the University of Washington (UW) to "do something about technology." They collaborated with faculty, librarians, technologists, and students, and gathered resources from wherever they could to bring technology into the service of teaching and learning in a more systematic way, first with the Center for Teaching, Learning and Technology (CTLT), established in 1996. By 1998, drop-in visits to the CTLT had increased dramatically, seriously taxing staff resources. At this point, staff conducted thorough assessments with faculty, librarians, instructors, and teaching assistants who expressed three overriding needs: technology support that is smooth and easy-to-use, flexible, and scalable. The Catalyst Initiative was created to meet these objectives.[1]

The Catalyst Initiative

The Catalyst Initiative, a result of collaborations between many partners, provides UW instructors with four levels of support for integrating technology into their teaching: 1) the Catalyst Web site, 2) Catalyst Web Tools, 3) face-to-face consultations at the CTLT, and 4) Catalyst workshops. The Catalyst model provides the grounds for a symbiotic and iterative relationship where the support activities feed and lead to partnerships, which in turn result in the development of more and better support resources and activities.

The Catalyst Initiative is carried out by a permanent staff that understands the needs of both instructors and the units on campus with a stake in teaching and technology. This staff, called the Educational Technology Development Group (ETDG), is perfectly situated to arrange collaborations and bridge gaps between educators and other units on campus. This position as an intermediary and a change agent has allowed ETDG staff to not only develop a scalable support strategy but to participate in high-level experiments that push the boundaries of innovation.

Partnerships

Excellent support resources and exciting technology infused teaching practices are found all across campus, but few people know about these resources and practices beyond their own departments. The Catalyst Initiative was created to identify and the make these resources and practices visible, scaling innovation across campus through collaborative partnerships. Resources and materials generated from these partnerships are placed on Catalyst and co-branded, giving credit to the partners who helped create them.

The co-branding strategy allows staff to maintain current and innovative resources on Catalyst and to use them in the workshops and one-to-one consultations in the CTLT while alleviating the burden of generating new materials whole cloth. Informal partnerships also yield tremendous benefits. Instructors who use the Catalyst Web site, attend workshops, seek help at the CTLT, or use the Catalyst Tools offer feedback which is incorporated into all parts of the Catalyst Initiative. Not only do these strategies leverage resources, but they also forge a sense of ownership and a measure of comfort with educational technology among faculty and support staff who come to see themselves in the offerings on Catalyst.

Catalyst Web site (http://catalyst.washington.edu)

The Catalyst Web site provides examples, promotes good teaching practices, builds technology skills, and makes technology easy for instructors to use.[2] Catalyst places good teaching and student learning at the forefront, treating technology as a means to these ends. The resources on the Catalyst Web site shape and inform the other levels of the Catalyst Initiative: Catalyst workshops, one-on-one consulting delivered in the CTLT, and Catalyst Web Tools. This interlocking support strategy ensures that campus educators receive clear, consistent help for integrating technology into their teaching.

A great deal has been written about the creation of the Catalyst Web site,[3] but it is worth reemphasizing that its homegrown content is built solely through collaborative partnerships with campus teaching practitioners. A look at the six major content categories on Catalyst makes clear the close connections to campus instructors: 1) *Profiles* tell stories of educators who are using technology in teaching; 2) *Teaching* lets instructors explore the ways that technology can help achieve specific teaching and learning goals; 3) *Action Plans* are "road maps" for particular tasks, such as creatinga class Web site; 4) *How-to* pages take users step-by-step through specific tasks needed to make technology work; 5) *Learning* offers information on CTLT workshops and other campus activities related to teaching with technology; and 6) *Web Tools* is a gateway to Web-based software and also links to innovative uses of Catalyst Web tools by UW educators, again helping to spread good practice beyond disciplinary boundaries.

Leveraging the expertise available, the ETDG staff has collaborated with specialists on campus to create the following pages and tools with partners:

- *Distance learning courses*: UW Educational Outreach co-developed Catalyst content that helps faculty design distance-learning courses.
- *Evaluations, Web-Ed forums, how-to documentation*: The Program for Educational Transformation Through Technology works with ETDG staff to evaluate the Catalyst Web Tools, to post streaming video from the Web-Ed forums on the Catalyst Web site, and to contribute how-to documentation.
- *Online journals*: UW Libraries' co-branded content explains how to locate and link to online journal articles.
- *Accessible Web sites*: The UW DO-IT office is working with the ETDG staff to integrate accessibility issues into the content on the Catalyst Web site.

- *MyUWClass*: Computing and Communications (C&C) is currently working with the ETDG to create *MyUWClass*, a personalized teaching portal for UW instructors. This portal integrates Catalyst Web Tools with course and student information systems and applications that let instructors post content directly to the Web. C&C will also continue to collaborate on technical documentation.

The Catalyst Web site fulfills the three needs expressed by faculty and staff during the foundational assessment period. First, the varied stories of teaching with technology, the step-by-step instructions, and the best practices make an educator's initial foray into educational technology smooth and easy. Second, Catalyst is extremely flexible; faculty needs and wants vary markedly across departments, disciplines, and course types, but the Catalyst Initiative allows them to pick and choose support options that suit their environment and needs. Finally, the Catalyst Web site and Web Tools are a campus-wide resource, available 24-7, which scales local solutions throughout the campus teaching community.
The Catalyst Web site is widely used by UW faculty-- instructors and staff view upwards of 100,000 pages per month. Clearly, the Catalyst Initiative has reached instructors from a wide range of departments.

Catalyst Web Tools
The ETDG created the Catalyst Web Tools to allow educators to add advanced content to their Web pages without learning complex programming languages. The Web Tools themselves are all founded in the wants and needs expressed by UW instructors and are constantly updated according to their feedback and suggestions. For example, the Political Science Writing Center asked the ETDG staff to develop a tool that would allow students to review each other's work. After determining that the tool could be used campus wide, ETDG developers created PeerReview. As more instructors use the tools, they ask for more features and additional functionality and, indeed, new tools. The current set of nine tools allows instructors to easily create threaded discussions; receive student assignments online; manage ListProcs; facilitate case-based learning on the Web; receive anonymous feedback; administer one-question surveys, online quizzes, and peer reviews; and even create course Web sites entirely through a Web browser from any computing platform. Instructors have requested over a dozen more tools, which will be assessed, prioritized, and developed. The next in line is MyUW Portfolio, an online portfolio system that students will use on their own and with guidance from faculty, advisors, and career counselors.

Because the tools are based on feedback from instructors and may be used by people in every department, they are popular with UW educators. More than 4000 instructors have used Catalyst Web Tools, and learners log in to use the tools more than 100,000 times every month.

Drop-in visits to the CTLT
Every year, 1700 instructors on average visit the CTLT for assistance with integrating technology into their courses. The Catalyst Web site supports these activities, and their face-to-face feedback often leads to the development of new content, tool features, and workshop materials.

Catalyst Workshops
Over 900 instructors attended the popular Catalyst workshops last year. The workshop materials and topics are continually modified as a result of feedback received from workshop attendees.

To take advantage of the expertise available beyond the small ETDG staff, several of the workshops are co-taught by the staff and specialists from other campus organizations. For example, an instructor from Educational Outreach team-teaches a workshop on developing a distance learning course, and the DO-IT office works with ETDG staff to integrate accessible design issues into the workshops and co-teaches an accessibility workshop.

Summary
The Catalyst Initiative's wild success is the result of the innovative model of working with partners --both formally and informally -- to create support materials and resources that scale campus-wide. Using four levels of support ensures that instructors have access to support that suites them, support that is created from their own suggestions, wants, and feedback.

References

[1] For a detailed explanation of this period see: Mark Donovan & Scott Macklin, 1998. *One Size Doesn't Fit All: Designing Scaleable, Client-Centered Support for Technology in Teaching.* Paper presented at Cause98: The Networked Academy in Seattle. http://www.educause.edu/ir/library/html/cnc9846/cnc9846.html

[2] This partnership has been so successful that it received the 2000 EDUCAUSE Award for Systemic Progress in Teaching and Learning.

[3] Mark Donovan & Scott Macklin, 1999. *The Catalyst Project: Supporting Faculty Uses of the Web with the Web.* Cause/Effect 22(#3). http://www.educause.edu/ir/library/html/cem9934.html
Mark Donovan, 1999. *Rethinking Faculty Support.* Technology Source (September/October). http://horizon.unc.edu/TS/development/1999-09.asp

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Models and Methodologies for Multimedia Courseware Production

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Abstract: Many new technologies are now available for delivering and/or providing access to computer-based learning (CBL) materials. These technologies vary in sophistication in many important ways - depending upon the bandwidth that they provide, the interactivity that they offer and the types of end-user connectivity that they support. Invariably, appropriate combinations of the available technologies are needed in order to produce the most effective and efficient learning environment for any given application. Bearing this in mind, it is important to consider how multimedia resources, interactivity and global connectivity can best be used in order to produce a software product that best fulfils the requirements identified in any given courseware requirements specification. In this paper we discuss the types of model that are needed to create effective interactive, multimedia courseware. We also indicate the nature of the interactions that exist between these models and the ways in which these can be used to optimise the trade-offs that are inherent in the creation of multimedia CBL materials.

Introduction

Multimedia computing technology has opened up many interesting opportunities for the creation of new types of learning and training products covering a wide range of subject areas for many different audiences (Barker, 1996; 1999). Examples of the types of product include: electronic books; educational games; interactive products based on the use of compact disk (CD) technology; intranet and World Wide Web pages; and tools to facilitate 'electronic' knowledge sharing. Together, products of this sort can be used to enrich the scope and quality of computer-based learning (CBL) experiences.

Within the remainder of this paper we shall use the term '*interactive multimedia courseware*' to refer to computer-based learning products in which some skill or knowledge is intentionally transferred to a user of that product as a consequence of its use. Such software can be defined in terms of 'learning products' in which optimal combinations of text, sound and images are used to achieve particular learning outcomes using interactivity in various ways to achieve these objectives. Typically, interactivity is used: to facilitate navigation through the corpus of materials that make up the product; to provide assessment and feedback mechanisms; and to facilitate communication between the group of users that constitute the 'learning community' at which the product is focused.

When designing courseware, it is important to consider how multimedia resources, interactivity and global connectivity can best be used in order to produce a software product that successfully fulfils the conditions identified in any given courseware requirements specification. Because of the complex nature of both software development and the cognitive processes that take place during learning, this is no easy task. The design and development processes therefore need to be guided by appropriate models that encapsulate 'best practice' with respect to both system design and implementation issues. Relevant pedagogic models also need to be employed in order to ensure that the subsequent learning processes are relevant to the knowledge and skills that are to be acquired. Therefore, in this paper we shall discuss the types of model that are needed in order to create effective interactive, multimedia courseware. We also indicate the nature

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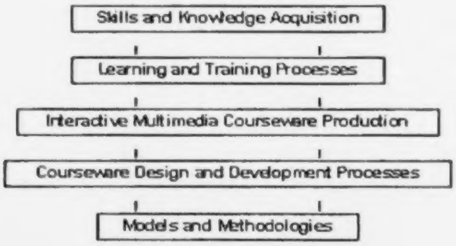
of the interactions that exist between these models and the ways in which these can be used to optimise the trade-offs that are inherent in the creation of multimedia CBL materials.

Underlying Models and Methodologies

There are two basic approaches to developing courseware products; we shall refer to these as the '*empirical approach*' and the '*theoretical approach*'. The first of these uses a strategy that is based essentially on a 'trial and error' procedure; that is, a learning product is produced and its effectiveness is determined; if necessary, an iterative 'fine-tuning' mechanism is then used in order to improve it. In the second approach, appropriate theories and models are used, in so far as they exist, in order to create a learning product that falls directly within a given 'region of acceptability'. This latter approach is attractive because it reduces the amount of uncertainty involved in product creation. It is our opinion that design and development models (and methodologies derived from them) should play a fundamental underlying role in guiding the production of interactive multimedia courseware. The underlying importance of these basic tools is reflected schematically in Figure 1.


Skills and Knowledge Acquisition
Learning and Training Processes
Interactive Multimedia Courseware Production
Courseware Design and Development Processes
Models and Methodologies

. These range from simple models, such as the 'waterfall' model to more advanced models and methodologies including: the CASE approach, SSADM, the spiral model, Siegal's approach, December's methodology, Dinucci's method, and so on. However, these models and methodologies are mostly used in the development and implementation of business-oriented information systems and are not normally suitable for the development of multimedia learning products.

Designing and developing multimedia learning products necessitates close co-operation between people with specific skills and expertise. Furthermore, the existence of diverse modes of storage and delivery necessitate the adoption of appropriate methodologies and suitable design models in order to create high quality learning products. In the remainder of this paper we shall discuss some of the more important issues relating to the formulation of the various models and methodologies that we feel are needed in order to underpin the successful development of interactive multimedia courseware products.

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Problems Arising in Multimedia Development

The development of interactive learning products usually requires a team of skilled specialists. Whilst many of these teams adopt their own approaches to the analysis, design and development of their products, there are no generally accepted models and methodologies specifically designed to assist in the creation of multimedia learning products. As the complexity of the products and the size of the development teams increase, it becomes more difficult to manage the production process efficiently. Most existing models and methodologies stress the importance of operation, providing information, handling events, and so on. However, these elements are not so important in courseware development, where the process involves the integration of all the available resources into a single piece of software. In this situation, the emphasis is on how to present a topic to users in a way that increases their knowledge and/or skills.

A multimedia project is normally composed of four equally important components: planning and design; resource and program development; testing and evaluation; and dissemination. Ideally, if we had adequate models, it would be possible to predict exactly how much time should be spent on each of the four phases. Invariably, the time spent on each individual phase is not equal and is often not predictable. In reality, many multimedia projects spend a much greater proportion of time on resource and program development and relatively little time on planning and design, testing and quality control, and dissemination and evaluation. Neglecting these major elements of the project life cycle could ultimately lead to a deficient product.

Of course, there are many other reasons why multimedia projects fail. For example, in a survey of the members of one multimedia development team, the three main factors contributing to unsuccessful projects were identified as: poor design; ineffective project co-ordination; and inefficient communication channels. Undoubtedly, most of these arise due to lack of a structured approach. In the following section of the paper we introduce a comprehensive methodology that is designed to improve the efficiency and effectiveness of multimedia development teams.

A Methodology for Creating Multimedia Learning Products

There are several good arguments in favour of adopting a sound methodology for developing multimedia learning projects. These include the necessity for good communication; consistency; effective quality control strategies; and accurate cost estimation. Some of the important issues that need to be addressed are outlined below.

Project Planning: the scope of a project, its budget and its intended completion date are usually negotiated prior to the commencement of any development activity. Once a project is formally agreed upon, management strategies are identified, milestones are established and tasks and resources (including individual team members) are identified.

Team Management: effective team management helps to establish a productive working atmosphere, deals with problems more readily and shares the workload efficiently. Figure 2 shows the structure of a typical multimedia development team in which the courseware designer and project manager co-ordinate the planning, design, development and testing. A clear definition of the roles and responsibilities of each team member ensures that all project tasks are allocated and allows contingency plans to be put in place in the event of any member of the team becoming unavailable.

Project Life Cycle: Figure 3 shows the four main phases involved in a typical multimedia project. The first three of these (preparation, design and development) are iterative processes. The fourth phase (dissemination) can be repeated if the product is revised or modified between releases.

Analysis of Requirements: a comprehensive project analysis determines the specific requirements of the end-product and should include an in-depth study of the users, the intended delivery systems and the scope of the project. These should be documented so that developers and clients can refer to them in order to ascertain whether the product is meeting the required standards.

Design Specifications: the design specifications provide a detailed description of the program requirements to all members of the development team. It incorporates essential information such as the font sizes to be used, colour palettes, file formats and flowcharts that outline the proposed content.

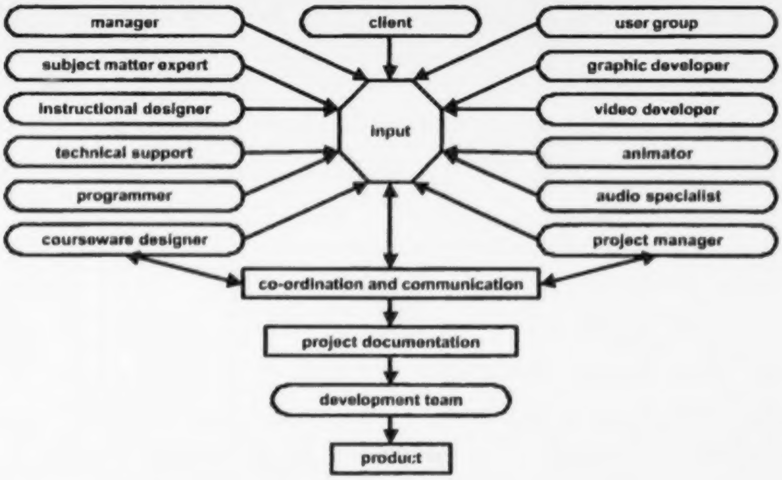
manager
client
user group
subject matter expert
graphic developer
instructional designer
input
video developer
technical support
animator
programmer
audio specialist
courseware designer
project manager
co-ordination and communication
project documentation
development team
product

Figure 2: Structure of a Typical Multimedia Development Team

Human-Computer Interface (HCI) Issues: the end-user interface encompasses a number of factors including the proposed screen layouts, navigation controls, user interaction, 'look and feel' and the nature of the various metaphors that are embedded within the courseware.

Delivery Medium: multimedia learning products can be delivered in a number of ways. For example, CD-ROM publication, the Internet, an intranet or local area network, and various types of turnkey solution. Each delivery method has constraints and limitations that should be addressed at the planning stage of the project.

Resource Production: multimedia learning products can contain a combination of text, graphics, audio, video and animation. The establishment of appropriate parameters for each of these at the outset of the project avoids inconsistencies within the final product.

Program Integration: the ease with which multimedia elements are integrated depends critically upon the availability of a comprehensive script and detailed flowcharts to assist the programmers and resource producers. A good file naming strategy is also essential to the integration of resource files.

Quality Control and Evaluation: both formative and summative evaluation strategies need to be identified during the planning stage and quality control should be regarded as a continuous process. A thorough testing strategy should be established that allows all errors to be noted and amended effectively. Ongoing testing and evaluation should be employed throughout Phases 1, 2 and 3 in order to ensure that the final product falls within a pre-specified 'region of acceptability'. As we discuss later, *'ongoing evaluation'* is an important aspect of the dissemination phase of the methodology.

Documentation: good documentation is essential to ensure that any project life cycle evolves efficiently and within the allotted time. The basic documentation required for most multimedia projects comprises: a project proposal; design specifications; scripts and storyboards; quality control and testing strategies; and progress reports

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Scripts and Storyboards: scripts are paper-based documents that provide a detailed description of the courseware content and howthis is to be implemented within the final product. Scripts contain details of all on-screen text, audio transcripts, written descriptions of graphics, video and animation along with their file names. These form the basis of audio scripts, graphics listings and video and animation storyboards. Scripts also provide special instructions and detailed flowcharts for the programming team.

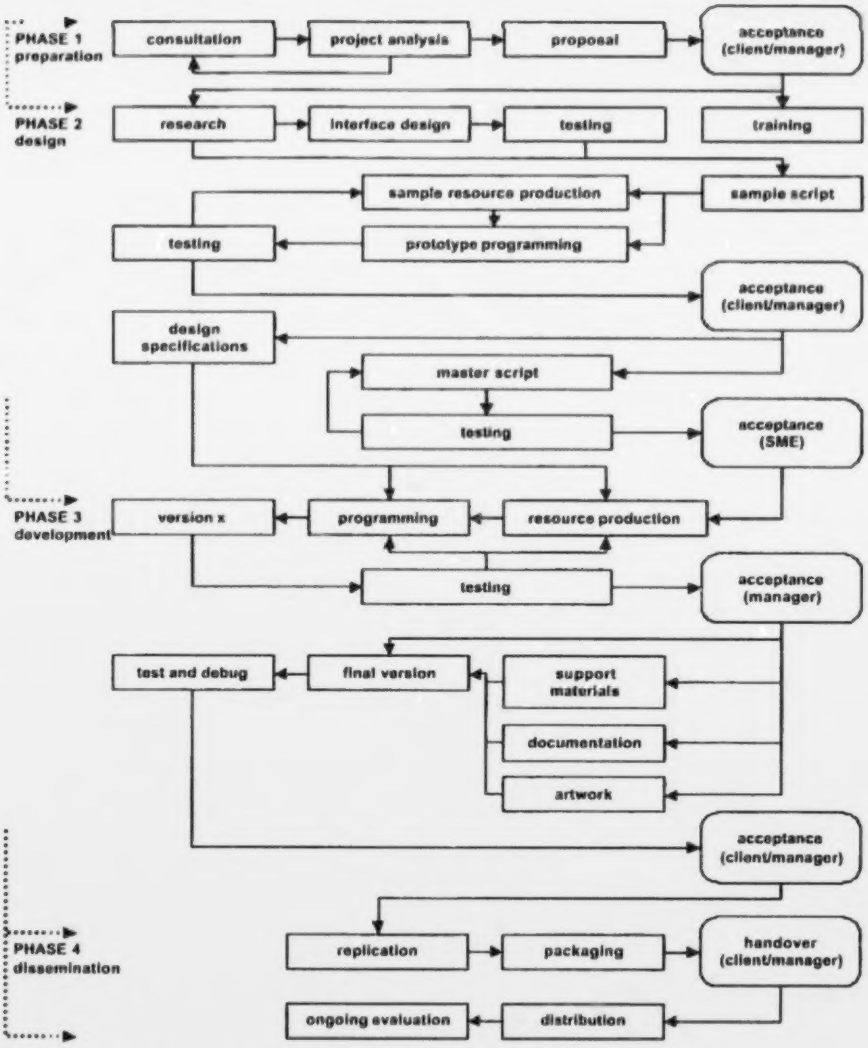
PHASE 1
preparation
consultation
project analysis
proposal
acceptance (client/manager)
PHASE 2
design
research
interface design
testing
training
sample resource production
sample script
testing
prototype programming
acceptance (client/manager)
design specifications
master script
testing
acceptance (SME)
PHASE 3
development
version x
programming
resource production
testing
acceptance (manager)
test and debug
final version
support materials
documentation
artwork
acceptance (client/manager)
PHASE 4
dissemination
replication
packaging
handover (client/manager)
ongoing evaluation
distribution

Figure 3: Development Methodology for Interactive Multimedia Courseware

Dissemination: the dissemination phase of product development involves all the processes necessary to package the product and make it available to customers. Of course, even after a learning product has been

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released for distribution (see Phase 4 in Figure 3) it is important to undertake a programme of '*ongoing evaluation*'. The results of this type of evaluative study can subsequently be used to fine-tune future releases of the learning product and also inform the design and development processes involved in the creation of new courseware products.

Discussion

One of the most convincing arguments for the use of models stems from the fact that they enable us to make accurate predictions about the properties and behaviour of the systems that they describe. In this paper we have described a methodology to facilitate the development of interactive multimedia learning products. The methodology that was outlined in the previous section has been derived primarily from our experiences with conventional multimedia learning products involving the creation of interactive CDs. It is therefore necessary to discuss whether or not the methodology (as presented in Figure 3) could be applied to the development of other types of interactive learning product - particularly those involving the use of an intranet or the World Wide Web. Our experiences to date suggest that the basic methodology (with some minor amendments) would easily handle this latter type of product. Essentially, Phases 1 through 3 could be used as they stand. So far, we have found that the only area where minor amendments may be needed is in Phase 4. In this phase, the 'replication' and 'packaging' steps may be less important for an intranet/Internet project than they would be for a CD project. We are therefore optimistic that the proposed methodology can be used to cater for a wide range of interactive multimedia learning product development projects

Conclusion

Developing interactive multimedia courseware products is a complex and costly process that requires a wide range of powerful models and a workable, practical design and development methodology. In this context, a structured design and development approach has a number of advantages. For example, templates and scripts provide essential information in easy-to-read formats that can be tailored to meet the requirements of individual team members. In addition, the production process can be made simpler and more efficient - as fewer program and resource changes are required at the development stage. Furthermore, quality control is made more effective by providing testers and evaluators with a program 'blueprint'.

A learning product development methodology, such as the one that has been described in this paper, should enable multimedia courseware products to be developed in a more predictable way - both in terms of learning outcomes and from the perspective of resource utilisation (time and money). Implicit in the various project phases that we have described in our methodology are a number of local and global interactions - both between the underlying models and the system variables that are involved in managing the preparation, design, development and dissemination processes. It is through a greater understanding of these interactions that we will be able to gain further, much needed, insight into the various factors that are responsible for causing multimedia learning projects to fail.

References

Barker, P.G., (1994). Designing Interactive Learning, 1-30 in *Design and Production of Multimedia and Simulation-Based Learning Material*, edited by T. de Jong and L. Sarti, Kluwer Academic Publishers, Dordrecht, The Netherlands.

Barker, P, (1996). Electronic Libraries of the Future, *International Encyclopaedia of Library and Information Science*, Volume 59, Supplement 22, 119-153, edited by A. Kent and C.M. Hall, Marcel Dekker, New York, NY, USA.

Barker, P.G., (1999). Using Intranets to Support Teaching and Learning, *Innovations in Education and Training International*, 36(1), 3-10.

Skill Sets for Online Teaching

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Abstract: the electronic dissemination of information via computer networks is having a considerable impact on educational institutions in terms of the mechanisms that they are able to employ for course delivery. As a result of this, the number of courses that are taught electronically through the Internet and/or the World Wide Web has increased considerably over the last few years. Such courses require two fundamental types of resource: appropriately designed electronic course materials (for students to study) and a network of online tutors who can provide active support, advice and encouragement for students. This paper discusses the nature of the skill sets needed by online tutors in order to fulfil their roles effectively and efficiently within an online learning community. Some mechanisms for acquiring these skills are also briefly discussed.

Introduction

Electronic teaching through the Internet and the World Wide Web is rapidly becoming an established practice in many educational institutions. This is particularly the case in situations where there is a need for flexible course provision and/or a demand for 'time and place' independence of course delivery (Beckstrand et al, 2001; 2002). Non-academic institutions are also using 'e-learning' techniques as a mechanism for facilitating staff training, reducing the costs of training, improving the effectiveness of educational delivery and providing continuing professional development opportunities.

Naturally, designing electronic courses for online delivery is, in many ways, different from the ways in which conventional courses are developed and used. Indeed, according to Galpin (2001), *'simply taking a traditional classroom or paper-based experience and putting it online is not enough'*. Techniques for designing and supporting online courses are well-documented in the literature - see, for example, Thomas et al (1998), Lockwood and Gooley (2001) and Jolliffe, Ritter and Stevens (2001). Our own approach to electronic course design and delivery has been described in detail elsewhere (Barker, 1999; 2000; 2001; 2002). Essentially, the methodology involves the creation of four basic types of resource. First, an online corpus of study material (a teaching web) that students can access through an intranet or via the World Wide Web. Second, the use of computer-mediated communication to facilitate both synchronous and asynchronous computer conferencing activities. Third, the creation of shared workspaces to facilitate collaborative group working. Finally, the provision of appropriate assessment infrastructures to enable students (and staff) to monitor and gauge the progress they are making with the course.

Obviously, online teaching is different from face-to-face instruction. The main differences between the two approaches arise because teachers and students are not physically present together at the same geographical location. This absence of '*proximal presence*' has two important effects, which are briefly discussed below.

First, the shared environmental artefacts that may be present in a face-to-face teaching situation (such as walls and windows, posters, desks, books, students, and so on) are usually 'absent' from a distributed online teaching environment. Of course, within an online system, virtual analogues of these 'missing' objects may be generated in order to substitute for them. However, many of the more common approaches to online teaching do not do this due to the complexity of the software that is needed.

The second 'missing component' from online teaching environments is the various types of body language that are normally associated with small-group, face-to-face teaching situations. Within online teaching, various textual conventions are sometimes used to substitute for the absence of non-verbal communication – for example, the use of emoticons, various font styles for representing different modes of expression (such as the use of coloured text, italicisation, and so on) and iconic forms. However, these conventions have only met with various degrees of success (Yazdani and Barker, 2000).

Because online teaching is different from face-to-face instruction, it therefore requires different skill sets - both for the students who use the electronic resources (Montieth and Smith, 2001) and for the staff involved in supporting the various activities associated with a particular course (Duggleby, 2000; Salmon, 2000; Bennett and Marsh, 2002). Because of the growing importance of electronic course delivery and online tutoring, the remainder of this paper attempts to identify and discuss some of the staff roles and responsibilities associated with online teaching and learning - and the skill sets needed to undertake these activities.

Possible Roles for Online Tutors

Within environments that utilise electronic course delivery, there are a number of different course 'development and delivery' scenarios. These are likely to require instructors to play several different roles. Bearing this in mind, Table 1 depicts some of the major roles that any particular individual may have to fulfil in relation to producing and/or using an online course.

Table 1: Roles for Online Tutors

- a member of a course design team
- the sole designer of a course and one of its online tutors
- an online tutor for courses produced by others
- a moderator and/or examiner for various courses

It is easy to deduce from Table 1 that there are three basic types of involvement that an online tutor might have with any given online course. First, in the *development stage*, a tutor might become involved in various aspects of designing (and possibly, producing) an online course. Second, in the *delivery stage* of a given course, particular individuals (who might not have been involved in the development phase) might act as an online tutor for that course. Third, in the *assessment phases* of a course the tutor might be involved in various quality assessment or quality assurance activities.

Each of the above roles will have an appropriate skill set associated with it. Each skill set will require an appropriate mix of *pedagogic*, *technical* and *organisational* skills. The nature of these three skill sets is discussed in more detail in the following section of the paper.

What Skills are Needed?

In order to undertake their responsibilities in an effective way, online tutors will need to be equipped with the skills and knowledge needed to perform the tasks that they are required to undertake. The detailed nature of these tasks is discussed elsewhere (Barker, 2002; Duggleby, 2000; Salmon, 2000). This section of the paper therefore briefly describes and discusses the three major skill sets (pedagogic, technical and organisational) that we believe are a necessary pre-requisite for effective online tutoring.

(a) Pedagogic Skills

Skills in this category relate to the ability of an online tutor to design and create teaching and learning materials for online use. There will normally be two contexts in which these resources might be used. In the first instance, they could form the *primary resource set* that students use in order to study and learn. Alternatively, they could constitute an *ancillary resource set* that is intended to complement a primary resource set that has been produced by someone else. Some of the important pedagogic skills needed to facilitate the design and development of these learning resource sets are listed in Table 2.

Most of the necessary skills in this category will be similar to those needed to prepare and use conventional teaching and learning resources. For example, topic research, knowledge structuring and the design of self-study tasks and assessment strategies are fairly generic activities that are applicable to virtually all modes of teaching. Naturally, it will be necessary to consider what special requirements need to be accommodated as a consequence of using web-based delivery. This is especially so in the case of knowledge structuring - where electronic resources can be interlinked in many different ways that are not feasible with conventional media. Of course, the use of electronic resources also offers many pedagogic facilities (such as animation and interactivity) that may not be possible using conventional approaches to instruction.

Table 2 Major Pedagogic Skills for Online Tutoring

- Researching a Topic
- Knowledge Structuring
- Designing Individualised Self-Study Tasks
- Designing Group Work Activities
- Formulating Assessment Strategies
- Mentoring, Counselling and Advising
- Marking, Monitoring and Giving Feedback

(b) Technical Skills

The skills in this category relate to the ability of an online tutor to use a range of different software tools in order to conduct his/her tutoring tasks in an effective and efficient way. Some of the more important of these tools are listed in Table 3.

Table 3 Technical Skill Requirements for Online Tutoring

- Using Electronic Mail
- Creating, Managing and Participating in Asynchronous Conferences
- Designing, Creating and Controlling Real-time Chat Rooms
- Using a Word Processor, Spreadsheet and Database
- Using Web Page Authoring Tools
- Using Special Purpose Software

Although online tutors often use telephone, facsimile transmission and postal services in order to communicate with their students, by far the most important (and heavily used) mechanisms of communication are computer-mediated. Undoubtedly, electronic mail is probably the most widely used tool. This is used both to send 'simple' messages and 'compound' messages containing various types of attachment - such as text files, spreadsheets, sound and image files, multimedia documents, and so on. A variety of different computer conferencing tools (both synchronous and asynchronous) are also usually employed to facilitate teaching and learning tasks. These electronic tools, and the others identified in Table 3 are discussed in more detail elsewhere (Barker, 2002).

(c) Organisational Skills

Skills in this category refer to the ability of online tutors to organise their own activities as well as those of the students who are following the particular courses for which they are responsible. Some of the main skill requirements in this category are listed in Table 4.

Table 4 Organisational Skills for Online Tutors

- select and organise cohorts of students for group activities
- maintain online conference structures in a logical fashion
- structure and maintain students' demographic data
- collect and archive students' work for assessment
- archive and maintain personal teaching resources
- maintain administrative proformas and document templates

As is the case in conventional teaching situations, one of the major organisational responsibilities that online tutors have to undertake is the facilitation of students' learning activities - especially for group work and projects. A useful way of achieving this is through the use of an electronic 'noticeboard'. Such a tool can be used to publish lists of students and details of group activities - for example, project specifications, milestones, deliverables and time schedules. Tools of this sort can be regarded as being a part of a broader organisational toolset that is provided within the framework of an 'electronic office' environment. Many organisations involved in electronic teaching and learning especially within a virtual campus context) now provide their network of online tutors with this type of facility - see, for example, the facilities at the Robert Gordon virtual campus at *http://campus.rgu.com*.

Skill Acquisition Mechanisms

Any discussion of the skills that an online tutor needs to possess must also consider how these skills might be acquired. Naturally, there are two major issues that need to be discussed. First, we must consider how 'new' online tutors gain the skills that they need in order to participate in an effective way within an online learning community. Second, we should consider how established online tutors participate in 'professional updating' activities - that is, the mechanisms that they use in order to keep up to date with the new software systems, technologies and course modules that they may be required to use.

Ideally, the mechanisms for each of the above skill development processes should be found embedded within the online learning communities themselves. That is, the organisations responsible for providing courses for students should also provide online training opportunities for the network of tutors that is needed to support these courses. Many distance learning universities do in fact provide online courses and online training for their staff. The UK's Open University (OU), for example, uses its computer network infrastructure in order to provide online, interactive training for many of its tutors. As an example of this, the OU makes available online training for the *FirstClass* conferencing system (which it uses for many of its distance learning courses).

Many other universities also provide various online courses both for their own staff and for other people who want to find out more about electronic distance learning and online tutoring activities. The '*virtual campus*' at the Robert Gordon University in Scotland (*http://campus.rgu.com*), for example, has a number of online courses that visitors to the campus can study - see, for example, the '*Campus Induction Module*'. This module shows users how to: build an online office; access and use course materials; enter online discussions; join an online community; and use the virtual library. It also provides a series of 'top tips' for online learning.

The need for professional development opportunities for staff in the area of online learning, tutoring and distance education has been recognised by a number of authors - see, for instance, Salmon (2000), Montieth and Smith (2001), MacKenzie and Staley (2001), Bernath and Ruben (2001) and Bennett and Marsh (2002). Based on the results of their study into using a virtual campus, Montieth and Smith (2001: p. 126) report the finding that '*It is in the area of computer mediation we consider staff need more training ... staff skills with respect to mediation through CMC do require updating*'. Bennett and Marsh (2002) have reported similar findings. They suggest that '*... the majority of tutors new to online teaching do not have the background of online learning experience upon which to draw ...*'.

Various mechanisms for the provision of online training opportunities for academic staff have been explored. For example, in their research, Bernath and Ruben (2001) have described the use of a '*Virtual Seminar in Distance Education*' for facilitating training opportunities. This is an online, asynchronous discussion forum (based on the World Wide Web) that was designed to provide university faculty and administration with professional development in the field of distance education. The success of their research leads one to suggest that the provision of online training opportunities for online tutors is of paramount importance. This view is supported by the findings of Bennett and Marsh (2002) who have described their experiences in preparing 'new' online tutors for the roles they will play within an online electronic learning community. Their study outlines the nature of the training given to potential online tutors and how the effectiveness of this was evaluated. The results of their evaluation suggest that the '*online teaching practice may be the single most important element of the training and development process*'.

Naturally, as the roles of academic staff in higher education institutions change, there is obviously considerable scope for the introduction of online training courses that can provide adequate and appropriate skill development for the new tasks that tutors have to undertake.

Using Online Learning for Skill Acquisition

One important approach that we have used for developing the skills needed to become an online tutor is through on-the-job training using an 'apprenticeship' model (Barker, 1994). In this situation, potential online tutors become involved in running tutorial and teaching groups in conjunction with an experienced and/or 'qualified' e-tutor. Another approach, that we are exploring, involves the creation of an online environment for facilitating skill development. The architecture for our proposed training facility is illustrated schematically in Figure 1.

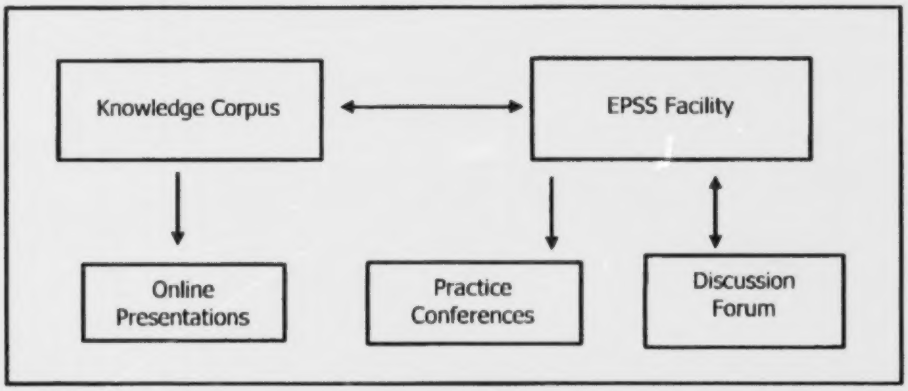

Figure 1: Skill acquisition environment for an online community of trainee e-tutors.

There are four important components within the skill development system: the knowledge corpus that documents the skill sets and procedures to facilitate their acquisition; an electronic performance support system (EPSS) that is able to assess the ability of a potential tutor and his/her current knowledge/skill levels and then recommend a 'course of study' for that tutor; various online presentations that are designed to facilitate knowledge/skill acquisition; a range of practice conferences; and a discussion forum. The latter two resources are particularly important because it is through these that new tutors can practice their skills, discuss any problems that they are having and share their experiences.

Conclusion

For a variety of reasons, many academic (and non-academic) institutions are now becoming involved in electronic learning initiatives. There are two main 'driving forces' underlying the developments that are taking place. The first of these arises as a result of the need for many organisations to become involved in *computer-based distance education* involving the Internet and the World Wide Web. The second arises as a result of organisations wanting to take advantage of the many *pedagogic benefits* that online learning can bring. A computer-based network infrastructure (such as the Internet or an intranet) is able to facilitate two major educational objectives. First, the delivery of electronic learning resources in a flexible way that is independent of 'time and place'; and second, the realisation of 'educational conversations' between students themselves and with their tutors. Naturally, with the growing demand for online learning, it is important that students following particular courses are supported by an adequately trained network of online tutors. Such a requirement necessitates that we should identify the skill sets that online tutors need and then provide appropriate (online) infrastructures and mechanisms to enable the requisite skills to be developed. This paper has attempted both to identify some of the required skills and to suggest how the training mechanisms might be realised.

References

Barker, P.G., (1994). Designing Interactive Learning, 1-30 in *Design and Production of Multimedia and Simulation-Based Learning Material*, edited by T. de Jong and L. Sarti, Kluwer Academic Publishers, Dordrecht, The Netherlands.

Barker, P.G., (1999). Using Intranets to Support Teaching and Learning, *Innovations in Education and Training International*, 36(1), 3-11.

Barker, P.G., (2000). Developing Teaching Webs - Advantages, Problems and Pitfalls, 54-59 in *Proceedings of the EDMEDIA 2000 International Conference on Educational Multimedia, Hypermedia and Telecommunications*, Montreal, Canada, edited by J. Bourdeau and R. Heller, Association for the Advancement of Computing in Education, Virginia, USA. (This paper is also available in electronic form at *http://www.philip-barker.demon.co.uk/edmd2000.htm.)*

Barker, P.G., (2001). Creating and Supporting Online Communities of Learners, 92-97 in *Proceedings of the EDMEDIA 2001 International Conference on Educational Multimedia, Hypermedia and Telecommunications*, University of Tampere, Finland, edited by C. Montgomerie and J. Vitali, Association for the Advancement of Computing in Education, Virginia, USA. (This paper is also available in electronic form at *http://www.philip-barker.demon.co.uk/edmd2001.doc*.)

Barker, P.G., (2002). On Being an Online Tutor, *Innovations in Education and Teaching International*, 39(1), 3-13.

Beckstrand, S., (2002). *A Comparison of Distance Education Delivery Methods in Southern Nevada*, PhD Thesis, University of Teesside, Middlesbrough, UK.

Beckstrand, S., Barker, P.G. and van Schaik, P., (2001). Towards More Independent Learning: a Southern Nevada Perspective, 106-110 in *Proceedings of the EDMEDIA 2001 International Conference on Educational Multimedia, Hypermedia and Telecommunications*, University of Tampere, Finland, edited by C. Montgomerie and J. Vitali, Association for the Advancement of Computing in Education, Virginia, USA.

Beckstrand, S., Barker, P.G. and van Schaik, P., (2002). Computer-Based Distance Education for Vocational Use in Southern Nevada, paper submitted to the *EDMEDIA 2002 International Conference on Educational Multimedia, Hypermedia and Telecommunications*, Denver, Colorado, USA.

Bennett, S. and Marsh, D., (2002). Are we Expecting Online Tutors to Run Before they Can Walk?, *Innovations in Education and Teaching International*, 39(1), 14-20.

Bernath, U. and Rubin, E., (2001). Professional Development in Distance Education - a Successful Experiment and Future Directions, 213-223 in *Innovations in Open and Distance Learning - Successful Development of Online and Web-Based Learning*, edited by F. Lockwood and A.Gooley, Kogan Page, London.

Duggleby, J., (2000). *How to be an Online Tutor*, Gower, Aldershot, Hampshire, UK.

Galpin, G., (2001) Exodus to E-learning, *Computer Bulletin*, Series V, 5(5) 28-29.

Jolliffe, A., Ritter, J. and Stevens, D., (2001). *The Online Learning Handbook*, Kogan Page, London.

Lockwood, F. and Gooley, A., (2001). *Innovations in Open and Distance Learning - Successful Development of Online and Web-Based Learning*, Kogan Page, London.

MacKenzie, N. and Staley, A., (2001). Online Professional Development for Academic Staff: Putting the Curriculum First, *Innovations in Education and Teaching International*, 38(1), 42-53.

Montieth, M. and Smith, J., (2001). Learning in a Virtual Campus: the Pedagogical Implications of Students' Experiences, *Innovations in Education and Teaching International*, 38(2), 119-127.

Salmon, G., (2000). *E-Moderating - The Key to Teaching and Learning Online*, Kogan Page, London.

Thomas, P., Carswell, L., Price, B. and Petre, M., (1998). A Holistic Approach to Supporting Distance Learning using the Internet: Transformation, not Translation, *British Journal of Educational Technology*, 29(2), 149-161.

Yazdani, M. and Barker, P.G., (2000). *Iconic Communication*, Intellect Books, Bristol, UK.

Distributed Internet2-Based Mission Training and Collaborative Research Using an Agent-Based Platform

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Abstract This paper describes approach, methodology, and potential application areas for agent technologies in Command and Control (C2) performance and primarily focuses on the development of agent-based constructed forces. The platform involved is the AWACS-AEDGE™. This is a distributed, real-time team decision support environment comprised of simulators, entity framework, intelligent agents and user interfaces. The AEDGE is constructed as a federation of intelligent agent-based functions that enable user-friendly scenario construction, emulation of friendly and hostile entities, and dynamic scenario control. Its architecture and decision making algorithms are examined, as well as agent technology and utilization in the realms of constructive forces, synthetic team members, and decision support.

Introduction

This paper describes the approach, methodology, and potential application areas for agent-based synthetic task platforms (STE) to enhance C2 performance, as exemplified in the AWACS-AEDGE™ . We focus particularly on the development of agent-based constructed forces and decision support to enhance C2 training and performance (Barnes et al, in review).

The Airborne Warning and Control System (AWACS) Weapons Director (WD) team serves as a vital airborne Command and Control (C2) node, providing airborne surveillance, control, and communications functions for tactical and air defense forces. It is clear that AWACS WD duties exemplify core characteristics of a C2 team. They perform in highly interdependent roles, tracking and coordinating some type of tactical action, in a manner consistent with overall strategic goals and procedures, for a defined sector of air and/or land space over a sustained period of time (Elliott et al., 2001). To accomplish this, they exchange, interpret and effectively weight information and optimize resource allocation decisions across team members. As a prime example of a command, control, and communications paradigm, the AWACS team is an area where C2 research has often centered.

The Air Force has recently focused on investigations and enhancement of operational expert training through an internet-based research infrastructure to enhance Distributed Mission Training (DMT). The USAF DMT program is national in scope, with the goal of enhancing operational training through the use of high-fidelity military simulation systems that are networked using secure, classified systems. The DMT-Research Net (DMT-RNet) project, the subject of this paper, is a local project that will support DMT through basic research accomplished using PC-based systems networked through the Internet. The project will establish an I-2 based infrastructure for collaborative research and training, along with identification of specific research issues related to enhanced skill acquisition and operational performance. This research will guide improvements in the operational USAF DMT training environment.

The USAF DMT project relies on a network of highly realistic battle simulators that allow expert operators to train in a virtual battlespace across a highly secure and classified communication network. In contrast, the DMT-Rnet project is developing less expensive PC-based systems that can run in unclassified mode on I-2. This allows the PCs to be distributed and deployed as training systems in almost any setting. It also allows research to be conducted in nonclassified environments, using these simulation systems that reflect essential components of operator expertise. For example, multiple universities and research companies can and have been networked to enable real-time multidisciplinary collaborative research.

As a pioneering technology, DMT-Rnet shows how other collaborations in research will be possible. Other universities, agencies, and companies will be able to link up to similar sorts of networks and pool their talents and resources to produce high level research. The applications of these concepts and technologies to other realms are nearly limitless, as future research will show to be the case (Barnes, Elliott, & Entin, 2001).

This research network has thus far developed two platforms. The initial phase of the DMT-Rnet project utilized the dynamic distributed decision making (DDD) team-in-the-loop simulation environment (Hess, MacMillan, Elliott, & Schiflett, 1999; Kleinman and Serfaty 1989). An internet-based version of the DDD was developed, the DDD Network (DDDnet), which allows players in distributed locations to connect and perform a distributed mission in real time. The DDDnet is an internet-ready version of a Linux-based collaborative gaming space that connects players to each other and to others, such as observers, confederates, trainers, or researchers. In the DDDnet observers at any location in the network are able to observe the scenario play in real time. They can view the screen display and electronic communications of any player, and communicate to one another via email or voice. In addition, the DDDnet can connect players to one another for interactive mission planning, debriefings and after-action reviews.

The second platform developed is the AWACS-AEDGE™ (Agent Enabled Decision Guide Environment). The AEDGE is constructed as a federation of intelligent agent-based functions that enable user-friendly scenario construction, emulation of friendly and hostile entities, and dynamic scenario control. The remainder of this paper goes into the detail of this platform and the agent technology that it employs.

It has been stated that advanced technology in itself is not a training system and should not be seen as a training solution (Salas, Cannon-Bowers, & Kozlowski, 1997). We are in complete agreement. The purpose of this effort was to build a platform with advanced-technology features that will augment, enable, and/or investigate new approaches, methods and measures in training and performance research.

AEDGE™ [1]

The Airborne Warning and Control System (AWACS) Weapons Director (WD) team serves as a vital airborne Command and Control (C2) node, providing airborne surveillance, control, and communications functions for tactical and air defense forces. In this paper, we describe development of an agent-based C2 team decisionmaking platform for research and training, the AWACS-AEDGE™ (Agent Enabled Decision Guide Environment).

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[1] AEDGE, AWACS-AEDGE, and 21CSI are registered trademarks of 21st Century Systems Inc.

The AWACS-AEDGE, built using 21^{st} Century Systems Inc.'s AEDGE™ infrastructure, is a distributed, real-time team decision support environment comprised of simulators, entity framework, intelligent agents and user interfaces (Barnes et al, in review). The environment supports a wide variety of air, sea (surface and sub-surface), and ground assets in a combat environment (Chiara & Stoyen, 1997), primarily based on the roles and responsibilities of AWACS WD team members. The environment has been tested with an excess of two hundred physical entities (planes, ships, SAM sites, etc.) operating with realistic yet non-classified performance characteristics in an interactive environment in which real-time decision support is available to each WD.

The behavior and decisionmaking of all hostile and friendly entities not controlled by humans is directed by agent-based technology. If a human decides to "log in" as a particular entity, he/she may choose to view recommendations generated by the agent for that entity. Even if the human operator chooses not to view recommendations, the agent recommendations are still logged by the computer. This enables direct comparison of human to agent decisionmaking. We expect these capabilities will facilitate skill acquisition, decision making, skills assessment, and human/team performance modeling.

AEDGE agent capabilities enable more detailed and innovative approaches to measurement and modeling of individual and team workload, communication and decisionmaking. Tracking the number and type of recommendations generated by the agent at any given time contributes toward new ways of conceptualizing and representing cognitive workload of individuals and teams. Agent-based recommendations may also serve as a standardized benchmark by which human tactics and decisions can be compared. In addition, the AEDGE platform can operate through speech – operators can speak to the system using predefined jargon, request tasks be performed or information provided/transferred, and the agents will respond verbally to the speech-driven requests, using voice generation technology. All agent communications to each other, as well as to humans, are transcribed, logged to data output files, and are available online.

The AWACS-AEDGE was conceived through cognitive and functional analysis of team member roles, responsibilities, and decisionmaking (Dalrymple, 1991), to optimize generalizability of results to operational settings. Systematic descriptions of AWACS roles, responsibilities, requirements, interdependencies, tactics, strategies, and task demands were collected from subject matter experts, cognitive task analyses (Fahey et al., 1998; MacMillan et al., 1998) and focal-group interviews (Elliott et al., 1999; Elliott et al., 2001). These data were examined to identify decision events, which were generic to performance, regardless of mission scenario, and likely to bottleneck under high tempo situations.

AEDGE architecture

The AEDGE product is based on an extensible distributed component-based architecture, which defines entities, agents, players/users, and their interactions. The interaction and communications among AEDGE elements are based on the Service Provider/Service Requester protocol (SPSRP), using flexible services and messages to exchange information among any two components.

In SPSRP, Service Providers implement a number of services and register service-templates with a Component Registry, which maintains the location of all components and the services provided or required by each. The registry is used by Service Requesters to locate components that provide the services required by the requester. After the requester is matched with one or more Service Providers, a direct connection is established between Service Providers and Service Requesters. This prevents the Registry from being a service dispatcher and a potential bottleneck. Let us consider the interaction between users (via user interface components) and agent components. In most cases users will interface with specialized Agents, called Agent Managers. The managers are designed to coordinate, synchronize and manage the work of multiple "worker" agents. Without an Agent Manager, the user will need to interfaces with each "worker" agent individually, while using the Manager, the user is able to issue higher-level requests (e.g. "Send me your current recommendations") by letting the Agent Manager (who knows the capabilities of its workers) to distribute and correlate individual agent tasks.

The Service Requester then sends Service objects directly to one or more Service Providers, who respond with ServiceResult objects. A Requester may wish to subscribe for service updates, in which case, the Service Provider will send a Message object to the requester every time it needs to advertise an update; it is up to the Requester to respond to that message by requesting the actual update (i.e. data is advertised, not pushed, to avoid client-side congestion).

The user may trigger a request for recommendations, which is sent to the Agent Manager via a Service request object. After receiving the request, the Agent Manager finds the best-suited collection of agents to perform the job (it may take one or more worker agents) and forwards specialized Service requests to each of them. The worker agents formulate their responses (usually, sets of recommendations and rationale) and send them back to the Agent Manager via ServiceResult objects. The Agent Manager may correlate (and even remove redundant or inconsistent recommendations) all service results and then sends the combined set of recommendations to the user, again via a ServiceResult object. The user interface component then knows how to extract the recommendations and present them to the human user for evaluation.

AEDGE decision making algorithms

The AEDGE architecture provides multiple levels of agent-based algorithms. Generic resource allocation, search and optimization algorithms are a core part of the AEDGE product. Each AEDGE application can use and further extend these fundamental agent algorithms by either providing parameters and applications-specific values, functions and rules, or by combining, modifying or supplying new algorithms. All new and modified algorithms must comply with a well-defined agent interaction interfaces, similarly to the generic algorithms.

The AWACS-AEDGE extends resource allocation, optimization and other algorithms with AWACS/WD-specific objective functions and constraints. For example, the AWACS weapon-target allocation algorithm, based on a generic resource-allocation with heuristic function evaluation, defines extended constraints such as Table 1.

Similarly, the AWACS weapon-target allocation algorithms define objective and cost functions for any potential allocation and let the generic allocator agent arrive at a (near-)optimal set of weapon-target pairings. The objective functions are based on the individual target values (as well as other factors, such as target priorities, probabilities for success and so forth) and cost functions are based on the risk for the team if the allocation is to be committed.

Further, the AWACS-AEDGE agents use the extended algorithms as a model of the desired. WD performance. Thus, the agents are able to generate a set of recommendations pertinent to a particular tactical position and the events that lead to it – agents do keep even history. Such recommendations can either be presented to the user (who may choose to accept or ignore them) or be used for internal evaluation of the user's performance as a function of the similarity of recommended-action versus actually-executed-action. A new application of the agent recommendation analysis involves the measurement of AWACS WD cognitive workload based on the volume and complexity of agent recommendations at any given time (Chaiken et al, 2001).

To enhance the utility of AWACS-AEDGE as a decision support tool, recommendations must not only be presented to the user in a unambiguous and intuitive manner, but in some cases they may need to be pre-processed to ensure that the human user can maintain strong situational awareness and be alert. For example, in periods of exceptionally high-activity, unsupervised agents may tend to generate large number of recommendations that will be confusing and even detrimental to the human performance. The Agent Manager must thus not only coordinate and synchronize recommendations, but also prioritize and reduce the number of presented recommendations to only the top-most critical ones (Chaiken et al, 2001). Conversely, in periods of lull, artificially increasing the number of recommendations may help keep the human alert and situationally aware.

```
        IN_RANGE(TargetCandidate,
WeaponCandidate ) OR
        INTERCEPT_TIME( WeaponPlatform,
TargetCandidate ) < MAX_TIME
AND
        Pk( TargetCandidate, WeaponCandidate )
> DesiredPk( TargetCandidate )
AND
        FUEL_TO_INTERCEPT(
WeaponPlatform, TargetCandidate ) +
        FUEL_TO_BASE( InterceptPoint,
WeaponPlatform ) < WeaponPlatform.currentFuel
```

Table 1: Decision Making Algorithms

Utilization

In the AEDGE, the experimenter can control the autonomy and configuration of the decision aide agent. If the agent is allowed to make all decisions, the scenario is effectively being run independently of any human intervention. This allows (a) assessment of reliability of recommendations, (b) assessment of effects of uncertainty in a dynamic environment, and (c) investigation of "what-if" scenarios, where algorithms underlying recommendations are manipulated.

The aide is, and should be, configurable. First, it needs to be configurable in order to maintain effectiveness. The manner in which decisions are made can and will change according to the particular mission scenario and rules of engagement. The software allows variations in its rule structure. It also allows changes (in real-time) to the perceived value and priority of various assets and targets. This enables fine-tuned research in decision process, as the agent can be tailored to be more or less risk-taking (when information is uncertain), have directional bias (more or less "aggressive", "passive" in threat assessment or rules of engagement), or bias in central tendency (decisions are always "moderate"). In addition the probabilistic nature of the environment can be manipulated by specifying the probability that the decision made will be successfully executed. When that probability is very high, the environment is deterministic and very reliable. When probabilities are lowered, scenario events will unfold in different ways, each time the scenario is run.

Configurable decision algorithms enable in-depth descriptive and prescriptive investigations of decision process. Particular heuristics, biases, and models of decision choice can be predicted and compared to algorithm function. Results from descriptive investigations can inform refinement of the decision tool. In turn the algorithm can be modified to reflect a particular decision model, and compared to other models with regard to the degree to which either model accounts for performance data. For example, threat assessment decision events have been shown to be sensitive to order effects, in that information presented first or last (depending on tempo) is given more weight, even when other information is more important. The algorithm can be adjusted to reflect this tendency, and results compared to actual data. Other facets relevant to the decision process can also be investigated with this approach, such as risk-taking, aggressiveness, and information uncertainty.

Discussion

Despite agent limitations, we expect the AWACS AEDGE™ to enhance research, training, and performance in complex high-tempo scenarios. The aide as decision support is particularly useful where multiple decisions must be made within a short time frame or where an "out-of-the-ordinary" event must be spotted among numerous seemingly normal processes. The aide has the advantage of complete reliability regardless of stress, sustained operations, or consequences of failure. It will never forget to refuel a plane because of a tense situation occurring at a different part of the scope.

While the usefulness of the DSS function is apparent, the potential utilization of this platform for training and performance research is its greatest asset. The benefits of this general approach to STE-based research is detailed elsewhere (Schiflett & Elliott, 2000). To summarize briefly, the AWACS AEDGE™ was developed to primarily to support trainers and researchers. In fact, every characteristic and feature within this platform was developed in order to empower trainers and researchers with regard to methods, measures, manipulations, and transfer of training. First, internal validity is enhanced by providing researchers with more detailed performance measures, increased scenario realism, ease in generating scenario events, agent-based performance models, and comprehensive data output files. In addition, further control is provided to team performance researchers through the provision of synthetic team members—thus allowing investigations of performance within more highly controlled team contexts. It provides trainers with online scenario revision capabilities and visual online performance feedback for operators. Finally, this system was developed to enhance external validity—the degree to which research transitions to the operational performance environment. This was accomplished through comprehensive cognitive task analyses of the operational performance domain. While use of this system is no guarantee of good training or research per se, we hope it will accomplish its purpose—to provide tools that empower experts to more easily accomplish research and/or training goals.

References

21st Century Systems Inc (2000). AWACS Weapons Director Trainer Tool: Phase II Final Report. Brooks AFB: Air Force Research Laboratory.

Barnes, C., Elliott, L. R., & Entin, E. (2001). Employing Internet2 Technology to Enable Collaborative Research and Distributed Training in Complex Multi-Operator Settings. WebNet Journal, 3 (4), 24-31.

Barnes, C. M., Petrov, Petrov, P. V., Elliott, L. R., & Stoyen, A. (In review). Agent based simulation and support of C3 decisionmaking: Issues and opportunities. Proceedings of the Conference on Computer Generated Forces and Behavior Representation, June 2002.

Chaiken, S., Elliott, L., Dalrymple, M., & Schiflett, S., Coovert, M., Riddle, D., Gordon, T., Hoffman, K., Miles, D., King, T. (2001). Weapons Director intelligent agent-assist task: Procedure and findings for a validation study. Proceedings of the International Command and Control Research and Technology Symposium, June, 2001.

Chiara, J. & Stoyen, A. (1997). Intelligent, adaptive research and training platform for individual and team training, with web capabilities and applications. Phase II SBIR Report AF971-018. Brooks AFB, TX: Air Force Research Laboratory, Warfighter Training Research Division.

Dalrymple, M. A. (1991). Evaluating Airborne Warning and Control System strategy and tactics as they relate to simulated mission events. (AL-TP-1991-0049, AD A242820). Brooks AFB, TX: Armstrong Laboratory.

Elliott, L. R., Cardenas, R., & Schiflett, S. (1999) Development and Analysis of Team-based Rating Scales Of AWACS Performance in Distributed Mission Training. Proceedings of the Annual Research and Technology Symposium on Command and Control, Newport, RI. June, 1999.

Elliott, L. R., Hollenbeck, J. R., Schiflett, S. G., & Dalrymple, M. (2001). Investigation of Situation Awareness and Performance in Realistic Command and Control Scenarios. In M. McNeese, E. Salas, & M. Endsley (Eds.) "Group Situational Awareness: New Views of Complex System Dynamics". HFES Press.

Fahey, R. P., Rowe, A., Dunlap, K. and DeBoom, D.(in review). *Synthetic Task Design (1): Preliminary Cognitive Task Analysis of AWACS Weapons Director Teams*. Technical Report. Brooks AFB, TX: Armstrong Laboratory.

Hess, S., MacMillan, J., Elliott, L., & Schiflett, S. (1999). Team-in-the-Loop, Synthetic Simulation: Bridging the Gap Between Laboratory and Field Research. Proceedings of the 43rd Annual Meeting of the Human Factors and Ergonomics Society, Houston, TX; 1999.

Kleinman, D. L. & Serfaty, D. (1989). Team performance assessment in distributed decision-making. Proceedings of the Symposium on Interactive Networked Simulation for Training (pp. 22-27), Orlando, FL.

MacMillan, J, Serfaty, D., Young, P., Klinger, D., Thordsen, M., Cohen, M., & Freeman, J. (1998). *A system to enhance team decision making performance: Phase I Final Report.* Brooks AFB: Air Force Research Laboratory, Warfighter Training Research Division.

Petrov, P. V., Stoyen, A. D. (2000). An Intelligent-Agent Based Decision Support System for a Complex Command and Control Application. In Proceedings of Sixth International Conference for Engineering of Complex Computer Systems (ICECCS'2000).

Salas, E., Cannon-Bowers, J., & Kozlowski, S. (1997). The science and practice of training—Current trends and emerging themes. In J. K. Ford, S. Kozlowski, K. Kraiger, E. Salas, & M. Teachout (Eds.) Improving Traiing Effectiveness in Work Organizations.

Schiflett, S. & Elliott, L. (2000). Development of Synthetic Team Training Environments: Application to USAF Command and Control Aircrews. In H. O'Neil & D. Andrews (Eds.) *Aircrew Training: Methods, Technologies, and Assessment*. LEA Press.

Technology and Collaboration: A Qualitative Study in one Secondary School in Botswana

Introduction

Technology use in Botswana schools is relatively new compared to many other parts of the world, and because of its financial implications the decision to implement it had to be weighed against many other pressing needs such as access to basic education, food and shelter. However, improving the quality of education is one of the top priorities for the country mainly because education has been heavily criticized for failing to better prepare students to work and participate in their society. In 1994, the Revised National Policy in Education (RNPE) was released and the policy stated that computers be introduced in schools so as to help enhance learning and also help the country it its transition from an agro-based economy to an industrial one. Computers in Ledumang were introduced in 1997. These computers are used for different purposes. There is a course called Computer Studies, taken by only a few students because of the limited number of computers. The course is aimed at equipping students with different computer skills that would be useful for them once they leave school. Computers are also used in different subjects to assist learning.

Purpose of study

The purpose of this study was to investigate the kind of learning that takes place when computers are used, and also find out the roles that both the teacher and students play in the classroom.

Significance of study

Computers have been introduced in schools as an effort to improve learning and one of the ways through which we can find out if this is happening is by examining how students and teachers interact with these computers. Such knowledge is very useful for educators in determining whether technology is playing any beneficial role in education.

Description of site.

The school under this study is called Ledumang Senior Secondary School. The school is located in Gaborone, which is the capital city of Botswana. Students going to this school are doing four and five, which are the last two grades of high school. Students in this school come from diverse educational background in terms of computer use. Some come from junior high schools which used computers, some had used computers during their primary or pre-school education, and some have had no experience with computers at all.

Method

This study engaged qualitative methodology of in-depth interviewing and participant observation to collect data. Interviews were conducted among students, teachers, headmaster and officials from the Ministry of education. Each interview lasted for about 30minutes. The total number of participants in this study was 25. There were 15 students, 6 teachers, 1 headmaster and 3 officials from the Ministry. Observations were also made in computer-assisted classrooms while in session to get a better feel of what is happening in the classes. The study was done over a period of two months June 2001 to August 2001.

Findings of the study

Participants in this study reported a more changed environment in the classroom when technology is part of learning. Teachers reported that students are more excited and enthusiastic to learn. Collaboration came up as the most reported effect of computers in the classroom. The teachers mentioned that even though each student has their own computers to work at, they still spend a lot of time working with each other and learning from each other. Students enjoy watching over each other's work and finding out how they do things. Most of the time students prefer to ask their classmates if they do not understand something rather than ask the teacher. The teacher just acts as a facilitator in the classroom. One teacher said "I think it is good when students work together and like this and learn from each other, but I also have to make sure that things do not go out of hand. I have to make sure that they stay on the job and do not just play around and I also have to make sure that they do not mislead each other. I encourage them to check with me if they are not very sure of what their classmates are telling them." The students on the other hand expressed that they enjoy working with computers because they are kept so busy and the teacher allows them to freely talk with each other, do things together, which is not always something they do in other classes.

Collaboration is also enhanced outside the classroom and school premises. The teachers report that they have put up an e-mail system for students to communicate with students in other senior secondary schools in the country to discuss their work. Students also communicate with other students in the United Kingdom, which they find very exciting. This gives them an opportunity to bond with students in other parts of the world and learn from them.

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Another significant way in which collaboration is fostered is through the final project that is done by form five students. At the end of their senior secondary education, students write final examinations, which mainly determine their acceptance into institutions of higher education or work places. As part of these examinations, students doing computer studies have to do a project in which they consult with local companies or government agencies and together with the help of the teacher, identify a problem that they would like to tackle and use computer simulations to work out the solution. Students work on this project pretty much for the whole year. During the whole process, students work closely with the teacher and the companies they are working for. Students get grades for this work and they also have to present their solutions to the companies and discuss their findings. This gives students a great opportunity to interact and collaborate with other people outside their school environment. It also helps to narrow down the gap between school knowledge and the outside world. In this way students can make a connection between what they learn at school and what is happening outside. The companies even hire some of these students.

Conclusion

Collaboration is enhanced when students are encouraged to work with each other. They learn to respect each other's opinion and take criticism. These are some of the qualities that they would need once they enter the world of work. Taking learning outside the classrooms or even school premises is very important in helping students see the connection between what they are doing and real life. The teacher play a crucial role in directing this kind of learning and students on the other hand take a big responsibility for their learning.

References:

Ager, R. (1999). Information and communications technology on Primary schools. London: David Fulton Publishers.

Barnett, H. (2000). Assessing the effects of technology in a standards-driven world. Learning and Leading with Technology 27.7, 28-32.

Botswana: a cursory glance. (1999). (On-Line). Available: http://www.saide.org.za/worldbank/countries/botswana/ministry.htm

Busang, C., & Oabile, O. (2000). A Botswana Information and Communications Technology (ICT) Educational Development Perspective (A paper presented at the SCHOOLNET AFRICA Conference, held in Namibia).

Farrell, G. (1999). Technology, education and development. San Francisco: Opinion article 17.

Nleya, P. (1998). Improving computer literacy of young people: the case of Botswana. T.H.E. Journal, 6, 53-54.

Republic of Botswana, Revised National Policy on Education, Government Paper No.2. (1994). Gaborone, Botswana.

Republic of Botswana: National Development Plan 8 1997/98-2002/2003
Gaborone: Government Printer.

Report of the National Commission on Education (1993) Gaborone: Government Printer.

Republic of Botswana, Central Statistics Office, Education Statistics (1994). Gaborone: Government Printing and Publishing Services.

Beyond W3C: TruVision - Enhanced Online Learning for People Blind Or Vision Impaired

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Abstract: This paper describes the design and development of TruVision, an online learning environment designed to enable blind and vision impaired students to develop skills and expertise in elementary and advanced information processing strategies to enable them tom seek full-time employment within industry in such positions as administrative assistants, Help Desk personnel and data entry operators. Truvision is a product within The Flexible Learning Toolboxes Project, a component of the Australian Flexible Learning Framework for the National Vocational Education and Training System 2000-2004 (AFL Framework). The AFL Framework is designed to support the accelerated take-up of flexible learning modes and position Australian VET as a world leader in applying new technologies to vocational education products and services. This paper describes the TruVision product and showcases its innovative design based on very stringent accessibility needs and guidelines.

Introduction

Online learning environments in higher education are frequently criticised for their failure to make the most of the opportunities afforded by the new technologies (eg. Dehoney & Reeves, 1999). Too often the design of the settings is constrained by such practical factors as inflexible delivery systems, the need for converged on and off-campus settings, and the quest to generate on-line courses from existing print-based materials. Rarely do developers have the opportunity, the direction and the support to plan and build high quality online learning materials. One project in Australia, however, that differs from others in this regard, is the Flexible Learning Toolboxes Project (ANTA, 2001).

The Toolbox initiative is part of the Australian Flexible Learning Framework for the National Vocational Education and Training System 2000-2004 (AFL Framework). The AFL Framework is designed to support the accelerated take-up of flexible learning modes and position Australian VET as a world leader in applying new technologies to vocational education products and services (EdNA VET Advisory Group, 2000). A Toolbox is a collection of resources, suggested learning strategies and supporting material for the online delivery of vocational education and training. The learning resources are Web-based and designed in a manner which facilitates customisation and reuse in the National Training Framework, the basis of qualifications and accreditation in the Australian VET sector.

Flexible Learning in the VET sector

National and state authorities responsible for VET within Australia have recognized for some years that developing online materials is expensive and best achieved through a collaborative approach. It was this challenge that prompted the Australian National Training Authority (ANTA) to consider strategies that could motivate and support registered training organisations (RTOs) to embrace modes of flexible delivery for their students. A resource strategy was formulated by which sets of generic and customisable materials could be developed and applied widely throughout the training sector. The intention was to create efficiency and economies of scale though large scale production of learning materials capable of wide acceptance and use. This plan became the ANTA Flexible Toolbox Project which has evolved since 1999 into the Flexible Learning Toolbox Project of today. The Toolbox initiative was a strategy to encourage development and delivery of more flexible learning materials for the training market – particularly for online learning.

Flexible Learning Toolboxes

The phrase "Training Package" has a specialised meaning in the Australian VET sector, referring to a nationally endorsed statement incorporating the competency standards, assessment guidelines and qualifications relating to training in a particular industry sector. These components are uniform at a national level but allow for a range of flexible training pathways for achievement and assessment.

The introduction of Training Packages within the National Framework in 1998 provided a perfect opportunity for the Australian National Training Authority to explore the concept of Flexible Toolboxes to support learning. In the first instance, any products developed in this setting would have widespread application providing significant economies of scale. Secondly the use of on-line technologies appeared to provide and promote the many forms of flexibility associated with the delivery of the Training Packages in the national setting.

The Flexible Learning Toolbox Project has carried three main development stages to date, from Series One in 1999 to the recently completed Series Three. Developers bid for funding to build Toolboxes from funding managed by the Flexible Learning Advisory Group (FLAG), a committee with strong interest and expertise in flexible delivery in the VET sector. Teams and consortia work together to develop bids to build online learning resources for qualifications within the national Training Packages. Teams are required to demonstrate strong links with the industry groups and to propose online materials that demonstrate evidence of sound contemporary learning designs and development processes that create materials with high levels of product utility. The following descriptions from the developers' guidelines highlight these aspects of Toolbox design:

a. Toolbox learning designs

A fundamental requirement of Toolbox resources is the need to exhibit effective teaching and learning approaches. To support this requirement, proponents need to demonstrate their capacity to develop resources with the following features:

- *a firm basis in an educational model which recognises an active, constructive role for learners;*
- *learning activities which engage the learner in active processing of the subject matter rather than mere knowledge acquisition;*
- *learning settings and tasks that encourage meaningful online communication and interaction (between learners as well as between teachers and learners);*
- *content resources which are visually attractive, motivating to use and organised logically for ease of navigation; and*
- *representations of authentic and real life settings in preference to textual descriptions.*

b. Toolbox product utility

A second important consideration concerns product utility characteristics. Toolboxes are expected to allow for wide applicability across the target audience for whom they are intended. For this reason they are expected to be flexible, portable to a range of delivery platforms, and readily customised. Desirable characteristics include:

- *the use of readily available non-proprietary development software;*
- *the use of HTML code where customisation can be anticipated, with more sophisticated development software (eg Flash) reserved for components that are unlikely to be changed;*
- *the development of platform independent resources which allow for maximum portability to users' delivery platforms;*
- *avoidance of rigid structuring devices locking the learner into one pathway through the material (although a suggested learning sequence may be desirable); and*
- *a file and directory structure that facilitates the location of a particular learning segment, or the selection of a single unit as well as the use of the whole Toolbox.*

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Toolboxes are also expected to be widely accessible. They are expected to operate on client computers running at 300 MHz and guidelines are provided to developers for aligning the Toolboxes with:

- *the EdNA metadata standards;*
- *the W3C content accessibility guidelines (Priority 1); and*
- *the Preferred Standards Project.*

TruVision

TruVision (http://www.elearn.wa.edu.au/truvision) is one of six ANTA Equity and Access Online Product Development projects commissioned in 2001. It is an online learning environment that has been designed to offer on- and off-line options in the vocational education sector for learners who are blind or vision impaired. Through the establishment of a simulated Help Desk entity, TruVision provides a variety of authentic, work-based online learning experiences that prepare learners for vocational outcomes in the IT industry. IT Help Desk occupations are particularly attractive to people with a visual disability.

The framework that was used to inform and guide the instructional design process is a component model, described in Table 1, which comprises three elements which represent critical components of any learning settings. In particular, the framework highlights connections and distinctions between the elements which can be made in the design of online learning settings (Oliver, 1999).

Table 1: Framework describing critical elements of online learning settings

learning design elements	**description**	**examples**
learning activities	The tasks, problems, interactions used to engage the learners and upon which learning is based	Reading activities, computer-based interactions, simulations, inquiry tasks, projects, open-ended problems, inquiry tasks, collaborative tasks
learning resources	The content, information and resources with which the learners interact in completing the tasks	Web pages, readers, textbooks, computer-based tools, Web links, notes, documents, workplace manuals, case studies, databases
learning supports	The scaffolds, structures, motivations, assistances and connections used to support learning	Learning guides, discussions, chats, suggested learning pathways, mentors, buddies, workplace trainers

The framework provides a means to isolate and study the various elements within learning settings and suggests emphases which can be made in the instructional design process. Contemporary learning theories posit that the forms of learning design most appropriate to higher education are those based on constructivist learning principles. The above framework takes on particular and discrete forms when applied this way.

In the context of the instructional design for the TruVision setting, authentic tasks were used as the organising framework for the learning process. Students are provided with realistic and relevant tasks which they are required to complete. In order to assist them in completing the tasks, a range of learning resources and scaffolds for learning are provided. The learning setting is comprised of these carefully chosen learning tasks and learning supports to scaffold learners as they undertake them. The content in the setting takes the form of a variety of learning resources which are organised within the virtual office setting in much the same way as the learners will find resources in the workplace.

Design Considerations

With most online settings, the instructional design precedes any decisions about interface design. In this product, it was essential to marry the two so that the learning setting would provide the accessibility required. The design of TruVision needed to go beyond compliance to W3C standards alone. In its final form, it provides an audio and text-based interface for people that are totally blind so that they can hear the learning context and interactions through a combination of screen reader and streamed audio. In addition, TruVision interprets this audio and text-based interface with a graphical version for people with vision. In this way, two versions of the learning environment are provided on each and every web page, both of which are invisible to the other. The concept is represented as Figure 1.

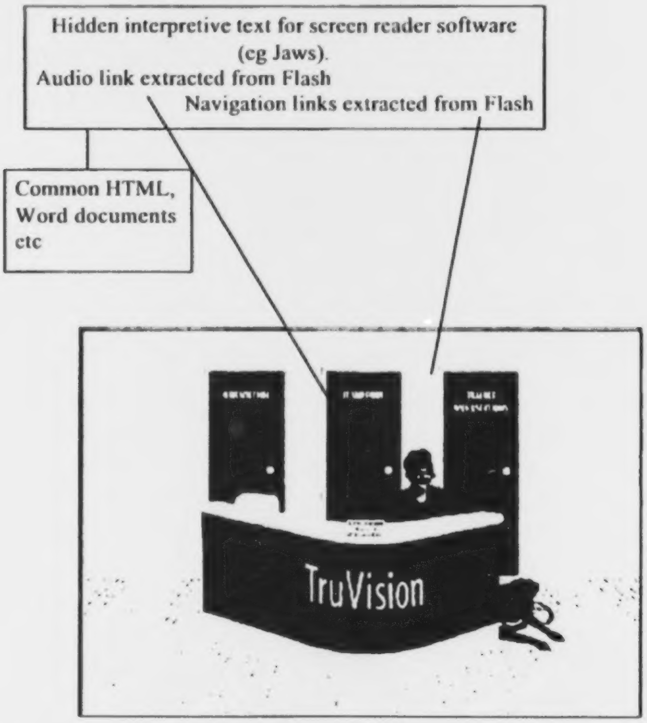

Hidden interpretive text for screen reader software (eg Jaws).
Audio link extracted from Flash
Navigation links extracted from Flash
Common HTML, Word documents etc
TruVision

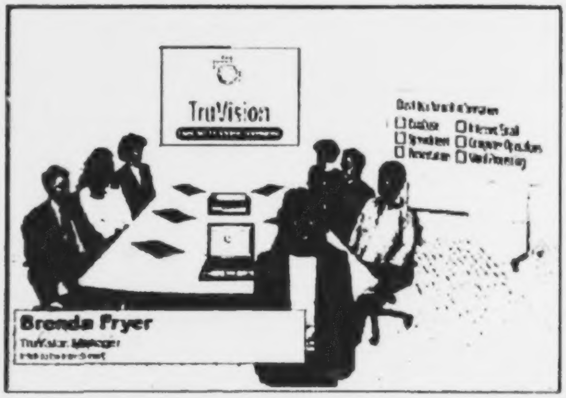
Figure 1: The TruVision Design Model

The TruVision Setting

The task of designing for the range of vision impairment and adaptive technologies was complex. The following sections of the paper explain the design considerations underpinning TruVision, and demonstrate how educational design decisions were taken.

Figure 2: Authentic learning tasks

TruVision is a learning environment based around authentic tasks. The learners find themselves immersed in a virtual workplace and undertake tasks and activities which accurately reflect how they will need to apply their learning in the workplace. Assessment, activities and resources are closely aligned with the learning outcomes that are sought.


TruVision
Brenda Fryer

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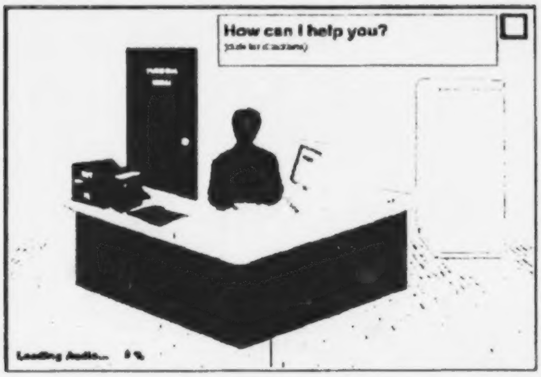
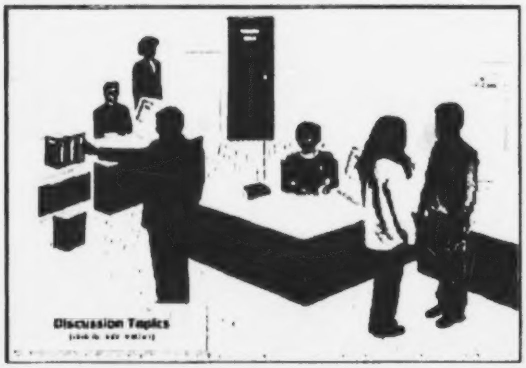

How can I help you?
Loading Audio... 0 %

Figure 3: Rich media usage
In order to provide accessible materials for blind and vision impaired learners, the setting makes extensive use of audio and visual materials to cater for the range of people that are vision impaired. The learners use the site with the same tools and processes that vision impaired people currently use in workplace settings.

Figure 4: Customisation and Reuse
The learning setting has been designed and built for customisation and reuse. There are many elements within to support this application including a comprehensive Teachers' Guide to assist others to implement TruVision. The Teachers' Guide provides a range of suggestions and strategies to help facilitators balance content and collaborative dimensions of online learning.


Discussion Topics

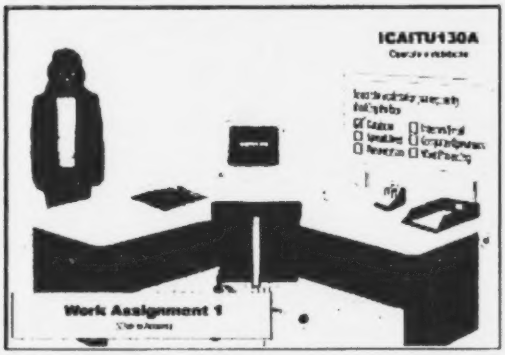
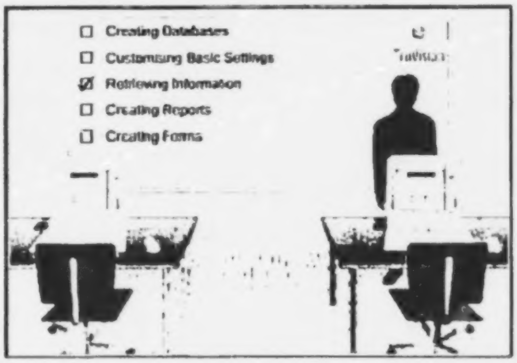

ICAITU130A
Work Assignment 1

Figure 5: Assessment
The learning setting includes a range of assessment activities to support independent and classroom learning usage. The assessment tasks include a range of formative and summative strategies as both supports and scaffolds for learning. The assessment tasks also provide strong measures of competence and achievement of course aims through the authentic tasks on which they are based.

Figure 6: Flexible use
TruVision has been designed in ways which will support a variety of instructional applications and able to support learners with a range of learning styles. The flexible nature of the setting with a separation of learning tasks, learning resources and learning supports makes it a tool that can be adapted to suit the needs of a broad range of learners and their preferred learning styles.


☐ Creating Databases
☐ Customising Basic Settings
☑ Retrieving Information
☐ Creating Reports
☐ Creating Forms
TruVision

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User-Testing

The development of TruVision was accompanied by a rigorous and comprehensive program of usability testing to ensure the product was able to meet the needs of the diverse target audience (eg. Nielsen, 1993). A comprehensive user-testing program was undertaken as part of the design process and feedback was gathered from learners in a variety of contexts. These include learners using screen readers, screen magnification software and with learners who were using no adaptive technologies at all. This program was undertaken in collaboration with:

-The Association for the Blind of WA (Inc)
-The Royal Blind Society (NSW)
-The Royal Victorian Institute of the Blind

Coupled with the usability testing was a series of formative assessments to explore the success of the learning environment among learners who were unaccustomed to online and computer-based environments. More comprehensive testing and evaluation of the learning setting is being planned to enable its capability to serve the diverse audience to be more fully explored. This testing will also explore strategies which will enable the learners to undertake collaborative and communicative tasks and to enjoy the enhanced learning opportunities that these strategies afford sighted learners.

Conclusion

The TruVision project is going a long way to be meeting the expectations of the stakeholders in terms of innovative and accessible design. Initial feedback from learners and teachers suggests that it is a successful learning setting for the target audience and that it provides a valuable template for sound educational practice coupled with accessibility for other online product development to follow.

References

ANTA (1998) *A bridge to the future: Australia's National Strategy for Vocational Education and Training 1998-2000,*. Australian National Training Authority, Brisbane.

ANTA, (2001). *Australian Flexible Learning Framework for the National Vocational Education and Training System 2000-2004*. Brisbane, Queensland. Australian National Training Authority.

Australian Flexible Learning Framework (2001). http://www.flexiblelearning.net.au [accessed: Dec 2001]

Dehoney, J., & Reeves, T. (1999). Instructional and social dimensions of class web pages. *Journal of Computing in Higher Education, 10*(2), 19-41.

Eccles. C., (1998) *A New Training Culture for Australia: The Right Stuff*, Australian National Training Authority, Brisbane.

Nielsen, J. (1993). *Usability Engineering*. Boston: Academic Press.

Oliver, R. (2001). Seeking best practice in online learning: Flexible Learning Toolboxes in the Australian VET sector. *Australian Journal Of Educational Technology, 17*(2), 204-222.

TruVision (2002). http://www.elearn.wa.edu.au/truvision

Utilizing the PDA as a Vehicle for User Interface Design Pedagogy

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Abstract

As computing and embedded systems become ubiquitous in our world, the importance of user interface design knowledge increases in our curriculum. Students of undergraduate information systems or computer science programs should possess some competence in this computing sub-discipline. However, many programs do not have the curricular space to host a separate course in usability or user interface design. To address this concern, results and observations of incorporating user interface design pedagogy in the context of a software engineering project course are presented. The project centers around a data collection application to be hosted on a PDA (Personal Digital Assistant). The application has significant constraints concerning usability and human factors that provide a rich context for teaching and demonstrating user interface design concepts.

Keywords: user interface design, usability, ergonomics, software engineering, laboratory course, PDA.

1. INTRODUCTION

While change in computing seems inevitable, educators continue to wrestle with the problem of packing more topics into a finite curricular space. Therefore, an approach that has gained momentum is to integrate some topics into the fabric of courses rather than creating individual courses for each topic [Johnson 1997]. In this work, we will investigate the goals and outcomes of integrating user interface design pedagogy into a traditional software engineering course. Specifically, we will look at the benefits and detriments of utilizing the Palm PDA platform as the focus of a semester-long student project.

The software engineering course for this project is a four-credit course taken during the senior year of a traditional undergraduate program in Computer Science. A significant component of this course is the semester long project. The project allows students to work in teams of no more than three students. The four phases of the project are: requirements specification, design specification, implementation, and test plan design and execution. Thus, the teams have the benefit of seeing a project through many typical phases of a software lifecycle.

Of particular interest is the utilization of the Palm OS® platform as a vehicle to reinforce fundamental user interface design and software engineering principles. This project concept has been employed for two consecutive academic years. The students have a background in Java/C++ programming, but no prior experience with the Palm OS® platform. The implementation and testing phases require the use of the Metrowerks CodeWarrior® IDE, which supports C++ for the Palm OS® [Rhodes 1999].

2. USER INTERFACE DESIGN GOALS

The software project in this instance is a basketball statistics data collection program for the Palm IIIc and Palm IIIxe PDAs. The program must allow a novice Palm user to track basic statistics (e.g., field goals attempted/made, personal fouls) on an individual player and team basis during the fast-paced action of a live NCAA basketball game. Therefore, the program's interface must be simple, minimize the user's memory load, provide intuitive short cuts, allow for easy reversal of actions (e.g., undo), and prove to be reliable in the real-time setting of a basketball game. Participants are given the opportunity to test their product at an actual NCAA Division II basketball game during the final week of classes of the fall semester.

During lecture, students are given the opportunity to dialog on a number of outside resources related to user interface design. Students are exposed to a variety of literature, some from the popular press [Carlton 1994] that illustrate, often in a very humorous fashion, the broad range of expertise that is common among users. Students are also given supplemental material from the traditional user interface design discipline [Shneiderman 1998, Nielsen 1993]. The following concepts are presented in this segment of the course:

- Prototyping
- Parallel Design
- Know the User
- Heuristics for Interface Design
- Usability Testing.

The students are required to develop interface prototypes as part of their requirements and design specification documents. The value of this has many facets, not the least of which is the reinforcement of demonstrating an iterative design process. Thus, we see an effective interface developing over time rather than developed in its entirety the first time. Furthermore, since each team is developing a unique interface, students may then compare designs prior to implementation in order to see the benefits of participating in a parallel design. Related to this point is the need for the instructor to communicate a relaxing of the traditional standards of academic dishonesty (i.e., we encourage the participants of this course to share ideas and to incorporate the "best of class" into their own implementation).

Classical user interface design pedagogy invariably includes the novice/expert user continuum. To apply this knowledge, students are encouraged to consider the attributes of the typical user of their system. Basketball scouts are typically assistant coaches who are novice Palm users that will use the system on an intermittent basis. Thus, many of the heuristics discussed in the course are applicable.

Simplicity of the interface is essential. For starters, the typical PDA does not provide an abundance of display real estate. Secondly, all game time features need to be placed on a single screen (navigating multiple screens during the fast-paced action is too burdensome). Student-developers are also encouraged to provide informational feedback, minimize the user's memory load, and provide consistent short cuts where possible. Given that users will invariably make input mistakes, the system must allow for the easy reversal of actions as well. The system also provides the opportunity to emulate direct manipulation versus indirect manipulation as developers are encouraged to minimize user input via Graffiti® in favor of stylus input (potentially integrating an error prevention strategy into the interface design).

The course introduces students to the differences between utilizing heuristics for user interface design (as discussed above) and actual usability testing. Although students don't typically have the time typically (nor the inclination) to recruit human subjects for usability studies, they are encouraged to give their system to a non-CS student for review. The process of looking at a software system's interface through someone else's eyes is an enlightening experience for many.

3. SOFTWARE ENGINEERING GOALS

The software engineering course that is the focus of this research is in many ways traditional. We utilize a well-known text [Pressman 2001]. We teach a variety of process models, paradigms, and techniques with an eye toward balancing theory with practice. However, after ten years of teaching this course, we have found that some unique aspects of our Palm OS® project illuminate certain lessons that are historically difficult to reinforce beyond telling (i.e., our assumption is that telling is not teaching and that students will embrace that which they self-discover through practice). Those lessons are:

- Difficulties of software maintenance
- Learning new tools/platforms
- Differentiating essential from accidental
- Applicability of non-technical skills
- Working in a team environment
- Dealing with non-contrived constraints.

The Palm project in this course gives many students their first hands-on experience with software maintenance. For most of them, the project represents their first attempt at modifying a non-trivial program written by another developer. This is accomplished with the students being given a base Palm C++ project as a jump-start. The base program includes over 1400 lines of C++ spread over four classes. The original motivation was that a typical Palm application was deemed too large for undergraduate students to develop in the context of a one semester course, given that they must develop requirements and design specifications before commencing with implementation. Students have typically added another 500 to 1,500 lines of C++ to the base project. Post semester student assessments have shown that at the conclusion of the project, students say they would prefer to write their own application as opposed to maintaining code written by someone else. Thus, we have achieved a significant learning outcome by allowing students to self-discover the hardships of software maintenance.

The Palm project also provides students with the opportunity to apply their knowledge of object-oriented software development to a novel target platform. For all of the students to date, this represents their first exposure to the Palm OS® Metrowerks CodeWarrior® development environment. Although the learning curve for a new tool causes a certain level of anxiety in most of us, the experience creates a nice backdrop to discuss the differences between the essential and accidental activities for a software project [Brooks 1986]. Thus, we are able to highlight the essential nature of many non-technical skills such as writing and speaking. Since the project includes written documents (requirements, design, test plan) in addition to source code, students are able to see first hand the essential nature of effective communication. The potential pitfalls of communication are further highlighted, some might say exacerbated, by virtue of the fact that the students work in teams.

Perhaps the most beneficial attribute of a learning experience is creating an enthusiastic atmosphere. We have found that the combination of a novel platform and a believable application provides students with enthusiasm in that they see the project as more "believable" than others that may have been contrived in the past. At the start of the term, students are shown a commercial Palm OS® application for tracking football statistics. The real-time differences between football and basketball game situations provide a nice scenario for discussing usability issues. Center stage in this discussion is the fact that football provides frequent, short breaks in the action that basketball does not permit. Fortunately, college students are almost universally aware of the differences between the games, although the presence of international students provides a ready reminder of cultural issues in software design. Thus, the elaborate multi-screen interface in the football scouting application is insufficient in this case.

4. DIFFICULTIES & DISTRACTIONS

Without question this project provides some hurdles that every team mentioned in their post-mortem survey:

- Limitations of the Palm screen
- Lack of implementation tools
- Frustrations with maintenance.

Due to a combination of the usability demands of the application and the limited screen size on the Palm III, all development teams concluded that the challenges in user interface design were more significant than they had faced previously. Specifically, participants noted that buttons needed to be large enough to tap accurately, yet not so large as to chew up too much screen real estate. On a related note, teams also mentioned that they were challenged to come up with meaningful abbreviations for each button (e.g., "FreeTAtm" or "FTA" as an abbreviation for "free throw attempt"). For these reasons and others, the use of the PDA in this course provides a pedagogical platform that allows students to deal with interface design issues that are commonplace among practitioners.

Every team lamented the fact that they were limited to the C++ programming language and the CodeWarrior® IDE. Participants are accustomed to a richer set of interface development tools such as JBuilder® or Visual Basic®. Previous work has considered user interface design in the context of the PC [Battig 2000]. However, the PDA target environment is significantly different from the PC. For starters, the resources of memory (both primary and secondary) and processor are significantly less on the PDA. Secondly, the PDA development platform has not been around for over two decades like the PC and thus has not been the recipient of the sophisticated tools that accompany such tenure. The result is that students are given the opportunity to learn a new development platform during development in much the same way as practitioners do routinely.

On the post-mortem surveys, a majority of teams indicated that they would have preferred to develop their own application from "scratch" instead of maintaining an existing one. For most, this is the first exposure to the tyranny of software maintenance. Professional developers experience this frustration more than some care to admit. However, the constraints of the marketplace do not usually permit developers to take the time and money to build new systems, even when it seems justified from their perspective. Therefore, the project has the benefit of demonstrating to participants the difficulties inherent in software maintenance.

5. CONCLUSION

The results and observations of using the PDA platform to teach user interface design and implementation to undergraduate computing students include many benefits. Students are confronted with usability obstacles that are more challenging than most they have faced to date. For example, several project teams labeled their player buttons in sequence (from 1 to 5) instead of using the player jersey number. This example provides a poignant application of reducing the user's memory load. Although usability heuristics like this are commonly taught, one final attribute of this project merits discussion. Because the PDA platform is fairly novel (i.e., most students own a PC, but none of the participants own a PDA), it provides a "gee-whiz" factor that increases student motivation. In other words, students are more enthusiastic participants and learners in a project that they perceive is using cutting-edge technology.

The project also addresses many software engineering issues that present problems for pedagogues. Because this project is larger than the typical student project (several thousand lines of code), it presents issues of software engineering that are hard to expose in the classroom and yet are common in practice [Dawson 1997]. Chief among the software engineering issues is the difficulty associated with software maintenance.

Most computing curricula [ACM 1991, AITP 1997] recognize the importance of user interface design. However, many undergraduate programs do not have the freedom in the curriculum to include a separate course in user interface design. Therefore, the benefits of teaching usability issues in a related course (such as software engineering) prove compelling. As an added benefit, project participants begin to see the important ways in which many usability heuristics are integrated into the fabric of user interface design, software implementation, and human relationships.

6. REFERENCES

ACM/IEEE-CS Joint Curriculum Task Force, Computing Curricula 1991, 1991 http://www.computer.org/education/cc1991.

AITP, IS'97 Curriculum Model for 4 Year Undergraduate Programs in Information Systems, 1997, http://www.is-97.org. Battig, Michael E and Ron

Sobol., "Migrating a Traditional Network and Data Communication Laboratory Course to an Information Systems-Friendly Environment," 2000, Proceedings of the Information Systems Education Confernece.

Brooks, Frederick P., "No Silver Bullet-Essence and Accident in Software Engineering," 1986, Proceedings of the IFIP Tenth World Computing Conference, pg. 1069-76.

Carlton, Jim, "Befuddled by PCs, Users Call for Help," 1994, The Wall Street Journal.

Dawson, Ray and Ron Newsham, "Introducing Software Engineers to the Real World," 1997, IEEE Software, vol 14, no. 6, pg. 37-43.

Johnson, Hubert A., "Integrating Software Engineering into the Traditional Computer Science Curriculum," 1997, SIGCSE Bulletin, vol. 29, no. 2, pg. 39-53.

Nielsen, Jakob, Usability Engineering, 1993, Morgan Kaufmann.

Pressman, Roger S., Software Engineering: A Practitioner's Approach, 5th Ed., 2001, McGraw-Hill, Inc.

Rhodes, Neil and Julie McKeehan, Palm Programming: The Developer's Guide, 1999, O'Reilly & Associates, Inc.

Shneiderman, Ben, Designing the User Interface: Strategies for Effective Human-Computer Interaction, 3rd Ed., 1998, Addison Wesley Longman, Inc.

APPENDIX

To give the reader a better understanding of the data collection application and user interface employed in this project, this section will highlight the evolution of the actual interface developed by one of the development teams. The user interface design changes were the result of feedback that students received from four sources: course materials on usability, direct instructor feedback, fellow classmate feedback, and outside-the-course student feedback.

Figure 1. First Prototype User Interface

Figure 1 shows the first interface implemented. This interface has numerous deficiencies. The most glaring is the memory load placed on the user to associate players on the floor with the numbers 1 through 5. Figure 2 shows the improved interface with jersey numbers providing a more natural approach. Note also that the improved version provides the ability to reverse previous actions via the "Undo" button. The latter interface includes features for two teams instead of just one. The developers of this interface also incorporated some feedback on usability to change the abbreviations used on the buttons. Notice that the abbreviation for a three-point shot attempt changed from "3pa" to "3ptAtm."

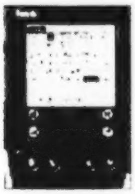

Figure 2. Revised User Interface

The revised interface in Figure 2 also provides buttons for substitutes ("Subs") and summary of statistics ("Report"). Screen shots for these features are shown in Figures 3 and 4 respectively. To make a substitution, the user clicks a player currently on the floor and a player currently on the bench and then clicks "Sub." Figure 3 shows that Johnson will be coming off the bench as a substitution for Strickland. Lastly, Figure 4 shows the summary statistics collected for Team 2. These statistics may also be viewed on an individual player basis.

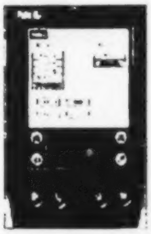

Figure 3. Substitution Screen Shot

Interested readers my access the syllabus for this course on the author's web site: http://personalweb.smcvt.edu/mbattig/CS407%20Syllabus.htm

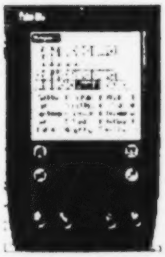

Figure 4. Summary Statistics Screen Shot

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Media Combinations and Learning Styles: A Dual Coding Approach

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Abstract: This paper reports initial results from a study which investigated if different media combinations could be shown to improve students' understanding of computer-based learning materials and to determine whether student learning style affected student understanding for different media combinations. Three groups of participants were given a presentation, each using different media combinations to present a topic. Dual coding theory was used as the basis for designing the presentation. Results indicate that participants' understanding was enhanced when the computer-based learning materials were presented using sound and diagrams. Understanding was worse when materials were presented using text and diagrams. The result supports the predictions of dual coding theory. Furthermore, the results indicate that the sound and diagram combination can improve participants' understanding regardless of their preferred learning style, and that intuitive learners seem to be exceptionally volatile to different media combinations.

Introduction

Many researchers of educational technology agree that learning materials should be designed for all types of learners, and learning styles, not just reflect the tutor's style of teaching (Felder, 1996). An effective way of achieving this is by using multiple media to target combination of media on the different styles of learner. There are many studies about the effectiveness of multimedia and learning styles in educational systems, but very few give an insight into why some combinations of media are more effective than others (Najjar, 1996). One theory that does provide such an insight is Dual Coding theory (Paivio, 1971, 1986).

According to Paivio's (1971, 1991; Clark and Paivio, 1991) dual coding theory, information is processed through one of two generally independent channels. One channel processes verbal information such as text and audio and the other channel processes visual information such as diagrams, animations and photographs. Paivio also advocates two different types of internal representational unit: 'imagens' for mental images and 'logogens' for verbal entities. Logogens are organized in terms of associations and hierarchies while imagens are organized in terms of part-whole relationships. Three types of internal processing are identified: representational - the direct activation of verbal or non-verbal representations; referential - the activation of the verbal system by the nonverbal system or vice-versa; and associated processing - the activation of related presentations within the same verbal or nonverbal system. Whilst it is agreed that a given task may require any or all of the three kinds of processing, it is not clear what and in which order people with different learning styles activate these types of processing. Furthermore, the effect on the learning outcomes of students with different learning styles is not clear when different media combinations are used.

Studies by Paivio and others (Baggett, 1989; Kozma, 1991) suggest that by choosing an appropriate combination of media, learning outcomes can be improved. For example, information that uses verbal and relevant visual illustrations will likely be learned better than information that uses text alone, audio alone, a combination of text and audio, or illustrations alone. Since 1971, dual coding theory has been used as an explanation for the effects of multimedia information on learning in a number of studies (Baggett, 1989; Kozma, 1991; Moreno and Mayer, 2000; Paivio, 1971). Many researchers agree that dual coding theory gives a reasonable explanation for the results of a large number of studies of multimedia learning (Najjar, 1996). The theory is particular useful because it gives an explanation for the way information is processed by human beings and relates this to visual and verbal styles of learning. A number of principles and guidelines for designing multimedia have since been derived from dual coding theory and applied to the development of computer-based learning materials. What is more, this theory seems to be as relevant today as it was some 30 years ago, in spite the advancements in new technology and changes in education (Paivio, 1991; Sadoski and Pavio, 2001).

Even after 30 years, there exist alternative views of memory storage that go against dual coding theory, such as propositional theory (Rieber, 1994). Propositional theorists argue that a transformation takes place of visual information into a semantic form of storage in long-term memory. The propositional theory disputes the superiority of pictures over words because people process and rehearse pictures more fully than words. Paivio (1991), however, still believes that the evidence shows that dual coding theory has more than held its own relative to the prepositional alternative and that other new theories such as the computational theory "connectionism" remain to be demonstrated.

Although much work has been done to date, more studies are needed to ascertain the effects of multimedia information on learning by students with different learning styles. It has long been acknowledged that dual coding theory can be used to study the effects of visual and verbal learners. However, little is known about the effects of multimedia information on learning by students with other learning styles, such as sensing, intuitive, sequential, global, active, and reflective styles.

One of the aims of the study described in this paper was to ascertain the effects of using multimedia information on learning by sensing and intuitive learners, as well as others, as compared to visual and verbal learners. The purpose of the study was to answer the following questions:

- Can different media combinations improve students' understanding?
- Do scores differ between learning styles for different media combinations?

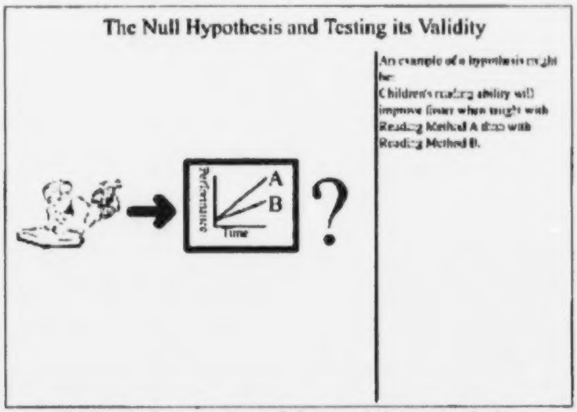
This area of research was identified as being of particular importance to researchers and authors of multimedia in providing them the necessary background to help select an appropriate combination of media for designing computer-based learning materials that are appropriate for all learning styles.

Experimental Study

To ascertain the effects of using multimedia information on learning by sensing and intuitive learners, three different versions of learning material were presented to three groups of students. One group was shown a version of the presentation containing text and diagrams, a second group was shown a version containing text only and a third group was given a version containing sound and diagrams. Data collected from each group were then compared. The remainder of this section provides further details of the presentation, the group characteristics, and the instruments and the methodology used in the experiment.

Presentation

A learning module, 12 minutes in duration, was developed in order to help assess the effectiveness of different combinations of media (see Figure 1).



The Null Hypothesis and Testing its Validity

An example of a hypothesis might be:
Children's reading ability will improve faster when taught with Reading Method A than with Reading Method B.

Figure 1: Screen shot of the module on statistics.

The module was developed using Macromedia Flash 5 and was about the topic of the use of statistics in experimental evaluation. The subject area of statistics was selected because it was felt that most students would have little previous knowledge about this topic and those students that did have previous knowledge

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about it often found the topic difficult. The aims and objectives of the module were defined and used to produce a series of 'messages'. These messages represented key points that a student needed to learn from the module. The messages were then represented and replicated in a textual, visual and audio form. Three copies of the module were then produced as presentations. Presentation 1 presented the topic using text and diagrams, Presentation 2 using text only and Presentation 3 using sound and diagrams. To ensure that only the media combinations changed, the three presentations ran for the same length of time. Each presentation was then published in an executable form and each was placed on a different but comparable laptop.

Group Characteristics

Forty-four students participated in the study. The participants were from the courses Computing and Management and Computer Science at Loughborough University. The study was carried out as part of a module on Human Computer Interaction, which the participants were taking. In the three groups, there were 13, 14 and 17 participants, respectively. The age of the participants ranged from 20 to 24. The three groups of participants were selected according to there learning style. This criterion was implemented to assure a similar number of participants with the same type of learning style were present in each group.

Instruments

The test instruments employed in this study were a pre-test questionnaire, a revised version of the Felder-Silverman Learning Style Model inventory on learning styles (by Richard M. Felder and Barbara A. Soloman), and a post-test questionnaire. The pre-test questionnaire obtained the participants' familiarity with the statistical terms 'the null hypothesis' and 'significance' using 'yes/no' questions.

The learning style inventory consisted of 44 questions about a learners preferred way of learning and a score sheet for calculating a learners preferred style. The inventory chosen was selected after reviewing numerous different inventories that are available in electronic and/or paper form. We discounted inventories that: (a) would have taken too long to complete in a classroom situation; (b) were aimed at children (i.e. pre-sixteen); (c) were specifically related to visual, auditory, tactile, since we decided these will reveal little new information or interest to us in general; and (d) were difficult to fill-in and could easily be skewed by erroneous answers. The Felder-Silverman Learning Model was used for a number of reasons. It did not contravene the criteria given above and the inventory has been tested and validated, and shown to produce reliable results (Felder, 1996).

The post-test questionnaire consisted of 10 questions on a single doubled-sided piece of A4 paper. The questions were about the learning material contained in the presentation. For each question there was also a field asking participants to identify whether they knew the answer before seeing the presentation, whether the presentation helped them to recall the answer, or whether they had not known the answer before seeing the presentation.

Methodology

All three groups were tested simultaneously in different locations. The aims of the study were explained to the students, taking care not to give away details about the content of the presentations and the expected result. A handout was then given to each student containing the learning style inventory and score sheet. Students were asked to complete the inventory. Instructions were then given to the students about how to complete the score sheet. Afterwards, the students were asked to focus on the score for the learning style category sensing and intuitive learners. This category of learning styles was chosen because the class contained a broad spread of styles. In contrast, the category of visual and verbal learning styles was not selected because the population was predominantly visual. Those subjects who were predominantly sensing learners were equally divided into three groups. Subjects who were predominantly intuitive learners were also equally divided into three groups and each assigned to one of the three sensing groups. Finally, subjects who had a balanced style of learning (neither being predominantly sensing nor intuitive) were equally divided into three groups and each assigned to one of the three 'sensing/intuitive' groups. This resulted in three groups consisting of a random selection of subjects containing a similar number of learning styles. Each group was then placed in a separate room where they were given one of the presentations. The first group was given the presentation containing text and diagrams, the second group was given the presentation containing text only, and a final group was given the presentation containing audio and diagrams. The audio in the third group consisted of a voiceover that spoke the text given in the first two groups.

Each presentation was presented using a laptop and a data projector. After each group had watched their particular presentation, they were given the post-test questionnaire to complete. Each participant's completed post-test questionnaire was then stapled to his or her learning style inventory and score sheet. This assured that we could compare the scores of those participants with different learning styles. All the learning inventories, score sheets and post-test questionnaires were then collected within the groups.

Having collected the data, the results were then analyzed using a 2 X 3 ANOVA test to identify whether there was a difference in the participants' scores of each group. Further analysis was also carried out to ascertain the effects of multimedia information on learning regarding each of the different learning styles.

Results

As part of the pre-test, participants in the study confirmed whether they knew what the statistical terms 'a null hypothesis' and 'significance' meant. 53.8% of the text and diagrams group, 14.3% of the text only group and 29.4% of the audio and diagrams group indicated that they knew what a 'null hypothesis' was. Similarly, 61.5% of the text and diagrams group, 35.7% of the text only group and 35.3% of the audio and diagrams group indicated that they knew what 'significance' was. These scores are shown in the bar charts in Figure 2. In the overall sample, the majority of participants had no prior knowledge of these statistical terms.

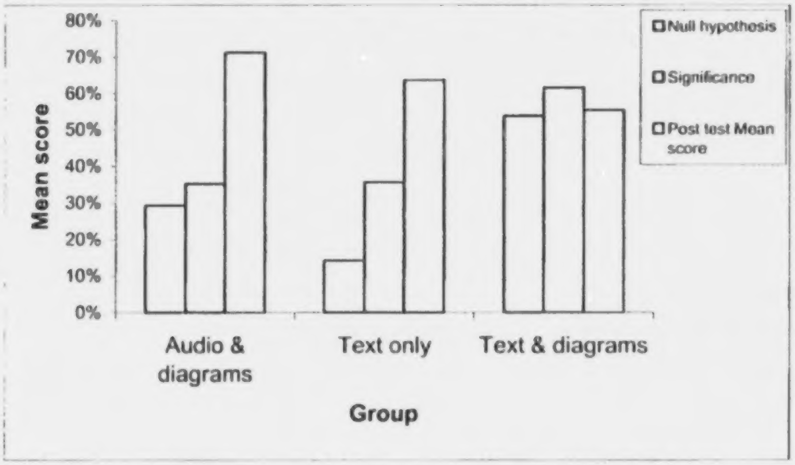

Figure 2: Comparison of prior knowledge with final scores.

Figure 2 also shows each group's post-test mean score after seeing a presentation. Participants who were shown the presentation containing sound and diagrams tend to score the highest marks followed by participants who were shown the presentation containing text only. Participants who were shown the presentation containing text and diagrams tend to score the lowest marks in the study. Interestingly, the text and diagrams group had reported a higher level of familiarity with the subject area than the other two groups (see above), so we would have expected them to do better in the test.

Statistically, overall there was no significant difference between the scores of sensing learners, intuitive learners and balanced learners. However, although not statistically significant, 'sensors' did seem to score higher marks than 'intuitors'. Moreover, as also suggested in the literature on learning theory 'balanced' learners did seem to score the highest marks. The findings seem to support the literature on learning theory that no single learning style is better than another, but balanced learners do seem to perform better overall.

Scores differ between learning styles for different media combinations. For some learning styles, the difference in scores is more evident. In fact, when learning style pairs are compared, one of the two is always more affected by the change in media, than the other. With the sensing-intuitive pair, there is a statistically significant difference in 'intuitor' scores between each media combination group, but not for the 'sensor' scores. 'Intuitors' noticeably scored the highest marks when shown learning material containing sound and diagrams and performed worst when shown learning material containing text and diagrams. This trend was also true of other learning style pairs and can be seen in Figure 3.

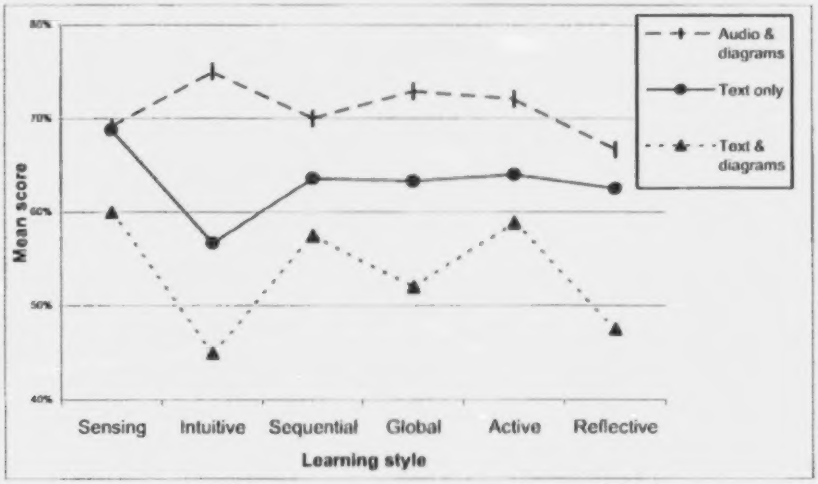

Figure 3: A comparison of learning styles.

'Global' learners tended to be more affected by media combinations than did 'sequential' learners (sequential -global pair). In the reflective-active pair, 'reflective' learners performed much worse with text and diagrams, than with audio and diagrams and with text only. However, the 'active' learners had closer scores for text only and text and diagrams, but performed much better with audio and diagrams.

Discussion

The results from this study offer two main findings. Firstly, different combinations of media, used to present learning materials to students, lead to significant differences in their understanding. Secondly, participants with different learning styles perform differently for different combinations of media. These findings support some of the ideas associated with dual coding theory. Our findings suggest that when information is represented by a verbal and visual combination people recall more items than when using text alone. However, the findings in our study also show that there are cases when a verbal and visual combination can cause people to recall fewer items than when using text alone (in our case text and diagrams). A reason for this might be the way that the text and diagrams were integrated. As a result, students may have been experiencing split-attention effect, an effect covered in cognitive load theory (Sweller et al, 1998).

Whilst our findings suggest that participants with some learning styles score higher than others between each group, this may be because people with particular learning styles are more suited to a type of media. For example, the presentations may have appealed more to sensing learners than intuitive learners because, as dual coding theory suggests, concrete nouns are better remembered than adjectives or abstract nouns. Sensing learner tend to prefer this type of information, whereas, intuitive learners tend to prefer to discover possible connections and relationships. As a result, intuitive learners may not have had the time to activate their preferred types of processing. Of course, another reason may have been because, more sensing learners were using a surface learning strategy and intuitive learners a deep learning strategy (Entwistle, 1997).

A difference in what and which order the students activated types of processing may also account for why participants' scores of some learning styles increased more than others between each group. Since dual coding supports the idea that people learn by connecting new knowledge to prior knowledge, intuitive learners may have been able to exploit this when sound and diagrams were used because time was freed up using this combination of media. Media synchronization may also have been a factor when comparing the difference in participants' scores between text and diagrams and sound and diagrams because dual coding helps learners to increase interconnections to information already in memory (Baggett, 1989).

A possible explanation as to why the scores of most learners were significantly different between each group is probably the result of the redundancy effect, the split- attention effect and the modality effect associated with cognitive load theory (Sweller et al, 1998).

It is clear that more research is needed to investigate whether there is a relationship between the effects on learning and on different types of learning style and media combinations. At this stage, it is unclear whether similar results would have been obtained given that participants had been divided into groups based on a different learning style category. Further investigation is required to understand why those subjects with previous knowledge about the topic in text and diagrams group were unable to exploit this. More research is also needed to investigate whether special groups of learners with a particular style of learning (such as dyslexics) conform not only to dual coding theory but also to our overall findings. These investigations will help to understand the complex relationship between learning tasks and media combinations. From our research, we intend producing guidelines to help developers of computer-based learning materials and develop an approach for developing Adaptive User Interfaces that change according to style and media combination.

Conclusions

This study of using media combinations to deliver learning materials has produced findings that not only support dual coding theory, but also suggest that students' understanding seems to improve the most when using sound and diagrams to present the learning materials. Furthermore, students' understanding seems to improve for some learning styles more than others. We have learned that the affects of dual coding theory are more influential towards learning styles and in delivery of learning materials than previously thought. These results seem to provide tentative evidence that the media combination used to present learning materials is just as important as the style of learning adopted by the student. If the combination of media is inappropriate, it does not matter which learning style a student adopts. Students will still not perform to their full potential. This finding is particularly pertinent given that more attention is often given by tutors to the way learning materials are taught and not to the types of media used. The use of dual coding theory as an approach to accessing the effectiveness of learning materials is still as relevant today with web-based and mobile learning environments. Further research is needed to determine how some learning styles come to be affected more than others when using different combinations of media.

References

Baggett, P., (1989). Understanding visual and verbal messages, *Knowledge acquisition from text and pictures*, H.Mandl & J.Levin (Eds.), Elsevier: Amsterdam, The Netherlands.

Clark, J.M. and Paivio, A., (1991). Dual coding theory and education, *Educational Psychology Review*, 3, 149-210.

Entwistle, N., (1997). Contrasting perspectives on learning, *The Experience of Learning: Implications for Teaching and Studying in Higher Education*, Scottish Academic Press, 2nd Edition, Edited by Ference Marton, Dai Hounsell and Noel Entwistle, Chapter 1, 3-22.

Kozma, R. B., (1991). Learning with media. *Review of Educational Research*, 61(2), pp. 179-211.

Moreno, R. and Mayer, R. E., (2000). A learner-centered approach to multimedia explanations. Deriving instructional design principles from cognitive theory. *Interactive Multimedia Electronic Journal of Computer-Enhanced Learning*, 2(2), [WWW document]. URL http://imej.wfu.edu, Cited: 18/12/01.

Najjar, L.J., (1996). Multimedia information and learning, *Journal of Educational Multimedia and Hypermedia*, 5(1), 129-150.

Paivio, A., (1971). *Imagery and verbal processes*, New York: Holt, Rinehart & Winston.

Paivio, A., (1986). *Mental Representations: A Dual Coding Approach*, Clarendon Press, Oxford.

Paivio, A., (1991). Dual Coding Theory: Retrospect and Current Status, *Canadian Journal of Psychology*, 45(3), 255-287.

Rieber, L.P., (1994). *Computers, graphics and learning*. Madison. WI: WCB Brown & Benchmark.

Sadoski, M. and Pavio, A., (2001) *Imagery and text: A dual coding theory of reading and writing*, Lawrence Erlbaum Associates, Inc.

Sweller, J., van Merrienboer, J. J.G., and Paas, F.G.W.C., (1998). Cognitive Architecture and Instructional Design, *Educational Psychology Review*, 10(3), 251-296.

Non-traditional Students Learning in a Non-traditional Environment

Students 24 years of age or older learning in a college setting with new technologies

The learning styles of undergraduate students vary a great deal. Technology is often used to address a myriad of learning needs. However, as non-traditional college students (24 years of age or older) enter the university setting, technology is often a hindrance to their success. The instructor and the non-traditional student must address not only the learning style issue, but also the challenge of learning with technology developed since their last formal educational experiences. The combination of unique learning styles and lack of technology skills presents an additional challenge for these students. As instructors design their courses to include a variety of media tools, specific measures can be taken to keep the non-traditional students abreast of the class. The session will focus on the unique learning of non-traditional undergraduates and a process for applying specific media tools to the instructional components of the university classroom.

Background

What started as a Cherokee Female Seminary in 1887 is known today as Northeastern State University (NSU), the second oldest institution of higher learning west of the Mississippi River. Since its inception, NSU has evolved into one of the leading regional institutions of higher education in Oklahoma, rich in the American Indian heritage of years past and strong in the changing world of technology today. The mission of the University is to provide undergraduate and graduate education leading to 64 bachelor's degrees, 14 masters' degrees in selected areas and a doctoral degree in Optometry.

Northeastern State University currently has an undergraduate student population of 8,378. While the average age of a traditional college undergraduate is between eighteen and twenty-three years old, the average age of a Northeastern State University undergraduate student is twenty-seven. The majority of students attending Northeastern State University bring new challenges to the campus and in turn to the classroom. One of the most ominous challenges these students and their instructors face is the application of technology to the learning process.

Problem

The vast majority of traditional students in the Northeastern State University classrooms have been exposed to the use of current technology throughout their educational experience. These students are comfortable with the computer, Internet and multimedia software used by the instructor in the classroom. Furthermore, traditional students, by in large, use technology in their learning process. This natural extension of the learning environment assists students in successfully attaining the learning goals of the college classroom.

Each semester, Northeastern's College of Education offers a course entitled, Technology in Education. Through this course, teacher candidates learn appropriate application of technology to the teaching and learning process. Successful completion of this course is required for all education majors. Nontraditional students enroll in the course as well as traditional undergraduates. The instructor of this course conducted action research to investigate two questions. The first question to be addressed: What is the nontraditional students' perspective of the challenges technology presents in their learning process? The second question: What resources, digital, analog and human, could assist nontraditional students in accommodating digital resources for learning?

Method

During the Fall 2001 and Spring 2002 semester, the instructor invited students from six sections of the Technology in Education course to participate in the action research. Information concerning student age, gender and computer anxiety level was collected using the Computer Anxiety Index (CAIN). The CAIN was administered to the students at the beginning of the course and again at the end of the course in order to measure the reduction or increase in computer anxiety. Students also maintained a journal of reflections completed at the conclusion of each major technology assignment. The assignments introduced various digital and/or multimedia applications for learning. These tools included PowerPoint presentations, web page construction, Internet scavenger hunts and focused searches and WebQuest construction. The CAIN and the reflective journals contributed information to determine the answer to each research question.

Application

Although the study is action research, the findings could be applied to the wider population of nontraditional students attending regional universities. The digital and multimedia applications can be adjusted to accommodate other content areas outside teacher education. Instructors in other university settings can easily duplicate the introduction of these tools and the support model developed through the process.

Results

The month of December marks the midpoint of the action research. A combined total (traditional and non-traditional students) of forty-seven students participated in the study. The journal entries and CAIN scores are collected. The remaining data will be collected during the Spring 2002 semester. At this time, all data collected thorough the CAIN will be analyzed using a statistical software package. The reflected journals will be compiled and presented in a concise manner.

References

Allison, L., (1995). The status of computer technology in classrooms using the integrated thematic instruction model. International Journal of Instructional Media, 22, 33 - 44.

Becker, H. J. (1994). Analysis and trends of school use of new information technologies (Office of Technology Assessment, U.S. Congress Contract: No. K3-0666.0). Irvine, CA: University of California, Department of Education.

Becker, H. J. (1999, summer). The influence of computer and Internet use on teachers' pedagogical practices and perceptions. Journal of Research on Computing in Education, 31, 356-360.

Dockerman, D. A. (1998). Great teaching in the one-computer classroom. Watertown, MA: Tom Snyder Productions, Inc.

Eddy, J., Spaulding, D., (1996). Internet, computers, distance education and people Technology, 10, 1 - 18.

Hill, R., & Somers, J. (1996, September-October). A process for initiating change: Developing technology goals for a college of education. Journal of Teacher Education, 47, 300 – 307.

International Society for Technology in Education Accreditation and Standards Committee. (1996). Technology standards and performance indicators [On-line]. International society for technology in education national educational technology standards and performance. Available Netscape: http://cnets.iste.org/teachstand.html

Marshall, J. (1999, winter). Training teachers to use technology. Journal of Research on Computing in Education, 32, 27-33.

Northeastern State University. (2001). About the Campus. [On-line]. Available Netscape: http://www.nsuok.edu/about/campus.html

Northeastern State University. (2001). College of Education. [On-line]. Available Netscape: http://arapaho.nsuok.edu/%7Ecollegeofed/#history

Office of Technology and Assessment. (1995). Teachers and technology: Making the connection. (p. 165). Washington, DC: U.S. Congress.

Papert, S. (1998, September). Technology in schools: to support the system or render it obsolete? [31 paragraphs]. Milken Exchange on Education Technology. [On-line serial]. Available Infotrac: http://www.mff.org/edtech/article.taf?_function=detail&

Robyler, M., & Edwards, E. (2000). Integrating educational technology into teaching. Upper Saddle River, NJ: Prentice-Hall, Inc.

Simonson, M. R., Montag, M., Maurer, M., Oviatt, L., & Whitaker, M. (1992). Test administrator's manual for the standardized test of computer literacy and computer anxiety index. (Available from the Research Institute for Studies in Education, College of Education, Lagomarcino Hall, Iowa State University, Ames, IA 50011).

Williams, A., & Williams, P. (1997, May). Problem-based learning: An appropriate methodology for technology education. Research in Science & Technological Education, 15, 91 – 104.

Computer-Based Distance Education for Vocational Use in Southern Nevada

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Abstract: This paper discusses the results of a study that compared two different course delivery methods. One of these used the Internet exclusively for module delivery while the other used a traditional campus setting. The two delivery methods were compared in order to determine if the Internet method was as good as the traditional approach. Results and suggestions for further study are described and some of the concerns identified are discussed. The module, which prepares students to take and pass an industry-recognised certification test, is currently being offered at the Community College of Southern Nevada.

Introduction

The Community College of Southern Nevada (CCSN) is responsible for delivering educational opportunities to a 45,000 square mile area in Southern Nevada. Enrolment at CCSN was approximately 40,000 students for the Autumn semester 2001 (September through December 2001). In order to meet the needs of so many students, CCSN has built six major and over a dozen outreach campuses. Despite this, many students, are still not able to take classes due to working schedules or because they reside at a significant distance from one of the campuses.

A continuing option for students who are unable to attend normal classroom instruction has always been distance education (DE). The increased availability and power of computers has created distance education opportunities that were not available years ago. However, the use of these is often sporadic, if they are used at all due to many factors including the cost of entry for both the institution (Matthews, 1999; Chambers, 1999; Barley, 1999) and for students (Matthews, 1999; Barley, 1999; Blumenstyk and McCollum, 1999). Many of the distance education modules at CCSN are delivered in a manner that requires students and instructors to meet at specific times for discussion, interaction and presentation. These modules offer students the opportunity to study in ways that are independent of place and time; indeed time and place flexibility are the two greatest advantages of distance education (Shave, 1998; Fender, 1999; Alexander, 1999). This is an attractive proposition for students with unusual or irregular work schedules or other time conflicts. This is especially the case for many people in the Las Vegas area due to the twenty-four hour nature of the entertainment industry.

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An additional constraint is the lack of experience and knowledge that instructors may have (Shave, 1998; Mudge, 1999; Twigg, 2001). Technology improvements alone do not offer most instructors the ability to offer distance education modules unless they are familiar and comfortable with the technology (Shave, 1999; Alexander, 1999; Matthews, 1999; Carnevale, 1999; Trinkle, 1999; Grill, 1999; Mudge, 1999). In addition, instructors must have the time and patience to learn how to use the technology. This can include expanding the frame of reference an instructor has from classroom-based instruction to instruction that is independent of place and time. Many instructors find this difficult. The steep learning curve experienced by instructors can be partially alleviated by a good computer support department at the college or university. However, the use of outside developers or content providers can affect a faculty member's control over his or her intellectual property.

Delivery that is independent of time requires the creation of online courses that can be accessed at any time and place, as long as Internet access is available. The module selected for delivery using the two methods described above was Computer and Information Technology (CIT) 106B. This module is a preparatory course for students who are preparing to take the Computing Technology Industry Association's (CompTIA) A+ Core certification test. This test is one of two tests required to become an A+ Certified PC Technician. Both delivery methods used the same textbook and tests.

In order for the Internet module to be as close as possible to the actual on-campus presentation, streaming audio and video were used to transmit the classroom lectures over the Internet (Beckstrand, Barker and van Schaik, 2001). Streaming does not require files to be downloaded before use. The use of streaming technology does not require specific class meeting times. Support, independent of time and place, was offered using email, voice mail, conventional mail, and office visits. All tests and questionnaires were delivered through computers using WebCT.

System overview

Any module that is delivered through distance education has three pre-requisites. First, the learning material that is covered needs to be disseminated. Second, communication between the instructor and student for questions and other feedback needs to be set up. Finally, learning must be evaluated and assessed. CCSN adopted a Web development tool set called WebCT. WebCT provides Internet-based tools for testing. While there is a learning curve associated with using WebCT, the curve is similar to that experienced when learning to use a new word processing program instead of a programming language. Once the tests are in place, students can receive immediate feedback after a test has been submitted for grading.

A Web site was developed to provide communication between the instructor and students. The Web site could be used to post messages of concern for all students as well as contain an email link so that students could send the instructor an email during the delivery of the module. Additional information could be added to the Web site if needed. Students' learning was evaluated and assessed through four tests administered on demand through WebCT. The first three tests were not comprehensive. The fourth test was comprehensive with questions covering all of the learning material presented. The Web site (http://itcert.ccsn.net) contained module syllabi, course information, textbook listings, and certification testing information.

Evaluation

An evaluation of the Internet delivery of the module, compared to the on-campus delivery, was conducted. This section describes the analysis plan and the results obtained.

The Computer Literacy Questionnaire (CLQ) (Murphy, Coover, and Owen, 1989) was administered to investigate any differences between the groups and as a possible predictor of students' performance. The first four questions on the CLQ collected demographic information. The thirty-seven literacy questions of the CLQ assessed self-perceived computer literacy. The scoring of the questionnaire was based on a five-point scale. Lower scores indicate less familiarity with computers while higher scores indicate more experience.

Analysis plan

The analysis of the study results consisted of four parts. The first part sought to discover if there were any differences between the Internet modules offered during the Summer time-frame and the module offered during the Autumn time-frame. Any major differences in the modules would prevent the combination of the groups into a single unit for comparison with students enrolled in the on-campus module. The second part of the analysis checked for any initial differences between students on the Internet module and students on the on-campus module that might have affected the outcomes and conclusions. The third part of the analysis involved the actual comparison of the on-campus module and the Internet modules. The results were expected to support the hypothesis of no (statistically significant) differences between the module outcomes. This would indicate that if an online module was designed correctly, students should be able to achieve the same results taking the online module as those taking the on-campus module. Finally, regression analysis was conducted in order to uncover factors that explain students' performance.

Data analysis was performed using SPSS for Windows (version 8). Students' names were not recorded in the data files. Students who registered and paid for the module were monitored to measure attrition. A total of 91 students were registered for the three Internet deliveries. Comparisons between the different presentation methods included age, pre-test, other tests, questionnaires, attrition, and final grade.

Results

All students responding on the CLQ indicated that they owned and used a personal computer.

Students enrolled on the Summer Internet delivery and Autumn Internet delivery did not have any statistically significant differences in the areas evaluated that precluded them from being combined as one unit. More Summer students registered for the Internet module because it was the only offering of the module and they did not want to wait until Autumn. Overall motivation concerning the modules was very similar between the two student groups. Since the results indicated that the two groups were similar, they were treated as one group in comparisons with the traditional module presented in the Autumn.

The analysis of the pre-test scores indicated that both groups were starting at an equivalent knowledge level. It was observed that the Internet module was the first non-traditional module for many of the enrolled students. However, as might be expected, most students following the on-campus delivery had previously taken other on-campus modules. Each of the tests administered during the module delivery was compared for differences. Questionnaire responses were also compared for changes during the delivery time frame. It was found that students registered for the delivery method they desired.

A number of different measurements were used to determine if the research hypothesis identified above was supported. Questionnaire One measured students' attitudes concerning motivation, delivery method motivation, and collected some demographic information. Questionnaires Two and Three measured students' attitudes concerning motivation, delivery method motivation and module delivery evaluation. Students' attitudes remained consistent during the module delivery with little difference between the two groups. A 2 x 4 mixed measures ANOVA showed there were no differences in test performance between the two delivery methods over time; the pattern of differences between the scores on the four tests was the same for both delivery methods. The test results thus supported the hypothesis stated above.

Regression analysis showed that students' test performance on test 1 was not related to their performance on the pre-test. Test performance on test 2 was significantly related to performance on the pre-test and test 1 combined, where performance on test 1 was a significant predictor. On test 3, performance was significantly related to performance on all previous tests combined, and performance on test 2 was a significant predictor. Test performance on the final test was significantly related to performance on all previous tests combined, with performance on test 3 and the pre-test being significant predictors.

Overall, the results indicated that students in the two delivery types were more similar than dissimilar. This conclusion was supported by the results of the first three steps of the data analysis. Even the attrition rate between the two delivery methods was not significantly different. Detailed results will be presented at the conference.

Lessons Learned and Emerging Guidelines

The study results support the stated hypothesis. The Internet module was comparable to the on-campus module in helping students attain results. The students in the groups were very similar in all areas of comparison, in spite of the lack of random assignment to the different delivery methods. Any differences identified were not major and did not influence the outcome. This study supports the developmental path used to facilitate the Internet delivery of the module. By using a known and established module, as well as the same support material, a successful non-traditional version of the module was created.

The study does identify some issues that need to be addressed. The attrition rate of both delivery methods is a concern. Additional study should be considered to identify the reason why many students began the module but then left before completing the work. Another issue is the large number of students that completed the modules but received fail grades. This is especially important for two reasons. First, CIT 106B is an introductory module for new and beginning students. Second, CIT 106B is an elective for many other study programmes in the CIT department. Failure in this module could have a negative effect on new students at the college and on students completing programmes of study.

The high attrition and large number of fail grades could be attributed to students' self-assessed levels of knowledge of computers and technology indicated by the CLQ results. Two-thirds of the students who responded on the CLQ scored in the novice range. The CIT 106B module is totally about computer technology. Identifying ways to help students develop basic computing skills prior to taking the module might help lower the high attrition and reduce the number of fail grades.

The CIT 106B module, developed using the above methodology can be viewed at http://webcampus.ccsn.nevada.edu. Select the "Logon to MyWebCT" option. The sample ID is tstudent and the password is temp. All lectures will be available, but due to academic constraints, the module tests will not be available. The account above will be active during the EDMEDIA 2002 conference.

Conclusions

The use of Internet technology, along with various tools can make truly independent learning a reality. The offering of a module with time and place flexibility offers opportunities for students who otherwise would not be able to take advantage of higher education and provides as good a learning opportunity in this instance as the on-campus module. Because the module is delivered via the Internet, learning can take place at home, while travelling, or at an institutional computer lab. Such modules can also be offered by an institution to students not included in its normal audience - a global audience. This type of module is also attractive because it offers self-paced study to learners. Lectures can be repeated multiple times if a student is having difficulty grasping the subject - something that is not possible in a normal classroom environment. The advantages associated with this type of distance education module were sufficient motivation to continue the development of two similar modules. The first of the follow-on modules was made available in Spring 2001 and the second of the follow-on modules will be made available in Spring 2002.

Not all disciplines will be able to use this type of distance education module. However, the ability to offer such modules provides benefits both for the college (CCSN) and the students. These benefits far outweigh the negative aspects. This first module, along with the additional modules, will provide educational opportunities for students that would otherwise not be able to enjoy the fruits of higher education.

References

Alexander, P. (1999). Pros and Cons of Cyberclassrooms. *Marketing News, 8/2/99 33* (16), 10.

Barley, S. (1999). Computer-based distance education: Why and why not. *The Education Digest,* 65 (2), 55-59.

Beckstrand, S., Barker, P. and van Schaik, P. (2001*). Towards More Independent Learning: A Southern Nevada Perspective.* ED-MEDIA 2001 Conference Proceedings (106-110), Tampere, Finland.

Blumenstyk, G. and McCollum, K. (1999). 2 reports question utility and accessibility in distance education. *Chronicle of Higher Education,* 45 (32), A31.

Carnevale, D. (1999). Distance education can bolster the bottom line, a professor argues. *Chronicle of Higher Education,* 46 (9), A60.

Chambers, G.S. (1999). Toward shared control of distance education. *Chronicle of Higher Education,* 46 (13), B8-B9.

Fender, D. (1999). Distance Education and the Safety Professional. *Professional Safety,* 44 (10), 26-29.

Grill, J. (1999). Access to learning: Rethinking the promise of distance education. *Adult Learning,* 10 (4), 32.

Matthews, D. (1999). The Origins of Distance Education and Its Use in the United States. *Technical Horizons in Education (THE) Journal,* 27(2), 54-60.

Mudge, S. (1999). Delivering Multimedia Teaching Modules via the Internet. *Innovations in Education and Training International,* 36(1), 11-16.

Murphy, C, Coover, D. and Owen, S. (1989). Development and validation of the computer self-efficacy scale. *Educational and Psychological Measurement,* 49, 893-899.

Shave, C. (1998). So you want to deliver a course using the Internet. Paper contributed to the Teaching in the Community Colleges Online Conference, *Online Instruction: Trends and Issues II.* Location: Kapi'olani Community College, Honolulu, Hawaii, USA.

Trinkle, D. (1999). Distance education: A means to an end, no more, no less. *Chronicle of Higher Education,* 45 (48), A60.

Twigg, C. (2001). Quality assurance for whom? Providers and consumers in today's distributed learning environment. *Pew Symposia in Learning and Technology Newsletter, April 2001. Accessible from the World Wide Web:* http://www.center.rpi.edu/PewSym/mono3.html.

Cooperative Learning: Assessment of Team-work

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Abstract: This paper examines the benefits and challenges of for an institution to support cooperative learning through assessment. The paper will focus on the key issues behind the design and management of teamwork assessment, and the development of guidelines to undertake the implementation of an institution-wide approach to cooperative learning.

1.0 Introduction

The main objective of cooperative learning is for learners to collaborate and use others as a resource, for sharing knowledge, "challenge other and their own views, hence to serve as a source of puzzlement that stimulates new learning" (VonGlaserfeld, 1989); yet stand separately for individual assessment.

In many cases the complexity or purpose of the task extend to include assessment, as part of the cooperative work. Therefore the need to develop different methods that explain 'how' to calculate individual marks from group marks (Lejk and Wyvill 1996; Brown, 1995).

But the true effectiveness of the assessment of cooperative work doesn't lay in the method, but in the goals, behind its design and implementation.

2.0 The Need for Collaborative Learning

Cooperative learning is among most effective learning method in higher education (Astin, 1993; Johnson, et al., 1991; CELT, 1995). It became the central strategy to learning at the Technical University of British Columbia (TechBC).

Critically, TechBC embedded the goals of: learning effectiveness, learner centeredness, responsiveness to workplace needs, and effective use of educational technology, at an institutional and cross-program level. The adoption of cooperative learning supported and interwove these goals very effectively.

How do you translate all the benefits of cooperative learning into an active every day working and learning environment that thrives across programs, schools, levels, instructors, diverse learners, cultures, and subject areas?

To date, research has dealt with common problems of cooperative learning at the course level, but many of the issues that were encountered at TechBC, are institution-wide problems, such as managing team activities across courses, team dynamics, and extending the cooperative work all the way to team assessment.

5.0 Results

At TechBC, we developed an approach that takes into account the values of cooperative learning and a framework that supports good instructional design, providing developers and instructors with guidelines that enforce sound team assessment practices.

In the following segments we describe why we considered instructional design, the principles of cooperative learning, peer and self-assessment and the assessment of learning best practices to be the core elements to be addressed in the development of our team assessment guidelines.

5.1 Instructional Design

Instructional design is a systematic approach to curriculum and course development that focuses on learning objectives as a means for the development of learning experiences.

The learning objectives communicate the knowledge and skills learners can expect as outcomes of the completed unit of study. They should be adopted as the basis for the design of assessment and feedback techniques and seen as an inherent part of the educational structure.

5.2 Principles of Cooperative Learning

The method of collaboration in the learning environment is for learners to work together in groups and individually assessed (Slavin, 1995).

The purpose behind cooperative learning is to design activities that motivate learners to work with each other, because they see the value of others views and sharing of knowledge, but also because the learning of their peers is important to them (Slavin, 1995a). It is in the course of this interaction that all group members' benefit, and it is through individual assessment that the value is measured.

However it is also often to see some examples in which the group activity is designed in a way that group cooperation and the assessment are linked together. It's when learning activities are translated into assessment activities (in which marks or grades are assigned); that learners start to worry about the effect that the actions of others will have on their marks.

There are five essential elements that make cooperative learning activities work: a) Positive Interdependence, b) Promoting Interaction, c) Individual Accountability, d) Team skills and e) Groups Processing. But it's Positive Interdependence and Individual Accountability that have a mayor role in the assessment of teamwork.

These two principles of cooperative learning seem so far apart, and difficult to accomplish at the same time. The success of team-based learning relies in heavily on the ability to design and activity balances both elements. There is a very fine line between collaboration and collusion (Isaacs, 2002).

Slavin (1995), describes the success of cooperative learning as the ability to have group goals but be capable of assessing individual accountability.

5.3 Peer and Self-assessment

Both peer and self-assessment methods have been widely used as variables to ensure that either or both individual accountability and positive interdependence have been achieved in team-based assessments.

Some research seem to suggest that peer and self assessment are more useful in the assessment of group processing, team skills and positive interdependence, while others suggest that it is successfully applied to assessment of individual accountability (skills and knowledge).

5.4 Assessment of Learning

"Effective learning occurs when learners come to internalize the project of learning, benefit from having meaningful assignments that develop their knowledge and skills, and receive useful feedback in order to improve performance" (Battersby, 1999). For that to happen, assessment must follow these basic principles:

- It should be clearly linked to the learning objectives.
- The benchmarks of satisfactory performance are clearly established before learner outcomes are measured.
- The assessment supports the learning process by providing clear and valuable feedback. Assessment provides data on performance for grading purposes, as well as information on the effectiveness of the instruction. (Diamond, 1998)

These principles can be attained following good instructional design practices. Assessment and learning are intrinsically related, "... the assessment methods and requirements probably have a greater influence on how and what learners learn than any other single factor" (Boud, 1995).

6.0 Conclusion

The design, development and implementation of cooperative learning can become a very complicated task, especially if the learning activities are extended to the assessment of teamwork. Specifically, critical issues of team assessment need to be addressed to achieve the effective learning, especially for the learners. Institutionally, if assessment supports the overall goals for learning, across programs, learning staff, and supporting staff, the goals are more attainable.

Hopefully, we have demonstrated the need, challenges, and the benefits of developing assessment guidelines for cooperative learning support the goals of a new and innovative university.

References

Astin, A. (1993). *What Matters in College: Four Critical Years Revisited*. San Francisco, Jossey-Bass.

Battersby, M. (1999). Guest editorial: Assessment and learning. *Learning Quarterly: Assessment and Learning* , Published by the Centre for Curriculum Transfer & Technology, 3(3), Fall.

Boud, D. (1995). *Enhancing Learning through Self Assessment*, London: Kogan Page.

Brown, R.W. (1995). Autorating: Getting Individual Marks from Team Marks and Enhancing Teamwork. Retrieved 10, March, 2002 from http://fie.engrng.pitt.edu/fie95/3c2/3c24/3c24.htm

CELT, Center for Excellence in Learning and Teaching, (1995). When learners learn in groups. *Originally published in the March 1995 issue of The Penn State ID newsletter.* Retrieved 15, March, 2002 from http://www.psu.edu/celt/newsletter/ID_March95.html

Diamond, R. M. (1998.) Chapter 10:Designing assessment instruments and procedures. *Designing and Assessing Courses and Curricula: A Practical guide*. Jossey-Bass. pp. 139-152.

Isaacs, G. (2002). Group assessment' assessment of learners on groups-based tasks: Issues and options. *The Teaching and Educational Development Institute*, The University of Queensland. Retrieved 10, March, 2002 from http://www.tedi.uq.edu.au/Assess/Assessment/group-summary.html

Johnson, D.W., Johnson, R.T., and Smith, K. A. (1991). Cooperative learning: Increasing college faculty instructional productivity. *ASHE-ERIC Higher Education Report*. No. 4. George Washington University.

Lejk, M. and Wyvill, M. (1996) A survey of methods of deriving individual grades from group assessment. *Assessment & Evaluation in Higher Education.* 21(3), p. 267, 14p.

Slavin, R.E. (1995). *Cooperative learning: Theory, research, and practice* (2nd Ed.). Boston: Allyn & Bacon.

Slavin, R., E. (1995a). *Research on Cooperative Learning and Achievement: What We Know, What We Need to Know*. Retrieved 23, March, 2002 from http://www.successforall.net/resource/research/cooplearn.htm

VonGlaserfeld, E. (1989). Cognition, construction of knowledge, and teaching. *Synthese*, (80), 121-140. In: Savery, Savery, J. R. & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology*, (35), 31-38. Retrieved 31, March, 2002 from http://crlt.indiana.edu/publications/duffy_publ6.pdf

Walvoord, B. E. & Johnson, A. (1998). *Effective Grading*. San Francisco, Ca. Jossey-Bass.

Kids Can Care About Cyberethics!

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Abstract This paper is a discussion of the importance of teaching cyberethics to K-12 students. It includes the results of two informal surveys: one of teachers and librarians regarding their experiences with cyberethics instruction, and one of students regarding their knowledge of cyberethics. A description of a school-wide project to emphasize cyberethics through a web collection of student created clip art is also included.

Introduction

Computer ethics, or cyberethics, is an area of technology education that is frequently neglected by teachers, librarians, and administrators. Students are using computers in ever-growing numbers, but in many schools are receiving little or no guidance about the issues relating to ethical use of technology. Defining cyberethics, whether for adults or for students, is a bit daunting because the term covers a multi-faceted array of issues, including at least the following: respect for intellectual property, respect for privacy, and hacking. Indeed one expert, Dr. Marvin Berkowitz, has included seven specific issues: computer hacking, copyright issues, hate speech, privacy, computer addiction, plagiarism, and personal identity.

Discussion

Part of the reason why students are not being offered information about cyberethics is because the adults who should be leading the way are themselves uninformed. Many publications, workshops, and technology courses do present information to educators about cyberethics. Unfortunately, as with other areas of professional development, too often people do not receive training due to lack of time, lack of access to workshops or seminars, or lack of awareness of these issues. Teachers and librarians must become informed leaders in this arena before they can help students to make changes.

Recently, I explored the issue of cyberethics and its emphasis in schools through an informal survey of teachers and librarians. The survey was directed to members of LM_Net and EDTECH discussion groups, and also to library science students. I posed questions about how ethical issues were handled with teachers and staff, and also about how these issues were addressed with students at their schools. I received thirty-four responses, with equal representation from librarians and classroom teachers.

I asked eight questions about the ways in which cyberethics was addressed on campuses with faculty and staff:

- Who is the voice for copyright and/or respect for intellectual property on your campus? A three to one ratio of responses pointed to the librarian or media specialist as the responsible spokesman. One notable exception was an individual who reported that her district had a specific position, Copyright Compliance Officer, who monitored copyright issues and situations. That administrator then directed training to librarians, who served as campus liaisons. Other comments about the role of librarian as champion of copyright included, "If anyone is going to do this, it will be me, the librarian."
- Are copyright notices posted on your campuses? Less than half of the respondents said yes, with the majority indicating notices were posted on or near photocopy machines. Unfortunately, this simple step does seem to be neglected in a number of schools.
- Who is the voice on your campus for protection of computer software? Responses to this question were evenly split between the librarian and the campus technology teacher or

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specialist. Only two individuals indicated a direct knowledge of a district wide emphasis on compliance in this area. Many people said the issue was not addressed at all at their schools.

- How widespread is the violation of software copyright by teachers and staff on your campus? Almost all respondents reported that it was their impression that copyright was respected in most cases. Several people reported campus guidelines and policies. As one computer teacher commented, "The fines for piracy are well known here." Another technology teacher offered a somewhat jaded comment, "I would not think it is very much as our school has provided the necessary software for its teachers. If the software is not provided, teachers will violate copyright laws." Many respondents were unaware of what measures were taken to protect software copyright in their buildings or districts.
- Who is the voice for privacy regarding technology, and is this issue taken seriously? As with the responsibility for software copyright, the vote was split between librarians and technology teachers. This is an issue that seems to elicit growing awareness and concern. Some respondents said building and district administrators supervised privacy issues. Several librarians pointed out that their automated circulation systems did not save student checkout records, thus making it easier to protect students' reading histories.
- Who speaks out against computer hacking and in what context? This issue was, in most cases, said to be under the domain of technology specialists and teachers. In many cases, respondents also mentioned the district acceptable use policy as a measure against hacking.

The second part of the survey was about how cyberethics are being taught to students, and comprised of five questions:

- Who tell students about copyright? As with informing faculty, the responsibility for telling students about copyright fell almost entirely to librarians. Most computer teachers who responded also reported that they try to include copyright in their lessons, but also named librarians as campus leaders. One librarian said she mentions copyright every time a class comes in for research during her introductory remarks.
- Who talks to students about software and copyright? Librarians and computer teachers were equally cited. However, about one third of the respondents were under the impression that it was not addressed at all on their campuses.
- Who talks to students about computer hacking as an ethical issue? For the most part, computer teachers were named as the voices for this issue. One such teacher commented, "We attempt to assuage the hackers by keeping a half step ahead of them. We don't always succeed! However, I have learned a lot from the kids when security is breached." Teachers and librarians from schools with strong acceptable use policies felt that guidance for students was enhanced by the policies, if students were sufficiently aware of them.
- Are there specific lessons taught about cyberethics on your campus? About half of the respondents said yes, but not necessarily to all students. Usually the lessons were offered in computer classes. The remainder said such lessons were not offered at all. Some of those who said yes mentioned state computer competency tests, which target these issues along with other computer skills, as the impetus for instruction in cyberethics.
- The final question was: In general, is your campus really pushing ethical issues? Responses were evenly split, with half saying the issues were truly emphasized and the other half saying not at all. Some were emphatic in stating that the issues were neglected. One respondent said, "Not enough time. Just trying to teach the basic subjects is the problem." Another said, "Mostly no. It is not a subject that fits into class lessons or requirements." On the other hand, a computer teacher reported, "At this point we are stressing the responsibility of the staff member. In a faculty meeting the medial specialist goes over both our acceptable use policy and copyright policy every school year." There were indications from several people of a growing sense of need for instruction about cyberethics. As one reported, "This year one of our goals is to raise awareness through improved signage, reminders to staff, and workshops with students." Another said, "It is difficult to find the staff and time to cover everything that needs to be discussed, but we are making an effort."

What conclusions can be drawn from this informal survey? Several points came to mind as I reviewed the responses:

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- First, I did not receive a single submission where the respondent thought that enough was being done at his or her school to address cyberethics. Everyone reported room for improvement. As computer use becomes more universal and pervasive, the need for adequate training about cyberethics will surely increase.
- Librarians are presently front and center in efforts to inform faculty and students about cyberethics, and this will continue to be the case. The general consensus from respondents was that if anyone on their campus were going to speak out on such issues, it would be the librarian.
- One thing that could be done easily and quickly would be to post signs with copyright guidelines near copy machines, computers, software shelving, and audiovisual equipment storage areas. This beginning step can provide initial awareness of the issue with other initiatives to follow.
- An AUP (Acceptable Use Policy) is an important first step in promoting ethical computer use, but it is not a solution in and of itself. Many respondents indicated that, while their schools had such documents, awareness on the part of students, parents, and faculty was not widespread.
- While instruction about cyberethics may be lacking, there is a growing awareness and concern. In the near future, librarians and teachers will need to address these issues with both faculty and students if they are not already doing so.

Librarians are in an excellent position to be leaders in promoting cyberethics because they work with staff and students, because they assist with research, and because they are often leaders in technology on their campuses. Training and informing teachers and staff should be offered through a variety of means, such as: in-service, web presence, handouts, one-on-one contacts, and any other creative means which can be developed. Often it is best to concentrate on one issue at a time when launching efforts to inform people about cyberethics, to avoid overwhelming them with information and guidelines. The emphasis should be on positive reasons to respect the issues rather than negativism or scare tactics. Once teachers on a campus begin to gain awareness, they can plan lessons to share the information with their students.

What are some effective ways to teach students about ethical computer use? As with adults, students will do best if they are not presented with an overwhelming amount of information all at once. After a general discussion, it is probably wise to present one issue at a time and explain each one simply and clearly. Students are even less apt than adults to respond to stern admonishing rhetoric. While it may be true, for instance, that stealing ideas or words is as bad as stealing merchandise from a store, lecturing students along these lines is likely to be poorly received and counter-productive. Teachers should explain each concept thoroughly, making it clear exactly what rights students do have and offering positive reasons for behaving ethically. This approach is much more likely to succeed in gaining students' attention and compliance. Students may be informed of the negative consequences of violating ethical guidelines, of course, but the information should be accurate and not couched in overly threatening tones.

Usually a school or district will have an Acceptable Use Policy (AUP) that addresses ethical issues for its students and staff. Unfortunately, in many cases, students and faculty are not thoroughly informed about their policy and may even be unaware of its existence. Making sure they get this basic information is one way to begin discussing cyberethics. Then the various sub topics can be addressed one at a time. One Texas school district, Conroe Independent School District, developed a test for students over the Acceptable Use Policy. The test was put into place as a requirement before students could gain permission to use the Internet. Teachers and staff were also required to pass the same test and answer additional questions about their responsibilities in order to get computer accounts. This tactic required everyone to have at least a basic awareness of district policies and gave teachers a starting point for instruction. The tests were made available online via the district web pages, to be taken online with the resulting passing scores stored in a database so that teachers could check, if necessary, to verify whether a student has passed. If such a requirement is not in place, a district Acceptable Use Policy is still an excellent springboard for discussions about cyberethics.

Another major resource to reference when discussing computer ethics with both teachers and students is the Ten Commandments of Computer Use. This widely quoted document was originated by The Computer Ethics Institute, and appears at the end of this paper. Doug Johnson, Director of Technology, Mankato Public Schools, Mankato, MN, has further synthesized ethical concepts into his "3 P's of Technology Ethics:

1. Privacy—I will protect my privacy and respect the privacy of others.

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2. Property—I will protect my property and respect the property of others.
3. a(P)priate Use—I will use technology in constructive ways and in ways which do not break the rules of my family, church, school or government.

Exposing students to clear and understandable guidelines such as these is instrumental in gaining their comprehension and compliance.

Respect for intellectual property is an obvious starting point for discussing cyberethics with students, since it is an ongoing and increasing problem. Students have been copying information for school assignments forever, of course, but it has never been easier than it is today. Sites that sell or give away complete research papers abound on the net. A quick search engine query brought up such sites as BuyPapers.com, ResearchPapers.com, CustomWriting.com and SchoolSucks.com, offering some instantly downloadable papers free and others for nominal charges. Students can easily cut and paste any amount of text from a digital reference and add it to their own work. In a recent New York Times article, Dr. Donald McCabe described his surveys regarding student plagiarism in high school. He reported that more than half of students surveyed in one project reported downloading an entire paper or a substantial amount of text and pasting into a piece of work without citation. He went on to describe how some enterprising high school and college students have mastered the art of pasting copied text into a word processing application, using the program's auto-summarize feature, and then pasting the summarized results into their own papers in an attempt to foil the teacher's efforts to detect plagiarism. Dr. Jamie McKenzie, editor of From Now On, The Educational Technology Journal, suggests that such widespread student copying is indicative of "mental softness," which results in the "cut and paste mentality." Teachers need to combat such plagiarism in order to encourage students to really learn from their research and the experience of creating final products.

One of the best ways to combat these sorts of creative plagiarism is to give assignments that do not lend themselves to copying. The old standby assignment to write a three-page report on a given topic almost cries out to students to plagiarize. Having students present their final product in the form of a multimedia presentation, newsletter, annotated bibliography, or some other format precludes cutting and pasting if the assignment is designed carefully with that as one goal. Also, teachers and schools can use services such as TurnItIn.com, plagiarism detection software that scans student work and checks for plagiarized text. In order to really combat plagiarism, though, teachers and librarians must teach students that they should not plagiarize regardless of the nature of the task assigned, as well as find ways to detect or discourage their doing so.

Respect for intellectual property does not apply only to words. One area of concern regarding plagiarism is the use of graphics and images. As with words, pictures can easily be copied and pasted into reports. They are even more likely to be appropriated for multimedia productions, where the student may be less apt to copy text. Often students and teachers do not even think about the fact that copying artwork, photographs, and other images can also be defined as plagiarism.

This particular type of plagiarism raised concern in one Conroe ISD school, York Junior High, where the librarian noticed how frequently students were copying and using images without any regard for citing their sources. The librarian and two art teachers teamed up to increase student awareness of the principle of respect for intellectual property and graphics. They developed a lesson and a project to provide a positive alternative to copying images. The lesson covered copyright basics, and the project was to build a collection of student generated clip art to be given away royalty free as a service to other students and teachers. On the first day of instruction, the librarian led a discussion about copyright and gave short quiz to test students' awareness of the issues. Before the lesson, students were unaware of fair use and actually thought they had fewer rights to use copied words and images than they do. They were also uninformed about when and how to cite sources. The tests results and other class discussion focused on positive reasons to honor other people's work. The teacher and librarian asked students to put themselves in the place of an artist and imagine how they would feel to find their work taken, and even marketed by someone else. Another reason to honor copyright that students seemed to accept, was that it encourages original work. If there were not copyright, the librarian suggested, we would never hear a new song or see a new work of art. Everyone would use the same old things over and over, with only slight variations or adaptations.

Before they began work, students were given a brief waiver to sign that waived their royalty rights to drawings contributed to the site. Students were told not to submit anything that they might someday want to market, such as an original cartoon character that they might want to develop in the future. The class brainstormed various topics for drawings such as academics, sports, animals, holidays, nature, fun, sports, and others. By the end of class discussion, they were thinking about ideas for images to create.

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During the second class session, the students worked on clip art to contribute. The art teacher gave each student a four-inch square of white paper, and told students to fold the squares into fourths. Then she directed them to create drawings to fill each of the four one-inch squares, using colored markers, map colors, or crayons. The librarian brought in picture books to help generate ideas, but reminded students that work should be entirely original. Two areas of concern were gang related drawings and reproducing of cartoon characters not well known to the teachers. Students were reminded to avoid commonly used images in gang graffiti, and to refrain from reproducing look-alikes of popular cartoon and animated characters. Before posting any pictures, the school's police officer reviewed images for gang connotations. Students had two class periods to work on the pictures and could work on them at home as well. The resulting products were clever and colorful. Student assistants and the librarian worked together to scan the images and post them to web pages. The only editing done to images was to remove smudges or stray marks. Otherwise, any picture accepted for use was posted without digital altering. After completing the web pages, the librarian and teachers unveiled them to the school with much fanfare and praise for the unselfish sharing and original work on the part of all participating students. Quickly images started to appear on school web pages, teacher made handouts, in the school newspaper, and in student projects. Students continued throughout that year and subsequent years to add images. During fall 2001, due to the world situation, students decided patriotic images would be an especially important category. This additional collection grew rapidly with other topics receiving additions as well, and new topics being added as needed. Students expressed pride in their clip art collection and enjoyed seeing their images used by teachers and fellow students. They also enjoyed sharing the work with their families and friends via the school web site.

During the 2001-2002 school year the librarian and computer teacher decided to expand the clip art collection and involve computer students as well as art students, and to encourage submissions of computer generated artwork. They presented much of the same information to the students as the art teacher, but because the computer teacher wanted to take the students beyond the issue of plagiarism, the quiz also covered the issues of hacking and respect for privacy. Again results showed that students were unclear on many of the issues, and the discussion that followed focused on clarifying misconceptions. Students reviewed the existing clip art collection and agreed to increase and add dimension to the collection by contributing computer created creations. They signed release forms, as had their classmates in art class, allowing their work to be shared freely. The resulting images have increased the size and variety of the collection and have encouraged participation by additional students.

Conclusion

Today's children are growing up with computers in their schools and homes. Dr. Marin Berkowitz asserts that educators should not wait until high school or even junior high to talk to students about cyberethics. He suggests that 9-12 year old children can grasp basic issues and benefit from lessons about the ethical, legal, and safety issues related to computer and Internet use. Realizing this goal involves informing educators, incorporating the issues into instruction, and making ongoing awareness an integral part of how we instruct students regarding the responsible use of technology.

Helpful Websites: An Annotated Bibliography

Copyright Tips and Issues, West Loogootee ISD, West Loogootee, Indiana

http://www.sicc.k12.in.us/~west/online/copy.htm

This page offers many helpful links and considerations for planning an Internet web page and paying particular attention to the ethical issues involved.

Crash Course in Copyright:

http://www.utsystem.edu/OGC/IntellectualProperty/cprtindx.htm#top

This University of Texas site lives up to its title in presenting basic issues related to intellectual property and copyright for the layman.

The Cyber Citizen Partnership Page

http://www.cybercitizenship.org/

This site, created with a grant from the U.S. Department of Justice, is dedicated to teaching children safe and responsible use of the Internet.

Ethics in Computing:

http://courses.ncsu.edu/classes-a/computer_ethics/
The first page of this project is a site map resembling an actual map, with regions marked off for various ethical issues such as computer abuse, intellectual property, and privacy. Clicking on the locations leads to articles and activities relating to the respective issues.

From Now On: The Educational Technology Journal
http://www.fno.org
Jamie McKenzie, author and consultant, edits and publishes this web journal which has a number of excellent articles relating to technology and ethics.

Homepage for Doug Johnson, Author, Speaker, and Consultant on School Library Media Center Issues
http://www.doug-johnson.com/index.html
Doug Johnson, Director of Media and Technology at Mankato Schools, offers articles and activities related to ethics and technology.

Internet Do's and Don'ts
http://www.usdoj.gov/kidspage/do-dont/kidinternet.htm
The U.S. Department of Justice sponsors this site which stresses safe and responsible Internet use.

Original K-12 School Student Clip Art
http://www.shsu.edu/~lis_mah/documents/clipartportal.html
This is the royalty free clipart collection described in the article, created by students and teachers at York Junior High School, Conroe Independent School District, Texas.

Technology and Learning's Copyright Primer: Fair Use Copyright Quiz
http://www.halldavidson.net/Quiz%20.pdf
This pdf document is an interesting quiz for teachers and librarians, with answers provided.

The Ten Commandments of Computer Ethics:
http://www.cpsr.org/program/ethics/cei.html
This is the official web site for this document, offered by the Computer Ethics Institute.

Web Awareness: Knowing the Issues:
http://www.media-awareness.ca/eng/webaware/home.htm
Canada's Media Awareness Network offers this site. It has information and activities for students, parents, and educators regarding the Intemet and ethical issues.

References

Crystal, J., Geida, C. and Salpeter, J. (2000, November). The concerned educator's guide to safety and cyberethics. Retrieved October 19, 2001 from the World Wide Web: http://www.techlearning.com

Berkowitz, M. (2001). Industry expert research report. Department of Justice and Information Technology Association of America: The cyber citizen partnership. Retrieved October 21, 2001 from the World Wide Web: http://www.cybercitizenpartners.org/Berkowitz%20Report.htm

Jacobson, F. and Smith, G. (1998, March 1). Teaching virtue in a virtual world: Internet ethics for students. School Library Journal. Retrieved October 21, 2001 from the World Wide Web: http://slj.reviewsnews.com/

Johnson, D. (1998, November/December). Developing an ethical compass for worlds of learning. Multimedia Schools. Retrieved October 19, 2001 from the World Wide Web: http://www.infotoday.com/MMSchools/default.htm

McCabe, D. (2001, June 28). Lessons in the school of cut and paste. The New York Times. Retrieved October 21, 2001 from Proquest database on the World Wide Web: http://proquest.umi.com

McKenzie, J. (2000, May). Beyond information power. From Now On: The Educational Technology Journal. Retrieved October 20, 2001 from the World Wide Web: http://www.fno.org

Simpson, C. (2001, September/October). Copyright-free graphics. Knowledge Quest, 30(1), 36-37.

Wireless Instructional Strategies in the Humanities (WISH): Training Traditional Faculty for Change

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Abstract: Placing powerful technology tools in students' hands along with activities designed to encourage collaboration, exploration, and critical thinking, causes a role shift to occur. Students become researchers and presenters, constructing knowledge and adding it to a global knowledge base. Faculty who incorporate technology into their course work then can become guides and facilitators. However, the challenges created by this role shift require a reframing of our faculty development model. The Innovative Technology Center at the University of Tennessee designed and implemented a pilot project, putting powerful, wireless laptops into student and faculty hands. The Humanities area of Arts and Sciences was chosen for this project because they are typically underserved in terms of technology resources, yet rich in opportunities for collaborative work. With laptop computers, a versatile suite of software tools, and a customized WISH institute for training before project launch, our implementation team crafted a model faculty development project that addressed key aspects of transitioning traditional faculty to a more collaborative and dynamic learning environment.

Context of the WISH Project

"To ensure that America's students are the best-educated in the world, we have to have top-quality, innovative higher education; replicate the educational approaches that work; and take advantage of all the new technologies that can strengthen student learning" (Office of Postsecondary Education, 2001). Many voices agree that students need to emerge from their undergraduate experience equipped for the modern work environment. Employers state unequivocally that they want information-savvy, team-comfortable, and problem-solving employees. In a government report surveying the impact of IT on the American economy, the authors note that "Even for workers in non-IT jobs, basic IT skills are becoming a requirement....Educators, too, recognize the growing need for skilled workers and are designing curricula to include basic IT skills training..." (Office of Policy Development, 2001, p. 41). We must move rapidly toward creating learning environments in which students receive the skills, both cognitive and technical, which will enable them to succeed in the contemporary world. While curriculum content is the same as in a traditional classroom, the ways in which we engage students with this content need to be dramatically altered. So our team at ITC sought a way to bring technology out of the lab into the classroom and then examined one model for how to prepare faculty for new opportunities and challenges.

A pilot project involving the use of technology and collaborative methods, appeared certain to pose challenges for traditional faculty. The shift from teacher-centric to student-centric classroom does not follow a smooth path. From the inception of the project, the implementation team understood that resistance to change would appear, even among self-described innovators. This paper will describe the WISH institute as a creative vehicle for assisting faculty in transforming the classroom. The workshops of our WISH institute were designed to explore and create new strategies for delivering material and structuring classroom interactions. Our training focused on designing collaborative activities that would increase students' engagement with the material. We looked at ways to utilize common communication tools such as email and discussion forums to leverage the power of networked laptops to enhance writing and discussion skills. At every stage of the project, we gathered faculty feedback and addressed pedagogical and technical issues as they arose.

Transformation of teaching practice in higher education requires a convergence of initiatives and the vision to identify opportunities for pedagogical research. In the WISH project, three university groups, the Network Services, ITC, and the College of Arts and Sciences, converged to allow exploration of numerous issues of critical importance today as higher education responds to the call for change in the way it educates students. The campus-wide wireless initiative was launched by the administration in the summer of 2001 and is being implemented by Network Services. The Innovative Technology Center brings together faculty development specialists, instructional designers, network and programming specialists, and graphic designers, to serve the pedagogical needs of the entire faculty. The College of Arts and Sciences, traditionally underserved in terms of access to technology, offered us access to traditional faculty who had expressed a desire to explore new pedagogical possibilities.

University Wireless Initiative

An administrative push for a wireless campus network had created the context within which the project unfolded. In the summer of 2001, The University of Tennessee was launching one of the largest 802.11b wireless initiatives in the United States based on number of access points, and the WISH project was developed concurrently. (For more information, please see http://wireless.utk.edu). This simultaneous development of initiatives, one technical and one pedagogical, added to the challenges we faced, but also offered extraordinary opportunities to observe how faculty and students function and adapt in an experimental environment. One of the first casualties of the project was the collaborative networking software, whose primary purpose was to permit the instructor to call up a student's screen onto the laptop connected to the projector. As Network Services added security layers to the wireless rollout and as they expanded the subnets, the collaborative software proved unable to negotiate clients on a network that dynamically assigned IP addresses to individual machines. The software had functioned well in a static IP environment, but simply collapsed when dynamic host addressing was introduced. However, it had functioned long enough to allow us to see the enormous potential for true exploratory sharing. In their Final Reports, several WISH participants referenced the teaching potential of this software, so our search for that particular tool continues. A positive convergence emerged from the classroom renovation project that was occurring concurrently. Smart classrooms were being created across campus, and our participants saw a concerted University effort to provide technology-enhanced learning environments for instructors and students.

In addition, the wireless cards often experienced difficulty when they tried to connect to the network through a malfunctioning access point. Unfortunately, the task bar icon which indicated a network connect was not discriminating enough to know that the access point was not offering "access" to the Internet. The network monitoring software also gave false positive readings for these "live" but malfunctioning access points. Much frustration and confusion ensued. Trouble-shooting these early obstacles proved time-consuming for our network specialists and frustrating for the instructors who simply wanted the technology tools to work.

Innovative Technology Center

The WISH Pilot Project was framed from the very start as an exploration of how to redefine the traditional classroom in a networked environment as well as the diverse support issues surrounding the University's wireless initiative. We invited faculty who wanted to establish innovative teaching practices and explore research possibilities related to implementing wireless computing in a classroom setting to apply for participation. We asked what the classroom might look and feel like when powerful computing potential was wedded to collaborative activities, specifically designed to challenge students to critical thinking and problem-solving. Unlike traditional grants, this call for proposals was open-ended in unusual ways. We asked for faculty willing to re-examine their traditional teaching strategies in the light of new possibilities offered by mobile, networked classrooms.

Supporting the project successfully involved a group of professionals with a wide range of expertise, a shared desire to expand definitions of teaching and learning, and a commitment to customer service. The implementation team consisted of the Director of ITC with her humanities background behind a doctorate in instructional technology, our technologies integration specialist, a web instructional technologist with a strong humanities background, and a program coordinator who handled technical issues, group communications, and the complexities of scheduling the two carts filled with laptops. In addition, the program coordinator did in-class training on the use of the laptops and the network, thus freeing faculty to concentrate on reframing the learning environment. Brainstorming sessions had launched the project and the team met regularly to deal with the issues as they arose.

College of Arts and Sciences

"Deep, hands-on learning through research is commonplace in the sciences, but it is more challenging to design these experiences for students in the humanities." (Brown, 2000, p. 222). Our project was deliberately crafted to examine the pedagogy as well as the mental maps of traditional instructors whose previous access to technology-rich environments had been limited. Thirteen faculty from Modern Foreign Language and Literature, Political Science, English, History, Philosophy, Religious Studies, African-American Studies, and Human Services were chosen to participate in the project. The courses impacted ranged from "Images of Jesus" in the Department of Religious Studies to "Introductory Conversational Portuguese" in the Modern Foreign Language and Literature department. Several WISH team members possessed strong humanities backgrounds and were intrigued by the idea of developing workshops to transition traditional faculty to new ways of constructing learning experiences in a networked environment. After putting out the call for proposals to this college and establishing project parameters, we then developed the WISH Institute to frame the key issues and open the dialogue. We now faced the conceptual challenge of moving instructors from lecture and face-to-face discussion paradigm to new ways to engage their students with course material. A shift in the structure and interaction in the classroom challenges faculty in two ways: their comfort level with the technology itself and their comfort level with new ways of designing and implementing learning activities.

Project Requirements

The call for proposals asked about faculty willingness to innovate and to explore current pedagogy with an eye to transforming it. The call asked about current uses of technology in teaching and thoughts on potential for change. From the pool of proposals we selected only 14, based upon our ability to offer ideal support as well as upon the energy and commitment we sensed in their writing. In addition, we deliberately chose faculty with diverse skill levels. The selected faculty received a fully equipped wireless laptop, a suite of software tools, and a stipend. In return they were required to commit to the project requirements.

- Integrate wireless laptops in your course for a minimum of 1/3 of the semester.
- Participate in the WISH Summer Institute. The WISH Summer Institute will require six hours of core classes (to be held at ITC) and ten hours of individualized training (that can be defined through flexible learning opportunities). The core classes will address technical, instructor-centered, and student-centered strategies. The individualized training will focus on reshaping the curriculum and content in order to make maximum use of networked resources.
- Attend bimonthly meetings with the ITC WISH Implementation Team (WISH IT) to be held for the duration of the project.
- Conduct student assessment at the end of the Fall 2001 term. ITC will provide the basic assessment tools.
- Participate in a WISH Faculty pre - and post-project assessment.
- Submit a final report.

WISH Institute

The WISH Institute held in the summer of 2001 directly addressed the challenges of weaving collaboration and connectivity into the traditional classroom. After surveying participants to identify their comfort level with software, hardware, and networks, the implementation team developed three courses to address pedagogical and technical issues and prepare the foundation for our research interests. The first course, "Technical Strategies for Wireless Laptops," focused on basics of handling, maintaining, and using a laptop computer. Issues included battery charging, hooking up projectors, and mobility across campus subnets. Participants discussed multiple log-ons, the realities of shared bandwidth, and explored classroom management issues. Laptops were stored on a "mobile" cart, but the term "mobile" was a stretch and negotiating crowded hallways and multiple floors challenged the instructors as well as the support staff. Each cart contained 16 PC laptops and one projector.

The second course focused on "Instructional Strategies for the Wireless Classroom." The University uses Blackboard as its course management system and our Institute addressed some of the built-in tools. Participants explored strategies for maximizing use of networked resources, from managing email to receiving assignments via the digital dropbox in Blackboard. We discussed how to manage increasing numbers of email messages to designing a discussion forum topic that would engage students in dynamic, professional discourse. We examined strategies for integrating the Web into the classroom environment. We went on virtual field trips and used a web-page archiving software to capture a website to the hard drive, in case of connectivity failure. Noted one WISH participant, "I have also learned and have re-committed myself to the notion of planning back-up lessons. When working with the wireless, my thought is that three backup plans are necessary…." (Woodside, 2001).

The final course, "Collaborative Models in the Wireless Laptop Classroom," explored ways to group students for effective collaborative work through issue groups, triads, and collaborative writing teams. We shared possible methods for assigning students individual roles based on divisions of labor to enhance learning. Participants ventured on a "webquests about webquests," in order to experience both the structure of a webquests and the way it felt to work collaboratively toward an end product. One of the key obstacles to faculty adopting collaborative, problem-based learning is the challenge of assessing both the process and the product, so we assembled readings and samples of assessment tools to address this potential barrier.

In addition to the six-hour WISH Institute, faculty were asked to schedule an additional ten hours of customized support, based on their curricular plans and their levels of expertise. Paul Hagner has noted that "many faculty, especially the Risk Aversives, need flesh and blood support to make their transformation." (Hagner, 2001). The WISH implementation team provided that "flesh and blood support" to assist these instructors in transforming their teaching as well as the learning environment.

Conclusions

We had initiated an ambitious project and garnered many insights from our experiences. Our greatest insights and understandings came from carefully watching these faculty members as they moved through the experience. Our recommendations emerge from a careful examination of the project as an experiential whole. Two major categories deserve addressing, technical and teaching/learning.

In the technical arena, expect heavy support demands and meet each demand with patient attention. Always expect the unexpected. The recognition of the false positives on connectivity did not emerge until we began to deconstruct the entire project, in search of areas to address in the next iteration. In addition, we would caution that you be very selective about the software that is included in the package for faculty and students. Two critical pieces of software, the collaborative networking software as well as the networked writing environment software, did not function as advertised, causing mutual frustration all around. In addition, the critical website capture tool did not function as efficiently as we had hoped as a backup tool. Increasing faculty comfort level with these new tools is essential. Student comments at the close of the project indicated that they were keenly aware of the impact on the learning environment of a faculty's readiness to use technology tools effectively.

In the area of teaching and learning, we recommend staying focused on pedagogy, instructional design, and multiple strategies for using the tools, even as the project seems enmeshed in technical challenges. Deliberately create community around the project and plan for its continuation. Only through rich dialogue will we move together into the future. Communicate constantly with all stakeholders, using all the tools available, from the ubiquitous email to discussion forums, to bi-monthly debriefings, and micro-teachings where successes are shared.

Success can be measured in many ways. Thanks in part to the range of faculty skill levels, we were able to note a wide range of successful learning strategies. One technically literate faculty member restructured an entire course around the wireless laptops. She comments in her final report, "I thought about why I was doing what I was doing in the classroom, right down to the last detail" (Kelly, 2001, p. 1). Another instructor used the brainstorming tool, Inspiration, for a collaborative exercise within one class. His initial, small success allowed him to be more aware of the possibilities for enhancing language learning with such tools.

As James Ellsworth notes, "When change is being driven by changes in the society around us (a suprasystem), we must be willing to rethink everything about the way you teach and learn (Ellsworth, 1997, p. 6). The WISH project, with an ambitious team of four ITC members, began the journey to identify the training that would empower the traditional faculty who have long been the mainstay of our universities to become the innovative teachers of the next generation. The task is urgent; the challenge formidable, and the journey exciting in every way.

Acknowledgements

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References

Brown, David G. (2000). *Interactive learning: vignettes from America's most wired campuses*. Bolton, MA: Anker Publishing Company, Inc.

Ellsworth, James B. Technology and change for the information age. (1997). http://horizon.unc.edu/projects/monograph/CD/Change_Innovation/Ellsworth.asp (24 April, 2002).

Hagner, Paul R. Interesting practices and best systems in faculty engagement and support. NLII National Learning Infrastructure. (2001). http://www.educause.edu/ir/library/pdf/NLI0017.pdf (24 April, 2002).

Kelly, Janet. WISH final report. (2001). http://itc.utk.edu/grants/wish2001/kelly_final.shtml (25 April 2002).

Office of Policy Development. (2002). Digital economy 2002. US Department of Commerce, Economics and Statistics Administration. http://www.esa.doc.gov/508/esa/pdf/DE2002r1.pdf (24 April, 2002).

Office of Postsecondary Education. (2001). zPrograms of the Office of Postsecondary Education. http://www.ed.gov/offices/OPE/programs/helping.html (29 April 2002).

Preston, Ana and Predrag Radulovic, ed. (2000).
Wireless technology at University of Tennessee Knoxville Campus. http://volnet.utk.edu/wireless/wirelesspaper.html (25 April 2002).

Sulla, Nancy. "Winning teachers over: how you can battle resistance to technology -- and win." (1998). http://www.electronic-school.com/0398f2.html (25 April 2002).

Woodside, Marianne. (2001). WISH final report. http://itc.utk.edu/grants/wish2001/woodside_final.shtml (25 April 2002).

Wireless Networking at UT. (2002). http://wireless.utk.edu/ (25 April 2002).

A Rose By Any Other Name Could Be a Daisy! How the Words Might Make a Difference.

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Faculty do not often engage the problem of designing research tools that evaluate the effectiveness of specific technologies in teaching/learning. When we do, we most often defer to student comments (e.g., "I liked the PowerPoint slides a lot!") which tend not to be very analytic or to our own informal observations. While data from a well-designed research study would help us to make better choices regarding pedagogical strategies using technology, it seems more common that we make those choices based on "teacher's instinct" and "what I like to do." It is hard to justify using the very latest technology simply because it is exciting and new. It is equally difficult to argue that we should teach students presentation skills when our content area is math.

Clearly the complexities of pedagogy stand in the way of developing assessment tools that evaluate the real impact of technology in teaching/learning in complex subject domains. Not only do teachers need to consider student learning styles in designing instructional materials, but they must also take into account the needs of their discipline as well as their course content, development, texts and objectives. Much of the literature on developing technology for learning seems to focus on the potential of the hardware/software toolbox rather than the potential of the learner.

In this short paper, I propose to develop and explore a taxonomy of characteristics specific to different educational disciplines. I do not expect this list to be exhaustive. The goal is to develop a research question that identifies discipline-specific needs that can be linked with specific technology-using pedagogical strategies (Benney, 1999). I suggest that the following list of "Primary Course Characteristics" illustrates my beginning point. To each is attached descriptive attributes and what seems to be an obvious connection with a discipline, a field of study or a specific learning problem. This is an exploratory and experimental approach.

Primary Course Characteristics:

1. Content intensive -- the major emphasis here is factual information presented in formulas, laws or contained in a relational database. There are many applications from engineering data to the phone book. Historical information certainly needs a factual base, but most historians would claim it is more than that.
   Comment – It seems obvious that presentation software, web pages and video, like text, can present even relatively complex factual information. But can a documentary film present the information needed by a history class in a way that simple text could not? Would a 30 minute "talking head" interview with an eye witness to the Vietnam war provide a more interesting learning experience than six 5 minute clips on various aspects of the same topic? What is appropriate for the content needs of the course?

2. Analytical -- reducing an idea to its logical components, but also in a laboratory setting (broadly defined), the strategy of experimentation.
   Comment – The noted scholar of Theology, Bernard Cooke has suggested that the biggest problem in undergraduate education today is that students cannot read! He explains that students cannot extract information – analyze the information – from text (Benney, A. (2001). How can technology be used to exemplify analytic skills and/or to demonstrate the process? When the process is the objective, it seems experience becomes more important than data.

3. Poetic – the use of words or images in a metaphorical and imaginative way to stimulate the creative interpretation of the learner. This could be practical in developing inventions or simply entertaining.
   Comment – Is it possible to teach creativity? Or can it only be exemplified? Does using a computer to demonstrate puzzles that have multiple solutions or requiring students to develop their own problem-solving web sites encourage creativity? This is another example of a process being central to the learning objective.

4. Organizational -- More the development of managing strategies, but also implies the need to understand social and psychological structures in a practical way.
   Comment – The use of role playing games as well as video presentations of cases for discussion and analysis have the potential of teaching (again by example) the skills needed for management tasks. Simulations have an effective application in many educational settings. For example, a flight simulator lets you learn from your mistakes and walk away unscathed.

5. Theoretical -- Similar to "Poetic," tries to get at the underlying reasons for why things are the way they are; grounded in fact and logically constructed.
   Comment – Are students so programmed that they think every question has an answer or is it possible to teach the hypothesis behind the question? Perhaps concept mapping that layers the question could exemplify the process of developing theories.

6. Sensory -- certainly oriented towards entertainment and enjoyment. Art, music and theater dramatizes the human environment. But the skill of a surgeon as well as a pilot have a sensory element.
   Comment – One of the best examples of an application of media to support this characteristic is M-TV. What is missing from a flight simulator is the "feel" of the controls – something essential to actual flying.

7. Manipulative -- forming artifacts from raw materials as in any manufacturing or construction process. The process itself is described in a complex series of interrelated steps.
   Comment – This is a clear case of providing instructions using video examples or animated step-by-step cases. But either the students must commit the process to memory or have the example available at the time of need.

8. Linguistic -- the basic art of communicating through words, symbols and images requires both the memorization of vocabulary as well as the experience of syntax and grammar none of which may have any rational foundation.
   Comment – The benefits of audio tapes, video and animated clips are well documented in language learning. Repetitive hearing, seeing and doing clearly facilitate the development of communication skills. But motive still remains a problem and it would seem that the task of memorizing vocabulary would make text more useful because it is more portable. Can technology motivate or would the possibility of contacting foreign language speakers via the web discourage learners who progress slowly?

This list is not final, but is intended as a place to begin a conversation. I hope that discussions with technology users/teachers from different content areas will lead to a refinement and clarification so that it might be possible to use these discriminators to design multimedia applications that are appropriate for discipline specific objectives.

Partial Bibliography

Benney, A.. (1999). 'I Made You Look You Dirty Crook, You Stole Your Mother's Pocketbook!' How To Surprise Your Students With the Opportunity to Learn. *Proceedings of Ed-Media – Ed-Telecom 99*, Charlottesville, VA: Association for the Advancement of Computing in Education.

Clark, R. E. and Craig, T. G. (1992). Research and Theory on Multi-media Learning Effects. In M. Giardina (Ed.), *Interactive Multimedia Learning Environments. Human Factors and Technical Considerations on Design Issues* (pp. 19-30). Heidelberg: Springer.

Kozma, R. B. (1991). Learning With Media. *Review of Educational Research*, 61(2), 179-211.

Liu, M. and Reed, W. M. (1994).The Relationship Between the Learning Strategies and Learning Styles in a Hypermedia Environment. *Computers in Human Behavior*, 10, 419-434.

Building a Molecular Workbench: Underpinning Core Science Concepts

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To develop a scientific way of reasoning and to understand macroscopic phenomena discovered by modern science and their applications to practical fields such as nanotechnology, molecular genomics or proteomics, students need robust mental models of atoms, molecules, and their interactions. Such understanding allows students to grasp what lies at the heart of modern biology, chemistry, and physics. There is considerable evidence that students have major misconceptions about atoms and molecules, and few ideas about how the forces and motions at this scale relate to macroscopic properties.

The Molecular Workbench project (http://www.concord.org/workbench/index.html), which is funded by the US National Science Foundation, is studying the effectiveness of using highly manipulable molecular dynamics models to enhance student learning. It facilitates learning through the use of guided inquiry about the connections between microscopic and macroscopic properties of materials. To this purpose we are creating atomic-scale models, several macro-scale simulations with interactive Flash applications, and are using an integrating language called Pedagogica. In collaboration with teachers, instructional materials using these tools are now being tested in a variety of middle and high school classrooms.

Our *Molecular Workbench* model can already demonstrate states of matter, gas laws, phase change, latent heat, diffusion, gas absorption, osmosis, thermal diffusion, conformational changes, and some of the properties of liquid crystals. Using scaffolded models and supporting curricula, students are able to predict new micro-macro connections.

The *Molecular Workbench2D* and *Molecular Workbench3D* (formerly called *Oslet*) are molecular simulation engines developed for the project. *MW2D* is written in pure Java. *MW3D* is written in Java and Java3D. The models are based on molecular mechanics, an important part of contemporary computational chemistry and biology. MW2D develops an object-oriented framework (OOF) for interactive molecular simulations. The core of OOF provides software abstractions of basic objects for atoms, molecules, fields, boundaries, data sets, and the interactions among them. *MW2D* consists of four major functional modules: a builder, a viewer, a simulator, and a data analysis environment. The software abstraction model in the OOF provides the interfaces for these modules to interact and integrate.

Pedagogica, which was developed by Paul Horwitz originally to control a genetics simulation called *BioLogica*, has now been interfaced with *MW2D*. *Pedagogica* simplifies the conversion of open-ended models and tools into learning activities that support guided inquiry and generate specific, useful assessment data. We call the combination of a model with *Pedagogica* a "hypermodel".

Pedagogica is a client application that controls models and their appearance, displays what options are available, receives input concerning the state of the model, controls the interactions with the user, and coordinates other resources that might be used with the model. Pedagogica not only facilitates student choices, but also queries the users and monitors their progress.

The curriculum activities are designed to encourage students to uncover key attributes of molecular systems, develop their own models, and test these against a professional model. Proprioceptive activities with visual feedback, a "virtual construction kit" to arrange molecules in polymer chains, explorations with interactive models followed by discussions revealing the explanatory and predictive power of the models – all work to build and enrich the student's mental models of the connection between macroscopic phenomena and molecular worlds.

Eight curriculum activities on Atoms in Motion, and a week-long "mini-unit" on States of Matter, both based on atomic-scale models have undergone formative testing and are now undergoing summative testing in public middle school 8th, 9th and 11th grade classrooms. The activities include integrated hands-on labs, computer modeling, and kinesthetic modeling activities. New research modules on Chemical Bonds and Solutions will be tested this Spring and Fall.

Our primary research questions are:

- Does experience with such a tool help students in 8-9th grades internalize accurate mental models of atomic-scale phenomena, and
- Does this in turn help them become more expert in reasoning about phenomena at different levels, from micro to macro.

We are conducting our research now. Students to date have been highly engaged, responsive in discussions, and have made connections between the various types of activities conducted. For example, they performed a computer simulation and a kinesthetic simulation of kinetic energy exchange between gaseous atoms during collisions—in other words, heat transfer through direct mixing of atoms. Their written responses regarding these activities indicated that most found both the computer and kinesthetic experiences helpful in understanding the concept and that doing both of them was better than doing one or the other.

For more details about the project, including the software, images and descriptions of activities, scripted hypermodels, and curricula, see: http://www.concord.org/workbench/download.html

Boris Berenfeld, co-PI: Dr. Berenfeld oversees the curriculum design and development. With a Ph.D. in radiation biophysics, he combines his interest in frontier science, curriculum design and networking technologies to advance the quality and accessibility of science education. His current research involves innovative approaches to teaching biochemistry through visualization. He has led innovative educational initiatives in Russia, Europe, Latin America, United States and in the Middle East, organized several East-West Conferences on New Technologies in Education, and served on the faculty of the Salzburg Seminar.

Qian Xie at the Concord Consortium is the primary scientist on the project, responsible for developing the algorithms and designing the Molecular Workbench code. Dr. Xie is a computational scientist with a PhD in Materials Physics from University of Science and Technology, Beijing, and post-doctoral experience at the Max Plank Institute in Dresden and at the University of Cyprus. He has developed the *Molecular Workbench* core software.

Dan Damelin teaches Chemistry and coordinates the computer lab at Lincoln-Sudbury High School. With a MAT from Tufts in Chemistry, Biology and General Science, and a triple major BA from Tufts that included computer science, he has been able both to develop and to test Molecular Workbench activities.

Changing Places: A Case Study in Adapting an Educational Pen-based Groupware System for use at a Distance

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Abstract: This paper presents a case study in adapting an existing educational pen-based groupware system for use in a distance-learning environment. After reviewing the key characteristics of the original educational groupware system, we describe our motivation for adapting the system for use at a distance. Next we describe the process that was used to carry out this adaptation, the problems that were encountered, and the resulting solutions that were developed. The paper concludes with the results of a user study demonstrating that the modified system can be successfully used at a distance.

Background and Introduction

Software that supports cooperative work, often called groupware, is commonly classified as belonging to one of the four quadrants of the time-place matrix shown in the following table (Ellis et al. 1991).

	Same Time	Different Times
Same Place	I	II
Different Places	III	IV

Table 1: Groupware Classification

For example, on-line chat systems belong to quadrant III of the matrix, while electronic mail systems belong to quadrant IV. The interested reader is referred to (Baecker, 1993) for an excellent overview of groupware systems including some examples of educational groupware that fall into each of the time-place categories noted above. The goal of the current paper is to describe a case study in "changing places"; specifically we describe our work in adapting an existing pen-based educational groupware system from the "same time, same place" paradigm to the "same time, different places" paradigm.

In the remainder of this introduction we describe the **D**ePauw **E**lectronic **B**lack **B**oard for **I**nteractive **E**ducation (DEBBIE), a groupware system originally developed by the first author for enhancing the way students and teachers share written information during class (the DEBBIE system is patent pending). In subsequent sections we describe the process of adapting DEBBIE for use in a distance environment, the obstacles we encountered and our progress in overcoming them, and an evaluation of the resulting system.

DEBBIE was originally designed as a same time, same place groupware system and has been in regular use since the spring semester of 2000. Courses that use the DEBBIE system meet in DePauw's electronic classroom, which houses one instructor station and sixteen student stations (Fig. 1). Each of these seventeen stations is equipped with a Pentium PC that uses a high-resolution flat-panel pen-based video tablet as its display device (see WACOM 2001). Our electronic classroom is distinguished from others that are described in the literature (see for example Shneiderman et al. 1995) by the fact that users can control the computers using a special electronic stylus in addition to using a keyboard and mouse. For example, when running a standard "paint program," a user can use the electronic stylus to make a sketch by drawing freehand directly on the surface of the video tablet. Allowing this type of freehand input is extremely useful when teaching topics that are hard to draw using only a keyboard and mouse. Examples include diagrams of molecules in a chemistry class, graphs in an economics class, complex formulae in a mathematics class, musical notation in a music theory class, and finite state machines (Fig 1.) in a computer science class.

The teacher's station is attached to a large rear-projection electronic whiteboard (see SMART 2001) located at the front of the room. The image from the teacher-station's video tablet is also displayed on the electronic whiteboard. Since the electronic whiteboard is touch-sensitive, the teacher can use a finger (or just about anything else) to draw directly on the surface of the board as an alternative to writing directly on the video tablet. The display on the electronic whiteboard is approximately five feet wide by four feet high and requires approximately four and one-half feet of space behind it for the projection system. In our classroom the projection system actually sits behind the classroom's front wall so that the display surface of the electronic whiteboard is flush with the standard (non-electronic) whiteboards that flank it on each side.

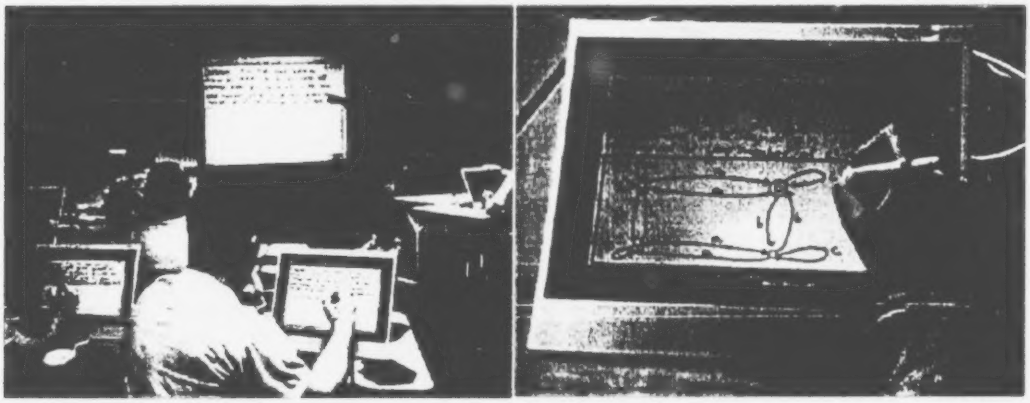

Figure 1: Electronic Classroom

DEBBIE allows the students and teacher in a pen-based electronic classroom to share written information during class. For example, when using the system, the teacher can extemporaneously draw freehand sketches directly on the surface of the teacher-station's video-tablet or electronic whiteboard. The teacher can also use a keyboard to type material, and can import material that was prepared ahead of time for use during class. All information sketched, typed, or imported by the teacher is transmitted over a network so that it appears on each student's video tablet.

Each student can write freehand on his or her display to make private annotations to the teacher's material. During class the teacher can import portions of a student's workspace for viewing and discussion by the entire class. Because of this, class sessions tend to unfold as highly interactive activities. In a typical scenario the teacher first presents some new material to the class and then asks the students to sketch answers to problems that are related to this material. The teacher then uses the system to share some or all of the student's answers with the class, responds to questions about these answers, offer alternative solutions, and determines if the class is ready for new material in which case the cycle repeats.

In order to accommodate an entire class session, each user's workspace is indefinitely scrollable in the vertical direction like a word processor, and each user can scroll through the workspace independently of the other users. At the end of the class period each user's workspace can be printed or saved for later retrieval. Portions

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of the workspace can optionally be "replayed" in a stroke-by-stroke fashion that, for example, allows a student to review how a complex diagram evolved. The reader who is interested in more information about the software itself is referred to (Berque et al. 2000) for a more complete description of the system's user interface.

The first author has taught four upper-level college classes that were delivered entirely using DEBBIE, and other faculty members have used the system to conduct individual class sessions in several other disciplines including mathematics and history. Attitude surveys demonstrate that students believe they are more attentive when using the DEBBIE system and that they prefer this environment to a traditional classroom. While admittedly anecdotal, comments from anonymous student course evaluation forms also indicate student satisfaction with the system (Fig. 2). The interested reader is referred to (Berque et al. 2001) for a more detailed and quantitative description of students' reactions to the system.

> *This level of interection in this class is more than I have experienced in any other class. There is a lot of interaction between the teacher (you) and us that has been very valuable. I don't think this could have been achieved outside of the DEBBIE classroom.*

Figure 2

The Adaptation Process: Motivation, Goals, and Methods

Our motivation for adapting the DEBBIE system for use at a distance stems from several sources. First, instructors at other schools have expressed interest in using the DEBBIE system to support traditional synchronous distance education classes where some or all of the students may be taking classes from a large number of remote locations. We also envision more limited scenarios in which the students and faculty may be located at only a small number of locations. For example, the Computer Science Department at the authors' home institution does not currently offer a course in "Analysis of Algorithms" although such a course is offered by the Computer Science Department at a neighboring college located approximately thirty miles away. Conversely, the neighboring college does not offer a course in "Human Computer Interaction" although such a course is offered at the authors' home institution. It is easy to see that an agreement enabling students at each campus to take classes from the other school remotely would be mutually beneficial. Each school could provide a distance-learning classroom with network and audio connections to the corresponding room at the other school. In this case all of the students would attend classes in one of the two classrooms.

As we began to consider what would be required to adapt DEBBIE for use in a distance education environment we decided to operate within a framework formed from several underlying assumptions. First, we assume that DEBBIE classes will be delivered synchronously since DEBBIE's feature set is built around the notion of same-time interaction. In addition we assume that DEBBIE will be used to transmit data between the teacher and students, while an external system such as a telephone-based or internet-based conference call will be used to provide a bi-directional audio link. Since reliable and inexpensive audio links are readily available, we see no reason to try to replicate this functionality within the DEBBIE system. Further, since fast, reliable, inexpensive video links are less common, we assume that none will be available for use during a DEBBIE class. Thus we need to ensure that users can interact using DEBBIE even if they cannot see each other. Finally, and most importantly, we strive to provide the same feature set for remote users that we have been providing to local users of the DEBBIE system for the past several years. For example, since students who are in the same room as the teacher can use DEBBIE to share their work with the rest of the class, we insist that remote users have access to the same functionality.

Major Problems Identified and Resolved

Working within the framework outlined in the previous section, we developed a list of problems that would interfere with the use of the original version of DEBBIE in a distance environment. These problems were then categorized as "critical", "high priority", or "low priority." Problems were assigned a critical rating if DEBBIE simply could not be used in a distance environment until this problem was resolved. An assignment of "high priority" indicated that a solution to the problem would significantly enhance the experience of remote users, while the "low priority" category was used for problems whose solution would have less of an impact. This problem categorization was subsequently used as a guide during the development phase of the project as we designed, implemented, and tested solutions to the problems starting with the critical ones. Approximately ten problems were addressed during the process of augmenting the DEBBIE system for use in a distance environment. Although a detailed description of every problem is beyond the scope of this paper, we summarize several of the problems and their associated solutions below (Tab. 2). The problems were selected to give the reader a feeling for the range of issues that were addressed.

Descriptions of Example Problems	Associated Solutions
Problem 1. Students at a remote location cannot see the electronic whiteboard by glancing at the front of the room the way local students can. Therefore, if the teacher points to an item on the board and says "Look how this works..." the remote students will have no way to know what the teacher is pointing to.	**Solution 1.** The augmented version of DEBBIE includes a new telepointer tool. Selecting this tool causes a pointer icon to track the teacher's hand movements on the electronic whiteboard or video tablet. Since this icon is also displayed at the corresponding location on each student's display, the students can easily determine what the teacher is pointing to.
Problem 2. Since each user's scroll can be positioned independently of the other users, students at a remote location will experience difficulty each time the teacher's scroll is moved to a new position. Local students can glance at the electronic whiteboard at the front of the room, notice that the teacher's scroll has been repositioned, and then reposition their scrolls appropriately. However, remote students have no way to get this visual feedback.	**Solution 2.** We added a toolbar button to the student version of DEBBIE that displays one of two images to signify whether or not the student's scroll is currently synchronized with the teacher's scroll. If the student's scroll is not synchronized, the student can click on this button, which causes the scroll to be adjusted appropriately. We also added an auto scroll feature which, when enabled, causes a student's scroll to adjust automatically as the teacher's scroll position changes.
Problem 3. When working with local students, the teacher can simply look into the classroom to see who is present. This can help the teacher to determine when enough students have arrived to start class, who to mark absent for a given day, and who to call on to answer a question. However, when dealing with remote students the teacher has no easy way to sense who is participating in the current class session.	**Solution 3.** The augmented version of DEBBIE requires each student to log into a DEBBIE session with a username. The teacher can then display a list of the currently connected users, and can use this list to import portions of selected student's notebooks. Students who join the class late will be added to the list as soon as they are connected and they will automatically receive the content transmitted by the teacher earlier in the class.
Problem 4. The teacher can transmit hypertext links (to spreadsheets files, movie clip files, etc.) to the students by inserting the links into the electronic notebook. If the linked files are located in a shared directory on a local area network, each local student will then be able to open the file. Since remote students will generally not have access to the local area network, they will not be able to open these files.	**Solution 4.** In the augmented version of DEBBIE the teacher can transmit a hypertext link that refers to a URL for the external file. The first time the student clicks on this link an FTP client is automatically launched to download the specified file to the student's PC. To handle subsequent references to this file by the student, DEBBIE simply opens this local copy of the file.

Table 2: Example Problems and their Solutions

Evaluation and Results

After receiving approval from the Institutional Review Board (Human Subject Review Board), we invited seven Computer Science majors to participate in a usability test to determine whether or not the augmented version of DEBBIE could be used in a distance education environment. All seven students agreed to participate in return for a gift certificate to a local restaurant, and they met as a group with the authors in our electronic classroom in order to begin. After signing an informed consent form, each student was given a pre-test consisting of six questions on the topic of "Regular Expressions." This topic was selected because: (a) we believed most students would have little prior experience with this area of Computer Science, (b) it is a topic that the first author regularly teaches in one of his advanced classes and therefore he had a good sense of how to present the material, and (c) the topic involves complex notation that is best explained using free-hand sketches.

After the pre-tests were collected, the students were given a five-minute orientation to the DEBBIE system. During this orientation the students learned how to create a new electronic notebook, connect to a network session, draw and erase using the electronic stylus, and navigate through the notebook. At the conclusion of the orientation session the first author went to a nearby classroom that had been temporarily equipped with a PC running the teacher's version of DEBBIE. A bi-directional audio link, external to the DEBBIE system, had previously been set up between the teacher's classroom and the student's classroom. When the teacher arrived at his classroom, he used the audio link to tell the students to connect to the DEBBIE session. The teacher then used the DEBBIE system to monitor the students as they connected to the session.

When the teacher saw that all of the students had connected, he began to teach a thirty-minute class on the topic of Regular Expressions. The class started as a lecture with the teacher presenting new material by transmitting extemporaneously drawn free-hand sketches using DEBBIE while simultaneously offering an oral explanation. During this time the teacher frequently used the telepointer to focus the student's attention on specific content matter, and the students used the auto synchronization feature to keep their scrolls synchronized with the moderator. The students were also free to use their electronic pens to make personal annotations alongside the instructor's material. Next the teacher had the students work through several interactive exercises that required the students to sketch answers to problems using their electronic pens. At the end of each exercise the teacher collected the student's answers electronically and quickly read them over in order to gauge how the class was doing. At several points the teacher chose to share one or more student solutions with the entire class so that alternative approaches could be compared. While explaining the correct answer to one of these exercises the teacher intentionally introduced a mistake into his explanation. In response the student participants quickly interrupted the teacher by calling out a correction thus providing additional evidence that the students were actively following the session.

At the conclusion of the class the students were given a post-test consisting of exactly the same questions that comprised the pre-test. A faculty colleague in the Computer Science Department who was not associated with this study graded the pre-tests and post-tests. The tests were provided to the faculty member in coded format so that he could not tell which were pre-tests and which were post-tests. In addition, the student's names were not revealed to the faculty grader. The results (Tab. 3) indicate a dramatic improvement on the post-test scores as compared to the pre-test scores.

	Pre-Test	**Post-Test**
Low Score	0%	67%
Mean Score	27%	91%
High Score	73%	100%

Table 3

After completing the post-test, the students answered some questions that were designed to measure how well they perceived they had learned the material. These questions were answered using a semantic differential scale with endpoints defined with 1 meaning *very comfortable* and 5 meaning *not at all acquainted*. When the students were asked to use this scale to rate the statement *"Prior to participating in the session today how comfortable were you with the concept of a Regular Expression?"* the mean response was 4.4. When the students were asked to rate the statement *"After participating in the session today how comfortable were you with the concept of a Regular Expression?"* the mean response was 1.6.

The user test described in the previous section was carried out using computers located in close proximity to each other and connected to the Internet via a relatively fast 10-megabit local area network. In order to determine the responsiveness of the system when used in a variety of different configurations, we carried out several additional tests. Specifically, we measured the time required to transfer a section of an electronic notebook consisting of a question posed by the teacher along with the student's associated answer between two computers under a variety of conditions. We repeated the test several times, each time using a section of an electronic notebook that had been saved during a real class session. When DEBBIE was used to transfer these sections between two computers that were both located at the author's own University, the transfer times ranged from 229 milliseconds to 1,463 milliseconds. Next we established a DEBBIE session between a computer at the authors' home institution (located in the USA) and a computer located at a University in England that was also connected to the Internet via a 10-megabit local area network. The transfer times remained similar in this scenario, this time ranging from 492 milliseconds to 1,483 milliseconds. Finally, we established a DEBBIE session between a computer at the authors' home University and a computer using a 56K modem to connect to the Internet from a local home via a community-based Internet Service Provider. The transfer times were somewhat slower in this scenario, ranging from 1,379 milliseconds to 6,386 milliseconds; however, these times demonstrate that the system can perform one of its most communication intensive tasks interactively even under sub-optimal network conditions.

Conclusions

The user test described in the previous section has demonstrated that the augmented version of DEBBIE can be used to support classes delivered at a distance, even when those classes use a mixture of pedagogical approaches ranging from a lecture-based approach to an approach that incorporates more student involvement. The responses to the survey questions presented in the previous section show that the students perceive that they are learning while using DEBBIE in a distance environment, and more importantly the results of the pre-test and post-test provide evidence that the students really did learn the material. Finally, the networks tests demonstrate that DEBBIE continues to perform interactively even under sub-optimal network conditions. Collectively these results encourage us to try to use DEBBIE to deliver an entire distance education course.

References

Baecker, R. M. (ed.) (1993). *Readings in Groupware and Computer-Supported Cooperative Work.* Morgan Kaufmann Publishers Inc, San Mateo, CA.

Berque, D., Johnson, D., Hutcheson, A., Jovanovic, L., Moore, K., Singer, C., & Slattery, K. (2000). The design of an interface for student note annotation in a networked electronic classroom, *Journal of Network and Computer Applications,* Vol. 23, No. 2, April 2000, pp 77-91.

Berque D., Johnson D., & Jovanovic L. (2001). Teaching Theory of Computation Using Pen-Based Computers and an Electronic Whiteboard. *Proceedings of ITiCSE 2001, the 6th Annual Conference on Innovation and Technology in Computer Science Education* Canterbury, England, June 25th - 27th, 2001.

Ellis, C. A., Gibbs, S. J., & Rein, G. L. (1991). Groupware: Some issues and experiences, *Communications of the ACM,* 34, 1, January 1991, pp 680-689.

SMART Technology (2001). SMARTBoard Interactive Whiteboard. http://www.smarttech.com

WACOM Technology Co. (2001). WACOM PL-300/400 Video Tablet. http://www.wacom.com/productinfo/pl300.html
Shneiderman, B., Alavi, M., Norman, K., and Borkowski, E. (1995) Windows of Opportunity in Electronic Classrooms, *Communications of the ACM,* 38(11), 19 - 24.

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Prototyping the Development of Groupware to Help Low-Vision Students View an Instructor's Blackboard Notes

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Abstract: The current lack of satisfactory technology to aid low vision students drives the development of a handheld Windows CE-based viewer for Visually Impaired Students (v-VIS) designed to assist in the realtime visualization of professor-written blackboard material. Instead of writing on a normal blackboard, the instructor writes on an electronic whiteboard. Students with normal vision view this material in the usual way, namely by looking to the front of the room. Simultaneously, the v-VIS system transmits the whiteboard contents, in realtime, to the low-vision student's handheld computer where it can be magnified and viewed at close range. After describing the v-VIS system, we discuss some of the problems we encountered during its development and our methods of overcoming these problems. Results of preliminary user testing are also presented.

Introduction

Classrooms present inherent problems for low-vision students, including difficulties reading written information on blackboards. In traditional classrooms, a significant portion of the lecture or discussion depends on the student's ability to refer to this visual information. Thus, students with reduced vision often employ human note-taking services to transcribe blackboard writing for later review. While utilizing such a service provides the student with a copy of the professor's writing, it is not immediate and it is subject to human misinterpretation of the blackboard information. Our current research has centered on designing a networked computer system called v-VIS (*v*iewer for *V*isually *I*mpaired *S*tudents). The prototype is designed to alleviate note-taking difficulties by providing immediate access to blackboard writing for low-vision students. Thus v-VIS is an example of *assistive technology*, the use of technology to aid disabled persons, which as (Perkins, 2001) states, may be the best method of providing immediate access to class information.

Interestingly, while significant prior research has developed assistive technology for completely blind users, little effort has been made toward helping the much larger population of low-vision users. Low-vision persons, who can make functional use of some portion of their vision with appropriate aids, likely outnumber fully blind persons three to one (Jacko, 1998). Our work on v-VIS serves this audience.

In the simplest sense, v-VIS collects the information written on an electronic whiteboard (instead of the traditional blackboard) and transmits it to a handheld viewer near the student (see Fig. 1 and 2). This viewer not only displays a copy of the professor's writing in real-time, but also enhances it through magnification and color pallette manipulation, which according to (Kline, 1995) are essential features for low-vision GUI accessability. The v-VIS prototype uses a recent advent in mobile computing technology, the Handheld PC, for the viewer hardware, which classifies v-VIS as *mobile assistive technology*. This allows for increased portability of the system as well as several advantages that will be described later.

Prototype Development

The current v-VIS prototype has been developed for a Handheld PC running Windows CE 2000. While a Handheld PC has a relatively small screen (approx. 2" x 5"), we feel that a handheld will provide several advantages over a desktop system. One benefit is that the low weight of a handheld allows it to be lifted to the user's eyes, greatly reducing the neck strain that many low-vision computer users experience when leaning to as close as one inch from the screen (Vener, 1988). Handheld PCs are also portable devices, which allows them to be used in multiple locations, especially when configured for wireless networking. Additionally, the hardware chosen for v-VIS is one-fourth the cost of the desktop system that would be required to achieve similar functionality.

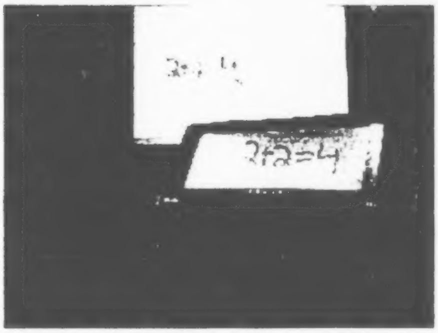

Figure 1: The v-VIS system

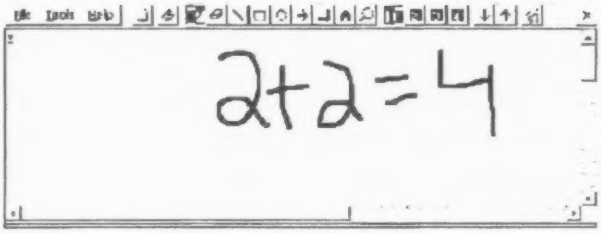

Figure 2: The v-VIS viewer (handheld) main screen

The v-VIS Interface

The foundation of the v-VIS interface is the draw space; the main screen of v-VIS is dominated by a large, blank panel (see Fig. 2). When the professor wishes to write a particular item for the class to see, he moves his finger (or stylus) on the large touch-sensitive rear-projection whiteboard screen (approx. 4' x 5') and writes just as he would on a marker board or chalkboard. A desktop computer attached to the whiteboard runs the professor or "moderator" version of the v-VIS software and interprets each motion, laying digital "ink" onto the draw space. Students with normal vision view the professor's drawing by looking at the large image on the whiteboard. v-VIS also transmits the coordinates of each ink "droplet" in real-time over a high speed network to the viewer, which then recreates the image on its screen for the low-vision student, after adjusting for his or her magnification and color preferences.

As each screenful of space is used up, a new panel or "page" of drawing space is automatically made available. In fact, the v-VIS panels are infinitely scrollable in the vertical direction, as if each new page was taped to the bottom of its predecessor. Due to the smaller handheld screen of v-VIS, each panel is also scrollable in the horizontal direction, to allow the full width of the whiteboard draw space to be viewable on the handheld. In this way, the handheld becomes a viewing "window" into the selected page of the whiteboard draw space.

Beyond the basic interface specifications, v-VIS is designed to operate in a flexible manner. The goal has been to make the system as customizable as possible, so that it may best serve the needs of students with many vision impairments. According to (Jacko, 1998), assistive devices must be fully configurable in order to serve the large range of vision profiles that exist. Thus, the v-VIS viewer prototype has multiple control methods and two independently configurable image enhancements – magnification and color customization.

Interface Control

Control of the handheld viewer is accomplished in many ways. As with most current software packages, a menu-toolbar set is accessible at the top of the screen. This may not be functionally visible to low-vision users, however, so every command has a keyboard shortcut. Scrolling, for example, is accomplished in three different ways: By using the stylus to control the scrollbar, by using the arrow keys, and by selecting a "grabber tool" that allows the user to place a stylus on the draw space and drag it to its desired position, much like moving a piece of paper to a different location on a desk.

Magnification

Magnification is one of the most important visual enhancements for a low-vision person (Fraser, 2000). Making the drawn objects larger allows students with low visual acuity to see the objects more clearly, effectively capitalizing on their available vision (Jacko, 1998). v-VIS takes the mathematical description of

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each drawn object and scales it by a factor ranging from 100% to 1000%, which is set by the user according to his or her individual needs. Not only do the dimensions of the objects increase, but so does the thickness of their defining lines, making the digital ink appear as if it were being examined under a powerful, distortionless magnifying glass (see Fig. 3).

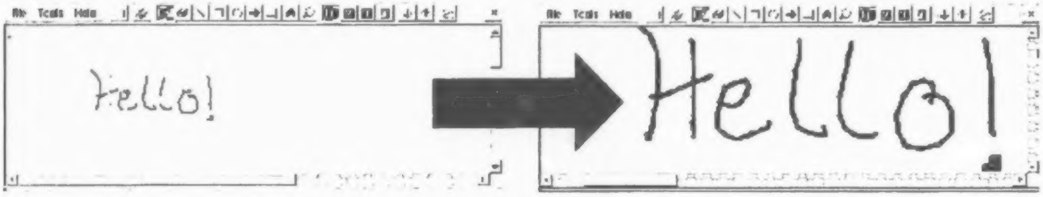

Figure 3: Effects of magnification in v-VIS

Color Customization

As important as magnification is to the use of v-VIS, many persons with reduced vision cannot see even magnified images unless they are presented in specific colors or contrast schemes (Kline, 1995). For this reason, the draw space of v-VIS can be set to use any combination of colors. Both the background and four distinct drawing colors can be chosen from any RGB value based on the user's specific needs.

User Response

Two low-vision persons have informally evaluated and commented on the v-VIS prototype during its development. One of these evaluators was pleased with the magnification features of an early version, but made several suggestions for improving the color customization option. The second evaluator also found the magnification settings helpful. This person did, however, mention a preference for a larger monitor, since it can display the same amount of draw space as the whiteboard. Since she cannot see to the front of the room, she has no indication of where on the large screen the professor is writing when looking at the image on the smaller handheld screen. She felt a larger monitor would help her locate the newest writing on the screen with contextual relation to previously drawn objects. Interestingly, this evaluator also suggested the addition of auditory feedback to signal the arrival of new information to the viewer, since writing on the whiteboard does not make an audible sound like chalk on a blackboard does. Thus the evaluator was concerned that she would have trouble knowing that new drawings had arrived at the viewer and discerning where to look for them.

The Object-In-View Problem

As mentioned by one of the evaluators, the handheld's limited screen size makes it difficult to know where the professor is writing. The large whiteboard and the smaller handheld screen display corresponding images, but the complete whiteboard image cannot appear on the handheld at any given time, since this requires reducing its size. v-VIS aims to make the professor's writing more visible for a low-vision student, not to shrink it. In fact, it is likely that reduced-vision students will have their view magnified, centering on an even smaller section of the professor's writing. In our prototype, the handheld maintains the same amount of draw space as the large forward display, but only a portion of it is visible at any given time. The student's view thus acts as a scrollable "window" into the whiteboard draw space, like a camera zoomed in on one particular section of the whiteboard. The major problem for low-vision students is that as the professor draws new objects on the whiteboard, it is not likely that they will be within the current window's focus on the handheld. In this situation, the new writing will not be displayed on the handheld until the view is scrolled to its location on the draw space. We call this the object-in-view problem.

This problem is only a minor inconvenience for a user with normal vision, who simply has to look at the

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whiteboard and reposition the viewing window on the handheld to the area where the professor is writing. The users of v-VIS, however, will likely have no ability to see the whiteboard or the professor. Therefore, not only will it be impossible for them to adjust their scroll, but they will have no indication as to how the newest drawings are oriented among previous writing. Since the professor will likely write several v-VIS "pages" of information during a class session, the draw space can be expected to change numerous times. A low-vision user cannot be expected to follow along with the rest of the class without an effective, automatic method of displaying new writing on the handheld viewer as the draw space contents change. We have attempted to develop a solution for this problem, a feature called AutoScroll.

AutoScroll - A Possible Solution

The solution to the object-in-view problem that has been developed is called AutoScroll. As the viewer receives new objects drawn by the professor, it repositions its scrollable draw space to place the newest object on the screen. This is similar in functionality to a visually enhanced text editor, MAGNEX, which maintains the cursor, and thus new text input, near the center of the screen (Vener, 1988). Initial efforts have also been made in v-VIS to ensure that previously existing objects nearby are retained on the screen.

The basic principle behind AutoScroll is rather simple: If a newly received object is not completely visible on the screen, the system automatically repositions the draw space so that it is. At the same time, AutoScroll attempts to retain the context of the newest object by keeping other recently drawn objects on the screen. This is especially important to low vision students who have no other means of knowing where the newest information is being written. By keeping nearby and often related objects on the screen, AutoScroll provides contextual information to the v-VIS user.

AutoScroll is based on the fact that each object drawn on the v-VIS screen has a bounding box, a rectangular set of boundaries that define the object's position (see Fig. 4). This box allows v-VIS to easily determine if an object is visible at all and if it is, the portion of the object that is visible on screen. The algorithm uses a *Tolerance Frame* to determine if a newly received object is completely on screen (see Fig. 5). This frame is a small area around each edge of the viewing area outside of which an object is considered to be out of view. The *Interior Tolerance Border* marks the beginning of the frame on the inside of the viewing area, and the *Exterior Tolerance Border* marks the outside edge of this area.

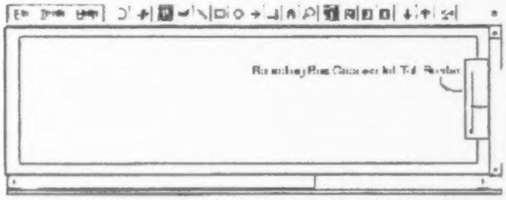

Figure 4: An object with its bounding box crossing the Interior Tolerance Border

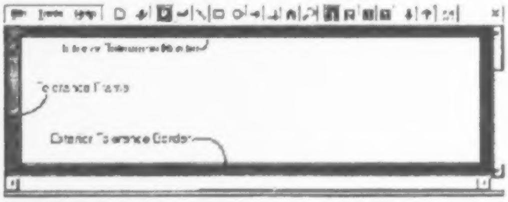

Figure 5: AutoScroll borders

When new objects are received, their bounding box location is compared to the location of the Interior and Exterior Tolerance Borders to determine what portion of the object is visible. If an object's bounding box is completely outside of both borders, the draw space is automatically scrolled so that the object is just inside the left and/or upper Interior Tolerance Borders; this action is called a "jump" (see Fig. 6). The draw space is only scrolled in the direction this border is crossed, so the Interior Tolerance Border is not really a rectangle, but a set of four boundaries that extend across the entire view. AutoScroll has been designed in this manner to move new letters (drawn objects) that are far from the current location of the viewing window to the left of the screen, providing space for the letters the professor may soon write. Preference is also given to the upper half of an object in the event it is too tall to fit completely on screen, since the upper half of handwritten letters is more recognizable than the lower half (Lynch, 1999).

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If an object has crossed the Interior Tolerance Border but some part of its bounding box still resides inside the Exterior Tolerance Border, AutoScroll performs a "slide". Here, the scroll places the object just inside the Interior Tolerance Border that was crossed (see Fig. 7). Slide actions are designed to place in view objects that are close to the current location of the viewing window while keeping other nearby objects on screen as well. This allows the completion of words that are being continued to the right, making them visible without pushing the first portion of the word off the left edge of the screen, which would happen if a jump action occurred. Slides then function to group letters of words together as the professor writes them and also to group phrases to relate the context of new words.

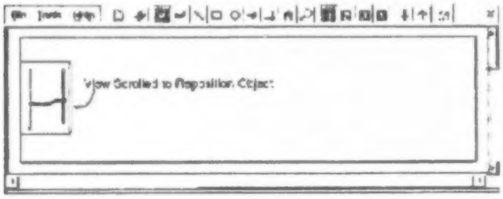

Figure 6: A "jump" repositioning of an object

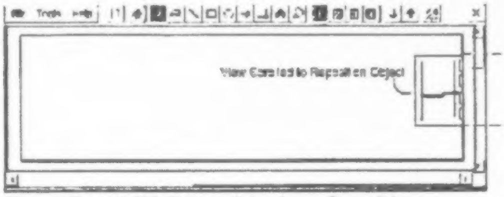

Figure7: A "slide" repositioning of an object

AutoScroll Performance

The performance of AutoScroll was evaluated objectively by counting handwritten word completion as described below. Ten pages of data recorded from a class taught on an electronic whiteboard were fed to the v-VIS viewer stroke -by-stroke. Two statistics were collected at multiple zoom factors:

- *How many times the most recent word was* ***completely*** *on the screen when it was fully received*
- *How many* ***complete*** *words were concurrently on the screen at that time*

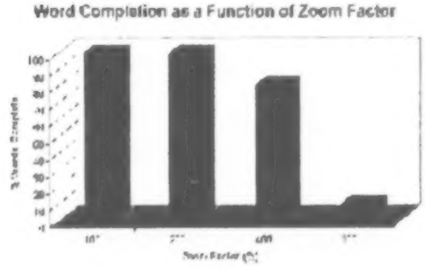

Figure 8: Completeness of one word

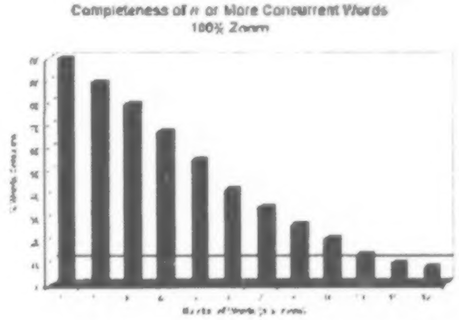

Figure 9: Completeness of n or more words

(Fig. 8) shows that AutoScroll is effective at grouping individual letters into words. Even at 400% magnification, 80.86% of possible words were completely displayed and close to 100% were complete at the lower zoom factors tested. Performance decreases at higher magnification levels, since the effective draw space is reduced and a large number of letters cannot be physically displayed on the screen. Similarly, the grouping of multiple words on screen at the same time to provide context is rather effective at lower magnification (see Fig. 9). For example, at 100% magnification, 4 or more words were completely on the screen a majority (67.1%) of the time. Again, performance decreased at higher magnification due to the limited screen size.

Conclusions and Future Work

The initial reactions from the two evaluators of v-VIS indicate that the system will likely be helpful in a classroom environment, after several improvements are made. The vision enhancements seem to be quite helpful, although the screen size of the Handheld PC may be an issue.

Based upon the performance test, AutoScroll appears to be a good method of placing the most recent objects on screen, helping to overcome the object-in-view problem. The results of the test, however, suggest that while the AutoScroll algorithm works well, its performance can still be improved, a fact mentioned by one of the low-vision evaluators. The current Tolerance Frame, for example, would most likely result in better performance if it were scaled in size based on the magnification level.

For future work, we plan to continue development of AutoScroll algorithms in order to improve the performance of this feature. The v-VIS interface can also be improved by including the addition of auditory feedback to announce the arrival of new information, indicating the location of the new objects through tonal differences. We also plan to develop v-VIS for a desktop system, so its usability can be compared with the handheld. After continued development, we plan to test the resulting v-VIS system in a classroom with low-vision students to determine its usability in a more formal manner.

References

Fraser, Julie and Carl Gutwin. (2000). A Framework of Assistive Pointers for Low Vision Users. *The fourth international ACM conference on Assistive technologies*, 2000, ACM, Arlington, VA. 9-16.

Jacko, Julie A. and Andrew Sears. (1998). Designing Interfaces For an Overlooked User Group: Considering the Visual Profiles of Partially Sighted Users. *Proceedings of the third international ACM conference on Assistive technologies*, 1998, ACM, Marina del Rey, CA. 75-77.

Kline, Richard L. and Ephriam P. Glinert. (1995). Improving GUI Accessibility for People with Low Vision. *Conference proceedings on Human factors in computing systems*, 1995, ACM, Denver, CO. 114-121.

Lynch, Patrick J. and Sarah Horton. (1999). *Web Style Guide: Basic Design Principles for Creating Web Sites*. New Haven, CT: Yale University Press. 86.

Perkins, Robert. (2001). Provision of Services For Students With Visual Impairments: A Case Study. *Information Technology and Disabilities*, 7 (2), <http://www.rit.edu/~easi/itd/itdv07n2/contents.htm>.

Vener, Avram R. and Ephriam P. Glinert. (1988). MAGNEX: A Text Editor for the Visually Impaired. *Proceedings of the 1988 ACM sixteenth annual conference on Computer science*, 1988, ACM, Atlanta, GA. 402-407.

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Introduction of Technology Integration through Case Based Learning

Abstract

In response to school-needs and state-requirements, the University of Northern Colorado is redesigning the two requisite educational technology courses for the undergraduate teacher preparation programs. The first course redesign has been implemented; the program's one-credit 200-level course is currently equipping UNC teacher candidates with basic computer and software-tool skills. The second requisite course—the 300-level—has been redesigned and is now in stages of development. The first part of the course will instruct teacher candidates in the concepts of technology integration. Then, to make those concepts more meaningful and transferable, the course will immerse students in a case-based learning unit. This proposal describes the unit's problem scenarios. It also details the electronic environment and graphical user interface in which the scenarios and the information necessary for problem solving are presented.

A study by Persichitte, Tharp, and Caffarella (1999) found that while technology is readily available to teacher education programs, only 45% of the programs' faculty regularly use technology during class and only 40% of those programs require preservice teacher candidates to use technology to design and deliver instruction. Those statistics exist despite current standards for technology-use in education.

Recently the Colorado legislature passed Senate Bill 99-154, which included eight standards for teacher education candidates to meet. The seventh standard states, "The teacher is skilled in technology and is knowledgeable about using technology to support instruction and enhance student learning." However, a recent survey of the University of Northern Colorado's (UNC's) partner schools (i.e., local K-12 schools) found a high need for successful implementation of that standard. In fact, many schools rated teacher technology skills as their highest need. Clearly, preservice teacher candidates have not been equipped to meet the demand for trained teachers who can integrate technology throughout their instruction.

Currently, UNC's undergraduate teacher education programs require preservice teachers to take two educational technology courses. However, each course is worth only one credit. The preservice teachers generally take the first course at the beginning of their teacher preparation and the second course just before their final student teaching experiences. The courses' curricula vary for elementary, middle grades, and secondary preservice teachers.

In 2000, UNC was awarded a Preparing Tomorrow's Teachers To use Technology (PT3). A major initiative of the grant was to redesign the aforementioned courses so that UNC's School for the Study of Teaching and Teacher Education will better prepare students to meet new standards for using technology for instruction. The first year of the grant, the university's PT3 team redesigned the 200-level courses (i.e., the first educational technology course students take). The PT3 team crafted those courses to give students the technology tools they will need for superior performance throughout their university careers, for successful synthesis of technology integration theories with other learning theory, and, ultimately, for effective classroom teaching. The curricula include introductions to both MAC and PC operating systems and introduce students to a variety of software, including Word, Excel, PowerPoint, Hyperstudio, Inspiration, and Dreamweaver.

Because the 200-level courses emphasize tools, the 300-level courses will concentrate on preparing preservice teachers to integrate those tools and other technology into instruction. The PT3 team wants the 300-level courses to give preservice teachers a picture of how integration looks in K-12 classrooms and how they can use technology integration to meet state standards and solve instructional problems. After determining the course objectives, the PT3 team split into sub-teams for designing and developing the different parts of the courses. The first part of the courses will provide more theoretical information about such topics as instructional design, technology management, and teaching strategies. Although assignments throughout the course will require preservice teachers to apply the concepts they learn, the PT3 felt that situating knowledge-application in a more authentic, problem-based environment would help the teachers better understand all that technology integration involves. Therefore, the team portioned the second half of the courses to be case-based learning scenarios that immerse teachers in rich environments for active learning (REALs).

Constructivist environments, like those of case-based learning, work well when "conceptual complexity and case-to-case irregularity" characterize the information to be learned. Learners of such information need to develop cognitive flexibility in order to transfer their knowledge to other situations and varying problems (Spiro et al., 1992). Constructivist, and especially case-based learning environments permit such development. A case-based learning environment will immerse students in multitudinous information and let them to make the connections necessary for understanding the importance of technology integration and how such integration might look in a classroom setting.

As is characteristic of all REALs, the 300-level courses environments will rely on authenticity as a student-motivator. The environments' authenticity will also give students the opportunity to organize concepts in such a way that they will transfer to the situations they may find in practice (Grabinger, 1996). The PT3 team talked with the university's teacher education professors and K-12 teachers to devise weekly scenarios enriched by reality-based electronic artifacts (e.g., emails from other teachers, phone messages in the form of audio-files). The team wanted the case-based learning unit's scenarios and materials to imitate typical experiences of first-year teachers.

The REALs for the 300-level courses specifically meet the criteria for case-based learning and instruction. Ertmer and Russel (1995) write, "Case based instruction is a teaching method which requires students to actively participate in real or hypothetical problem situations, reflecting the kind of experiences naturally encountered in the discipline under study." Students actively apply learned knowledge and skills to a problem situation. Ertmer describes these cases to be "ambiguous, messy, and recalcitrant."

Such a problem lies at the heart of the 300-level REAL. In fact, students must first analyze a fictitious school's Colorado Student Assessment Program (CSAP) scores in order to define the case's problem. The unit's Web site will then offer the resources and information necessary for solving the problem. However, the 300-level course instructors will model ways in which the problems can be solved and will also act as technical and organizational supports.

Throughout the unit's design and development, the PT3 team made a priority of building instruction that teachers toward the technology standards for teacher education as presented by the National Education Technology Standards and by the state of Colorado. Each piece of the case-based learning unit will enhance students' understandings of technology integration as well as linked directly to those standards.

The Scenarios

The case-based learning experiences will evolve from initial pretense that a Colorado school has hired the participating preservice teachers for their intended subject matter and grade levels; the unit will ask them to imagine that they have worked all summer to plan for their classes. However, much of that work will be undermined when, in Week One, the teachers receive a "voice mail" (in the form of an audio-file embedded in the unit's interface) informing them that they have been reassigned to other schools ... with below average standardized-test scores. Week One of the case based learning unit will expose the teachers to data—in the form of school profiles and standardized-test scores—that can acquaint them with the new school's environment. The Week One graphical user interface (GUI) will provide job-aids and a video-file of a district assessment specialist explaining how to read the test scores. The GUI will also link to electronic "cumulative folders," all of which will contain report cards and some of which will contain IEPs. Teachers will then analyze the available data and prepare a chart of class and individual strengths and weaknesses, as well as proposed strategies for meeting instructional needs. Also useful for helping the teachers visualize their simulation environments will be a letter embedded in the Week One GUI. The letter will announce that the teacher has received a grant that will provide classroom funding for six computers, a printer, a scanner, a TV, a VCR, a digital camera, and $200 in discretionary funds. In addition to familiarizing teachers with the simulated school environment, Week One must also familiarize them with the unit's online environment. Although each week's interface will be self-contained and intuitive, in Week One, the course instructors will model standard procedures.

Week Two's GUI will first point teachers toward an email from the district technology manager informing them that he has set up their computers, network connections, and peripherals and installed various software. The students can also access the classrooms' floor plans from the Week Two interface. The two "referrals" the teachers will find within the interface will pose the second week's problems: While working at the computers, students have been off-task and disruptive; they have not completed their work; and they have been crowding and rough-housing around the computers. To combat those problems and make the best use of the equipment, the teachers must create a list of classroom rules for technology-use. The teachers will also have the option of rearranging the classroom floor plan. To support the performance of those tasks, the GUI will make available a video that shows another teacher giving a tour of her classroom and showing a poster of the technology rules she has implemented.

In Week Three, after teachers are well acquainted with their environments, they will be asked to design instruction for their students. Week Three's task will be to revise a preexisting lesson plan so that the lesson meets the instructional needs determined by Week One's data analyses. The modified lesson plans must also use the classrooms' technology resources to enhance instruction. The Week Three GUI will provide access to a database of lesson plans (i.e., the fictitious lesson plan bank that the teachers spend their summers creating) that do not use technology. Week Three's GUI will also open a memo that contains a copy of the National Education Technology Standards for Students as well as a memo from the grant-giving foundation reminding the teachers to spend their discretionary funds. In addition, teachers will be able to open an audio-file of a teachers discussing best-practices for integrating technology into the classroom.

Week Four will be framed as a teacher workday. From that week's GUI , teachers will access collaboration worksheets then work with each other to improve their lesson plans. In Week Five's GUI, teachers will open a letter from the grant-giving foundation, asking that the teachers submit a report about how they've used the resources that the foundation has provided. In this report, teachers will need to reflect on how they can use technology as a tool to support their teaching strategies.

Week Six's GUI simply offers online resources for solving the problems that course instructors will create. During that week's class, the instructors will give each teacher a "trouble card" that plagues their lessons with technical difficulties (troubles will be individualized so as to disable the delivery of each teacher's lesson). In response, teachers must create contingency plans (e.g., handouts, library research of print materials) for their lessons. In the unit's final week, Week Seven, teachers will discuss their experiences and present their lesson plans and reports to the foundation.

The Graphical User Interface

Upon entering the Web-based environment, the preservice teachers will not find the menus, navigation bars or buttons typical of traditional Web sites. Instead, they will be stepping into their new offices. Materials—in the form of email and voice mail messages, letters, memos, and face-to-face meetings—that support the learning unit, will be stored in and accessed via five active zones: the computer, telephone, in-box, file cabinet, and daily planner.

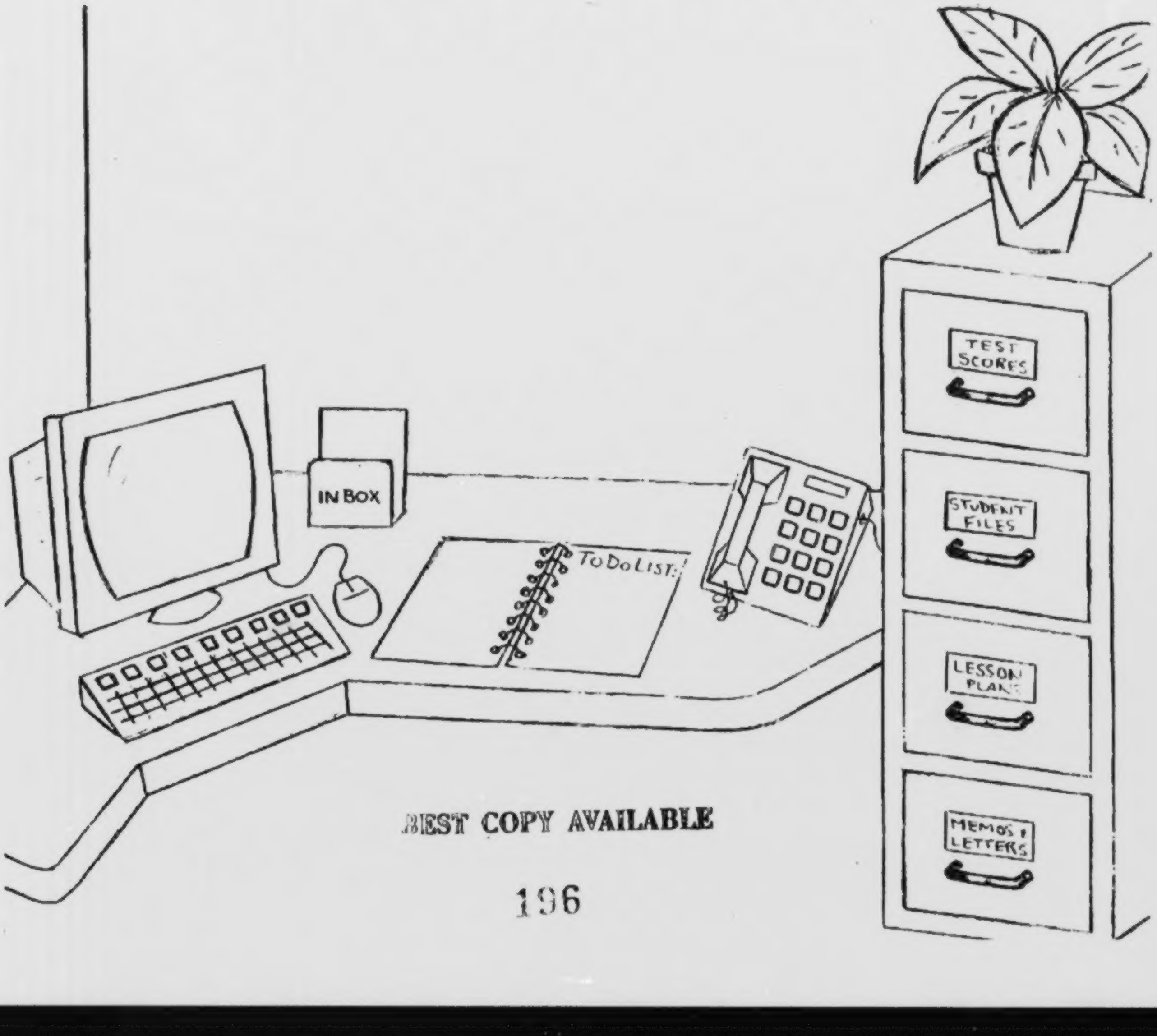
The daily planner will be the main user-cueing device; the planner is the user's the to-do list. The list will remind users of the week's important tasks, such as checking e-mail, and attending events (e.g., a lunch meeting with another teacher). A mouse-click on the appropriate active zone will open a small window and let the preservice teacher check their email, listen to voicemail messages, or investigate the contents of folders and files. The windows, which users can drag anywhere on the screen and have open simultaneously, will give users the ability to customize their work areas.

The complex design of the user interface is balanced by the authenticity of its elements. The office metaphor is not only relevant, but also familiar. Anyone who has ever read a letter, opened an email, or used an answering machine possesses the prerequisite skills for successfully navigating the interface.

From the first week of the unit to the last, the pre-service teacher will see this case-based learning environment evolve, as new scenarios and pieces of information present themselves. As a result, the interface must be flexible enough to accommodate this evolution, without forcing users to re-orient themselves each week. Just as one might save an old email or voice message for further review, the preservice teacher will have access to items introduced in previous weeks—as well as new items—through the same five active zones.

The unit's scenarios are designed to realistically mimic a teacher's work environment, including interactions with fellow teachers, administrators, and support staff. A mixture of audio, video and HTML file formats will make these interactions seem more real. Video clips and sound will let the user experience their environment with multiple senses and as though they were witnessing them first hand.

Initial Sketch of Graphical User Interface


IN BOX
To Do List:
TEST SCORES
STUDENT FILES
LESSON PLANS
MEMOS & LETTERS

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Timeline

The PT3 team has designed the case-based learning units, and development will commence January, 2002. The implementation of the course will begin May, 2002. A survey, the Stages of Concern Questionnaire (SOCQ) will assist the team in gathering data about the courses' effectiveness. The SOCQ measures how concerns about different innovations—in our case, technology integration—change over time (Horde & Hall, 2001). Currently, students are administered the SOCQ in both the 200- and 300-level courses, and, after implementation, the team will continue to administer the SOCQ several times throughout the course. The team will also analyze student projects as qualitative data that will indicate whether the case-based learning unit is effective in meeting instructional objectives.

With the importance of training teachers to effectively integrate technology, case based methods may be one of the most powerful tools one can utilize to meet state and national standards regarding this goal. Because teacher education students often do not see effective technology integration modeled in either their student teaching experiences, or in the majority of their college courses, one class often may not be enough to present the ill defined domain of technology integration to preservice teacher candidates. This case study may prove to provide enough information to give learners a basic understanding of what technology integration not only looks like but how it can be used to solve problems and help to meet state and national education standards. Activities such as these will also add to the body of knowledge regarding the effectiveness of constructivist environments, in particular, case based learning environments.

References

Ertmer, P.A., & Russel, D. (1995). Using case studies to enhance instructional design education. Educational Technology 35(4), 23-31.

Grabinger, R.S.(1996). Rich environments for active learning. In D.H. Jonassen, ed. Handbook of Research for Educational Communications and Technology, 665-692. New York: Macmillan.

Hall, G.E. & Horde, S.M. (2001). Implementing Change: Patterns, Principles, and Potholes. Needham Hights, MA: Allyn and Bacon.

Persichitte, K. A., Tharp, D. D., & Caffarella, E. P., Technology Integration in Teacher Preparation: A Qualitative Research Study, Journal of Technology and Teacher Education 7(3), 219-233.

Spiro, R.J., Feltovich, P.J., Jacobson, M.J., & Coulson, R.L. (1992). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T.M. Duffy & D.H. Jonassen, eds. Constructivism and the Technology of Instruction: A Conversation, 57-75. Hillsdale, NJ: Lawrence Erlbaum Associates.

Satellite Based Synchronous Tutorials vs. Satellite Based Asynchronous Videocassettes: Factors Affecting Students' Attitudes and Choices

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Background

The Open University of Israel (OUI) is a distance learning university. Learning is based mainly on specially written textbooks and tutorial meetings (once a week or once in three weeks) in learning centers throughout the country. Indeed, meetings with tutors at learning centers bring the university closer to the students and allow for face to face interaction between tutors and learners and among the learners themselves. However, these meetings sometimes do not materialize, as it is difficult to find enough expert tutors for all groups of students, or students are so dispersed that though many are registered for a course, there are not enough students in each region to justify hiring a tutor.

Synchronous virtual tutorials, via satellite communication, from a studio at the university to classrooms throughout the country (by the best tutor) - have been conducted during the last five years as a solution to these problems. The communication between the tutor and the students is visual, audio and data-based. The visual communication is uni-directional from the studio to the classrooms (where the tutor is seen on a big TV screen). Audio information is bi-directional (from the studio to the classrooms and from the classrooms to other classrooms and to the studio). The lecturer and the other students can hear the student who has been given the floor by the tutor. With respect to data communication, the lecturer can present multiple choice questions to the students, ask them to answer the questions by pressing an appropriate button on the satellite phone, and immediately present the distribution of answers to the students.

Seven such two-hour satellite tutorials were conducted in a "Basic Research Methods" course (for social science students) during 5 semesters. A number of factors gave rise to second thoughts about the choice of synchronous satellite tutorials as an ultimate solution: (a) only 25% of the registered students joined the tutorial sessions; (b) most students who joined the tutorials did not participate actively in the interactions initiated by the tutor or did not initiate any interaction themselves; and (c) the satellite technology has proved to be very costly.

Each satellite-based synchronous tutorial is saved on a videocassette. These cassettes can be sent to students as asynchronous tutorials. **Table 1** compares satellito-based synchronous tutorials to satellite-based asynchronous tutorials delivered on videocassettes.

Table 1: Factors differentiating between satellito-based synchronous tutorials and satellite-based asynchronous videocassettes

Dimension	Satellite-based synchronous tutorials	Satellite-based asynchronous videocassettes
The location of the tutorial	In classroom	At home
Time of tutorial	Specific – tutor and students at the same time	Flexible at students' convenience
Accessibility of materials	Not accessible after the end of the lesson	Accessible at any time
Interaction with the tutor during the tutorial	Possible	Impossible
Interaction with other students during the tutorial	Possible	Impossible
Cost of technology	High	Low

In light of the above comparison and students' behavior (absences and lack of participation), we decided to study students' preferences regarding the mode of tutorials. In particular:

1. What are students' attitudes towards the tutorial modes and their dimensions (i.e., flexibility, interaction and accessibility). As can be seen from Table 1, the two types of tutorials differ in the amount of control the student has over the learning process (the first three dimensions) and in the amount of interaction between tutor and students (in the last two dimensions). Learner control is known to be associated with active learning and student-centered learning (Doherty, 1998). Interactions between students and tutor and among the students themselves is one way to increase instructional immediacy and social presence which are positively related to students' satisfaction and motivation in learning (e.g., Christophel, 1990; Swan, 2001). Will students prefer control over their learning process at the expense of losing social immediacy, or vice versa?
2. Are students' attitudes and preferences related to their learning-habits preferences? Some research has been done on the relation between cognitive styles and instructional preferences (e.g., Sadler-Smith & Riding, 1999). The present study aims to examine the relation between learning-habits preferences and instructional preferences.
3. Are students' attitudes and preferences related to demographic and academic variables?

Some of our findings concerning these questions will be discussed in the next sections.

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Method

Participants: Two groups of students (in the Research Methods Course) and one tutor took part in the research.
Group 1: 92 students who studied during the fall semester of 2001. They had seven satellite-based synchronous tutorials (two hours each) with their tutor.
Group 2: 73 students who studied during the spring semester of 2001. They had 4 satellite-based asynchronous videocassettes (based on those recorded during the previous semester) and 3 satellite-based synchronous tutorials with the same tutor.

Questionnaires: Three questionnaires were constructed-
1. Questionnaire 1: A feedback questionnaire on the satellite-based synchronous tutorials. The questionnaire included items relating to (a) attendance rate; (b) attitudes towards the tutor and the tutorials; (c) attitudes regarding the advantages and disadvantages of meeting and interacting with peers; (d) comparisons between face to face tutorials and satellite-based synchronous tutorials and (e) attitudes toward a **potential** asynchronous mode of tutorial via satellite-based videocassettes.
2. Questionnaire 2: A feedback questionnaire on asynchronous tutorials delivered via videocassettes. It contained items similar to those in the first questionnaire but relating to videocassettes and a comparison between three modes of tutorials: satellite-based synchronous and asynchronous, and face to face tutorials.
3. Questionnaire 3 - "How do I prefer to study?": This questionnaire contained items on four dimensions: (a) the importance of autonomy in management of learning time; (b) the importance of ease of accessibility to all learning materials; (c) the importance of synchronous interactions with the tutor (d) the importance of synchronous interactions with other student s. For each of the four dimensions, a number of statements were formulated differing in the affective influence and in the cognitive influence of the dimension and the direction of that influence (positive or negative). For example, with regard to time management:
1. When I am responsible for my pace of learning I feel I have control (positive, affective)
2. When I am responsible for my pace of learning I feel helpless (negative, affective)
3. My learning is more efficient when I am responsible for my pace of learning (positive, cognitive)
4. My learning is more efficient when the timetable of the course is determined by the teaching team (negative, cognitive).

The questionnaire included 56 statements (in random order) on a Likert scale from 1- "doesn't describe me at all" to 5 - "describes me very well".

The "How do I prefer to study?" questionnaire was administered to 288 "Research Methods" students who were not part of the experiment. Factor analysis revealed four independent factors (scales): time management (high score indicates learning autonomy), ease of accessibility to learning material (high score indicates the subject's need to "have" all material), positive aspects of interaction (high score indicates that the subject has more positive views regarding interactions - with tutor and other students) and negative aspects of interaction (high score indicates that the subject has few views regarding the negative aspects of interaction)[1]. Thus, four scores were constructed for each subject, one for each factor. There was no correlation between the scores and the following variables: gender, age and number of credits accumulated at the OUI.

Procedure: At the end of the fall semester, Questionnaire 1 (experience with seven satellite-based synchronous tutorials), and Questionnaire 3 ("How do I prefer to study?") were mailed to students in Group 1, who were asked to fill them out in that order. At the end of the spring semester, Questionnaire 1, Questionnaire 2 (experience with the four satellite-based asynchronous tutorials on videocassette) and Questionnaire 3 (in that order) were sent to students in Group 2. Forty-three (46.7%) students in Group 1and 31 (42.7%) students in Group 2 returned the questionnaires.

Results

Group participation in learning activities: On average, Group 1 students participated in 2.9 of the seven satellite-based synchronous meetings (41.4%). Group 2 students participated on average only in 1.1 of 3 (36.7%). This difference is not significant. All students rated as high all audio and visual characteristics of the two technologies used. From reports of Group 2 students, it seems they created a learning environment at home in which others did not disturb them while they were watching the tutorial.

With regard to the activities associated with the satellite-based asynchronous videocassettes, 41.9% students reported they watched all 4 lessons, 91.7% stated they watched them only once, 56% used the back and forward option, 66.7% summarized while watching (most by stopping the video) and most of those who summarized (81.2%) indicated that they would read the summary before the final examination.

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[1] Contrary to intuitve perception which sees the two extreme sides of a dimension (e.g., high and low) as negatively correlated, the Psychology literature on attitudes demonstrates that often the two end points of a dimension are two independent factors (Eagly and Chaiken, 1998).

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Group comparisons: Groups 1 and 2 did not differ significantly in gender (males: 58.5% and 57.6% in the two groups, respectively). **Table 2** presents data comparing Groups 1 and 2 on background, academic and learning-habit preferences variables.

Table 2: Background, academic and learning-habit preferences in Groups 1 and 2

Variable	**Group 1**		**Group 2**	
	M	**SD**	**M**	**SD**
Age	29.6	5.7	30.0	5.8
Final grade in course	71.2	8.9	72.8	8.3
GPA*	78.8	6.5	79.8	6.0
Scale 1 – Time management	3.5	0.8	3.4	0.6
Scale 2 – Ease of accessibility to learning material	4.0	0.6	3.9	0.5
Scale 3 – Positive aspects of interactions	3.1	0.7	3.2	0.5
Scale 4 – Negative aspects of interactions	3.8	0.6	3.9	0.5

*Grade point average at the stage the student registered for the Research Method course

There were no significant differences between the two groups in none of the background, academic and learning-habits preferences variables presented in Table 2. Both groups were also similar in the learning materials they received (the same books and tutorials) and the tutor teaching them. As all these variables were controlled they cannot be considered an alternative explanation for any reported results (in the next sections) concerning the differences in the students' attitudes towards the different learning technologies used and their preferences (The Institute for Higher Education Policy, 1999).

Groups 1 and 2 evaluated the tutor and the satellite-based synchronous tutorials. Students were asked about the tutor's expertise, teaching pace, attentiveness to students, ability to excite interest and to clarify the material as well as command of the technology. They were also asked to rate the synchronous tutorials on a number of dimensions (how significant, interesting and organized they were, as well as the extent to which they contributed). On average, the tutor and the satellite-based synchronous tutorials were rated high (3-5 on a 1-5 scale) with no significant differences between Group 1 and Group 2. Group 2 students were asked to evaluate in a similar manner the tutor and the satellite-based asynchronous videocassettes (not including questions regarding the tutor's attentiveness to students and command of technology which were not relevant in the asynchronous mode of tutorials). Students' ratings of the tutor and the tutorials of the synchronous tutorials were compared to their ratings of asynchronous videocassettes (t test for dependent variables). No significant differences were detected. **Thus, when the same tutor gives the same tutorials to similar students, the evaluations of the tutor and the lessons are independent of the technology used.**

Attitudes toward interaction components: In both groups, subjects were asked whether the tutor devoted enough time to interaction with students. With regard to the synchronous tutorials, 73% of students were satisfied with the amount of interaction (no significant difference between the groups). Students in group 2 were asked the same question twice - once for the synchronous lessons and once for the asynchronous lessons. Most students indicated there was enough time allocated to interactions in both types of tutorials and the difference in response to the two questions was not significant. Most students in both groups (82.7%) indicated they participate less in synchronous satellite tutorials than in face-to-face tutorials. **Table 3** describes the results concerning interaction components in the satellite-based synchronous tutorials in Groups 1 and 2.

Table 3: Group 1 and 2 mean ratings for interaction components in the satellite-based synchronous tutorials.

	Group 1 - synchronous		Group 2 – synchronous	
	M	SD	M	SD
During the satellite lesson, to what extent:				
. when you wanted to ask or respond, were you given the floor?	4.32	0.86	4.14	0.57
. are you disturbed by the fact that the tutor can't see you?	2.53	1.34	2.38	1.36
Other students in my class:				
. are important to me from a social perspective	2.66	1.10	2.24	1.09
. are important to me from a learning perspective	2.72	1.20	2.76	1.09
. disturb me during the lesson	1.69	0.97	1.57	0.87
ents in other classrooms:				
. are important to me from a social perspective	1.38	0.75	1.38	0.87
. are important to me from a learning perspective	1.69	0.97	1.86	1.01
. disturb me during the lesson	1.31	0.59	1.33	0.48
Questions by other students and the tutor's answers:				

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. contribute to my learning	3.34	0.86	3.35	0.93
0. disturb my learning	2.28	0.99	2.19	1.08

None of the differences is significant, indicating that the **having less satellite-based synchronous tutorials** (3 instead of 7) **doesn't affect students' attitudes regarding the interaction components of those tutorials.**

Table 4 compares students' attitudes towards the interaction components of satellite-based synchronous tutorials to those components in the satellite-based asynchronous videocassettes. The numbers given to questions in Table 4 are similar to those in Table 3. None of the differences (for identical or for similar questions) were significant (t tests for two dependent variables).

Table 4: Group 2 students' attitudes towards the interaction components in satellite-based synchronous tutorials and asynchronous videocassettes.

	Group 2- synchronous*		Group 2 – asynchronous	
To what extent:	M	SD	M	SD
a. are other students in my classroom important for me from a social perspective?	2.06	0.83		
b. do I miss the presence of other students from a social perspective?			1.94	1.08
a. are other students in my classroom important to me from a learning perspective?	2.53	1.01		
b. do I miss the presence of other students from a learning perspective?			2.00	1.12
a. are other students in my classroom important to me from a learning perspective?	2.53	1.01		
c. are other students in the recorded lesson important to me from a learning perspective?			2.35	1.06
a. do other students in the classroom disturb me during the lesson?	1.59	0.94		
b. do other students in the recorded lesson disturb me during the lesson?			2.06	1.00
. do questions by other students and the tutor's answers contribute to my learning?	3.13	0.81	2.81	0.75
0. do questions by other students and the tutor's answers disturb my learning?	2.35	1.11	2.41	1.18

* The results in the first two columns are not similar to those in the last two columns of Table 3 as not all subjects in Group 2 answered both kinds of questions, as necessary for a within subjects comparison.

Individual differences in the attitudes towards interaction components: Do learning-habits preferences, as measured in questionnaire 3 correlate with students' answers to the interaction questions concerning the different technologies? **Table 5** presents correlation coefficients which were computed for each one of the questions presented in Tables 3 and 4 with two of the interaction scores (positive and negative) derived from the learning habit preferences questionnaire. The bold correlations with the Positive Interaction factor are expected to be positive. The bold correlations with the Negative Interaction factor are expected to be negative.

Table 5: Correlation between answers to interaction questions (in Questionnaires 1 and 2) and interaction factors (derived from Questionnaire 3)

Question	Positive interaction	Negative interaction
3a	**0.43****	0.02
3b	**0.41***	0.03
4a	**0.27**	-0.12
4b	**0.31**	-0.02
4c	**0.51***	-0.11
5a	-0.14	**-0.08**
5b	-0.07	**-0.54****

9a	0.52***	0.12
9b	0.48*	0.03
10a	-0.38**	-0.51***
10b	-0.26	-0.45*

* 0.05 ** 0.01 ***0.001

The results in Table 5 strengthen the validity of the learning-habit preferences questionnaire. Students with a high score on the positive interaction factor (the subject holds more positive views regarding interactions - with tutor and students) believe more than others in the social contribution of other students and in their learning contribution. Students with a high score on the negative interaction factor (the subject holds **few** views regarding the negative aspects of interaction) perceive students' interactions in class as less disturbing.

Preferences of different learning technologies: Subjects in both groups were asked the following question: "Below are two types of tutorials with which you are acquainted: face-to-face tutorials and satellite-based classroom tutorials. On the assumption that the same tutor teaches the tutorials, mark with an X the method that you believe is the best way of learning with respect to the dimensions below". The 11 dimensions listed were: I understand the tutor better; I concentrate better; It is easier for me to summarize the tutorial; I ask more questions; I answer more questions; I enjoy the lesson more; I understand the material better; The questions I ask get more responses; I feel that I have better control of the situation; I feel more obligated to attend the tutorial; I prepare myself better for the tutorial. For each dimension, the proportion of face-to-face choices was calculated (for each group) and a Chi-Square test for two independent groups was performed to identify differences. None of the results were significant, thus reinforcing the conclusion that having fewer satellite-based synchronous tutorials does not affect students' attitudes towards this type of teaching/learning. Face-to-face tutorials are considered advantageous with respect to ten of the eleven cognitive and affective dimensions (for most dimensions, face-to-face tutorials were chosen by more than 70% of the students). On the last dimension (I prepare myself better for the tutorial), only 48% of Group 1 and 66.7% of Group 2 chose the face-to-face tutorial as better.

Group 2 students were asked a similar question with the same dimensions and an additional five (I remember more; It is more convenient; I prepare a written summary; I control my learning pace; Overall) concerning the choice between face-to-face tutorials, satellite-based synchronous tutorials and satellite-based asynchronous videocassettes. For most dimensions (except for "It is more convenient" and "I control my learning pace"), most students chose face-to-face tutorials. Satellite-based asynchronous videocassettes over rode the other two types of tutorials for all other students. 51.9% and 77.8% of students chose satellite-based asynchronous videocassettes when asked about convenience and control, respectively. When asked to make an overall choice between satellite based synchronous tutorials and satellite based asynchronous videocassettes, 60.7% chose the asynchronous mode and only 32.1% chose the synchronous mode.

Group 1 students were also asked about a hypothetical choice between satellite based synchronous tutorials and satellite based asynchronous videocassettes (hypothetical, as they didn't experience the second option). On most dimensions, the dominant choice was satellite based asynchronous videocassettes (except for "I am more involved in the learning process" and "I am more active"). When asked to make an overall choice between the two, 76.3% chose the asynchronous mode and only 23.7% chose the synchronous mode.

Individual differences in the choice of learning technologies: Do learning-habit preferences, as measured in our questionnaire, correlate with students' choices of different types of tutorials? Students in both groups were divided according to their overall choice between the satellite based synchronous tutorials and the satellite based asynchronous videocassettes. The two groups were compared on the 4 learning-habit preferences scores. **Table 6** presents those comparisons.

Table 6: Differences in learning-habit preferences between students who chose satellite based synchronous tutorial and students who chose satellite based asynchronous videocassettes.

Factors	**Prefer synchronous tutorials**	**Prefer asynchronous tutorials**	**Significance level**
Scale 1 – Time management	3.1 (0.9)	3.6 (0.6)	T(60)=2.36*
Scale 2 – Ease of accessibility to learning material	3.7 (0.6)	4.1 (0.5)	T(59)=2.4*
Scale 3 -- Positive aspects of interactions	3.5 (0.5)	3.0 (0.6)	T(59)=2.4*
Scale – Negative aspects of interactions	4.0 (0.5)	3.8 (0.5)	---

The two groups of subjects differ in 3 of the 4 learning habit preferences scores. Those who chose the satellite-based synchronous tutorials were significantly higher on Scale 3 (believing in the positive aspects of interactions) and significantly lower on scales 1 (learning autonomy) and scale 2 (the need to "have" all the material).

Discussion and Conclusions

When choosing between face-to-face tutorials and satellite based-synchronous tutorials, most students prefer the former, replicating a previous study done at the OUI (Beyth-Marom et al., 2000). However, when choosing between satellite based-synchronous tutorials and satellite-based asynchronous videocassettes, two thirds of subjects prefer the latter. As in the previous study done at the OUI, most students prefer flexibility and control of their learning processes while studying at home with less social immediacy (with videocassettes) over the social immediacy they have (but less personal control) in synchronous satellite based tutorials.

In an effort to study the factors affecting students' choices and preferences, students were asked about their attitudes towards different interaction components. In both groups, students did not rate the interaction components (synchronous or asynchronous) as very important or contributing. All students answered a questionnaire about their learning-habit preferences. Students with a high score on the positive interaction factor (the subject holds more positive views regarding interactions with tutor and students) believe more than others in the social contribution of other students and in their learning contribution. Students with a high score on the negative interaction factor (the subject holds **few** views regarding the negative aspects of interaction) perceive students' interactions in class as less disturbing.

Students who preferred the satellite-based synchronous tutorials were compared to those who preferred the satellite-based asynchronous videocassettes on the 4 scales of the learning-habit preferences questionnaire. Those who preferred the synchronous tutorial were significantly higher in their belief in the positive aspects of interactions (Scale 3) and significantly lower on learning autonomy (Scale 1) and the need to "have" all material (Scale 2) than those who preferred the asynchronous mode.

In general, students' tutorial-mode preferences depend on their learning-habits preferences as measured on a Likert type questionnaire: their attitudes toward the control of learning and the possible contribution of interactions.

Bibliography

Beyth-Marom, R., Yafe, E., Privman, M. and Razy-Harpaz, H. (2000). Satellite home tutorials vs. Satellite classroom tutorials. Ed-Media, Finland.

Christopher, C. (1990). The relationship among teacher immediacy behaviors, student motivation, and learning. Communication Education, 39, (4), 323-240.

Doherty, P.B. (1998). Learner control in asynchronous learning environments. ALN Magazine, Volume 2 (2).

Eagly, L. H. and Chaiken, S. (1998). Attitudes, structure and function. In: Gilbert, D. T., Fiske, S.T. and Lindzey, G. The Handbook of Social Psychology, pp. 269-322. McGrow Hill.

Sadler-Smith, E. and Riding, R. (1999). Cognitive style and instructional preferences. Instructional Science 27, 355-371.

Swan, K. (2001). Building learning communities in online courses: The importance of interaction. The seventh Sloan-C international conference on online learning. Orlando, Florida, Nov. 2001.

What's the difference: A review of contemporary research on the effectiveness of distance learning in higher education. The Institute for Higher Education Policy, 1999.

Lessons Learned from the Teaching, Technology and Teamwork Program

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Abstract: Twenty-four Teaching, Technology, and Teamwork (TTT) projects sponsored by the Charles E. Culpeper Foundation at California Lutheran University were developed from Fall 1999 through Spring 2001. This project update reviews strategies used in this team-based model. Trends in project development and evaluation findings will also be reported.

This paper presents findings from the Teaching, Technology, and Teamwork (TTT) program sponsored by the Charles E. Culpeper Foundation at California Lutheran University. CLU's Information Technology Advisory Committee (ITAC) solicited and reviewed faculty proposals. Faculty whose proposals were accepted met with their team members once a week for one semester to develop their projects. Each project team included a faculty member (the content expert), a reference librarian (the information specialist who helped with research), an educational technologist, and a student assistant who implemented the technology elements of the project.

The projects used combinations of five major technologies. WebCT projects (14) outnumbered slide digitization and database development (2) and video production (7); custom web sites (6), and CD-ROM's (1). The total student development time in hours was greatest for video (840 hours) followed by slide digitization (750 hours). The fourteen WebCT projects required 560 student development hours followed by the custom web projects with 240 student hours. The digital video and slide projects are not scaleable; WebCT, with its difficult user interface, appears to be scaleable.

One course used the EduCue system to incorporate problem-based learning in the classroom. Students submitted answers via hand-held devices and the instructor's computer tabulated and displayed their responses. Students discussed the results and used the EduCue device to answer the same questions again. Because each of the devices has an ID number, the instructor knows who attended class and how each student performed. (For more information on EduCue, see http://www.educue.com.)

Some of the most successful projects have multiple audiences. Our California history project has been used by four audiences: pre-service teachers who will teach California history; fourth grade history teachers; students in CLU's California history class; and Computer Science students who are learning programming. A marine biology professor's *Beneath the Surface* Catalina Island video is used: by CLU students preparing for a Catalina Island field trip; and by passengers who visit Catalina Island on *The Rapture*-a marine biology expedition and research boat. Faculty and students use a WebCT "course" on Service Learning. (For more information on these projects and the Culpeper projects, see: http://www.clunet.edu/TLC.) .Our assessment of the TTT program included formative and summative evaluation. Our campus computing committee reviewed and critiqued projects at midcourse. In May 2001, we collected evaluation data on the Culpeper project via an on-line survey form using AAHE's Project Flashlight program. Fourteen of 24 faculty responded to the survey. We collected additional data from focused interviews with program participants during Fall 2001.

CLU's proposal to the Charles E. Culpeper foundation suggested that faculty lacked the time and expertise to extend their most successful pedagogies to include technology. Providing summer stipends or one course release during the year helped solve this problem. Half of the survey respondents commented on the importance of the teamwork component. For most, the experience of collaborating with a supportive team was very useful.

Not all faculty, however, embraced the team approach. One respondent commented, "Don't force the "team" aspect on everyone--provide the parts of the team that are helpful (for each case), and then get out of the way!" Several respondents mentioned problems with the students on the teams. The quality of student help in completing the project varied considerably. One faculty member observed, "Much was accomplished when I had good help working on the project. Things languished when I didn't." During the initial development cycle, student help was not screened as closely as it needed to be, and this was corrected. The development teams with technically competent and responsible student assistants usually resulted in a higher quality product. When the faculty member seemed to be in the program for the money or to teach one less class, progress was slow or the final product weak. In a couple of cases, these faculty resisted any organizational and planning meetings, something we felt was critical to getting the projects started and developed in a timely manner.

Some faculty reported new ways of envisioning how to teach. "Actually, the Culpepper project (Thespian Survivor) ... did force me to think differently, perhaps in more visual terms, about how to present the same material I had used in class for the last few years." Several slide and video projects were completed, and one faculty member commented that his project provided the "chance to better grasp the possibilities of how my images can be used more easily and (hopefully) more creatively in my teaching."

For faculty who do not understand technology, the problems surfaced during implementation in the classroom. When a faculty member would make the time to work with the team in the classroom prior to implementation, there were fewer problems. Media Services also provided technical assistance for some of the initial class sessions in case there were problems.

Post-project evaluations demonstrated that implementation of their online projects prompted faculty to envision new and more effective ways to teach and that they had observed improved student learning. Some also reported, however, that in order to enhance and quantify these improvements, new assessment strategies need to be identified and incorporated into subsequent versions of the projects. Other evidence of the Culpeper program's success can be found in: the fact that the University is funding the Teaching and Learning Center and its two new positions; and the dramatic increase in requests for and the availability of technology facilities.

An Empirical Evaluation of Sonar Courseware Developed with Intelligent Tutoring Software (*InTrain*™) at Naval Submarine School

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Abstract: With limits on both personnel and time available to conduct effective instruction, the decision is being made increasingly to enhance instructor-led courses with Computer-Based Training (CBT). The effectiveness of this conversion is often unknown and in many cases empirical evaluations are never conducted. This paper describes and discusses the evaluation and effectiveness of adaptive courseware authoring and utilization in the context of the Submarine Officer Basic Course (SOBC) at the Naval Submarine School, Groton, CT.

Introduction

The Naval Submarine School (NAVSUBSCOL), the "Center of Excellence" for Submarine Warfare Training, has recently dedicated a new, state-of-the-art electronic training facility that hosts ten Advanced Electronic Classrooms (AEC), a building-wide enterprise Classified LAN (CLAN), and external high bandwidth connectivity. The NAVSUBSCOL Officer Training Department provides the Fleet with Prospective Commanding Officers (PCOs), Prospective Executive Officers (PXOs), Department Heads, Division Officers, and a host of officer billet and specialty training courses. NAVSUBSCOL training responsibilities range from engineering, damage control, and ship control, to combat training simulation and tactical employment of the submarine. Currently, the curricula are based primarily on instructor-led presentations and practical exercises in lab/simulator environments.

Recently, NAVSUBSCOL determined that the demand for training was outpacing the available resources (instructor-led presentations and practical exercises). To address the situation, NAVSUBSCOL searched for a supplement to the instructor-led training by adding computer-based training (CBT). The goal was to leverage the available resources of the lead instructors while incorporating additional benefits of current courseware, maintaining internal control of content, and reduce staff loading.

This case study discusses the efforts made at NAVSUBSCOL to integrate CBT into the curriculum and the effects this type of learning will have on learning outcomes. Through a comparison study of both CBT and instructor-led courseware, supportive evidence can be garnered that support a savings in development time and improvements in test scores.

Traditional multimedia instruction creates an engaging learning environment in which multiple sensory pathways convey information to the student. NAVSUBSCOL wanted to choose an authoring tool that would allow instructors to re-use content and learning objectives throughout multiple courses, while delivering individualized instruction to a large volume of students. Likewise, it wanted the authoring tool to be easy to use and require low developmental times due to constant turnover of personnel.

InTrain™ provides such a tool. *InTrain* instruction builds and tailors the content and form of instruction to the moment-to-moment needs of the student. This results in faster acquisition and longer retention than is seen with conventional learning approaches.

In a marked contrast to conventional CBT, *InTrain* develops an individual education plan (IEP) for each student and makes its instructional decisions at run-time. Students proceed when they demonstrate that they are meeting the goals of instruction mastery. Students who need more time or different methods to reach the same level of performance receive the instruction they need.

While forming an IEP, *InTrain* considers information about the student (*e.g.*, the student's mastery profile and instructional history) and about the goals of the curriculum (*i.e.*, which objectives must the student meet at what level of proficiency). The IEP describes the order in which the system will introduce new topics and the training techniques that will support the introduction. When assessment is needed (both pre- and post-tests may be used), *InTrain* randomly selects among the assessment options (*e.g.*, test questions) associated with the learning objectives under investigation. Similarly, when *InTrain* wants to present instruction, it selects among the instructional options associated with the target learning objectives. Instruction and assessment continue until the student has adequately mastered all of the required learning objectives.

Shorter development times are also addressed by the *InTrain Author*! software (*InTrain Author*! is the interface through which *InTrain* courseware is authored. *InTrain* does not require any programming experience and offers an "as you go" tutorial on content development. This ease of use allows for shorter development time and less "training" time for new courseware development.

Method

To assess the effectiveness of the training to be demonstrated, Sonalysts, Inc. conducted a study in conjunction with NAVSUBSCOL. Traditional instructor-led classroom students were given 8.5 hours of instruction about SONAR, as were the CBT students. The learning objectives and goals of the content presented to each group was the same. In contrast, another group of students received *InTrain* instruction. Both groups were given the same amount of time to interact with the content.

After the second group completed the curriculum, both groups were then given a final written examination, comprising of 80 questions. Instructors scored the tests that included multiple-choice and true/false questions. The students needed to achieve a minimum of 70% to pass the course. The scores of the instructor-led group, were in-line with historical, satisfactory averages for this content and type of instruction.

Traditionally, training for the NAVSUBSCOL has taken place in instructor-led classrooms. Each classroom comprises approximately 24 students, who spend a portion of a 10-week course learning passive sonar theory and underwater acoustics. The focus of the comparison is on a specific 8.5 hours of the Sonar curriculum taught during the ten-week course. The 8.5 hours of instruction cover the following courses: Passive Sonar Equation, Total Background Noise, Beamforming, Figure of Merit, Source Level, and Propagation Loss.

While each course has a standardized set of Learning Objectives and a Curriculum Outline, each is modified accordingly. Courseware for traditional instruction has usually been developed in PowerPoint lessons with Instructor Discussion Points and Lessons Learned being conveyed by each instructor. PowerPoint are inherited by the previous lesson instructor and amended when the need occurs.

Students are scheduled for each of the above topics based on numbers of students, classroom availability, and instructor availability. Delivery time for each course is a pre-defined amount and scheduled by a central person. Students are assigned to the next course as they move through the curriculum. At the end of each component of instruction (sonar, tactics, plots, etc.) students are given a test comprising 80 questions.

In contrast to traditional methods, CBT was developed. To address NAVSUBSCOL's goal of authoring CBT "in house," Submarine School staff instructors, working with guidance from instructional designers and subject matter experts from Sonalysts, utilized *InTrain AUTHOR*! to develop an eight-hour, adaptive CBT course on the passive sonar theory equation, theories, and underwater acoustics. This development effort was a multi-stage process. Initially instructors were given a basic INTRO courses in courseware development and creating computer-based training. Instruction focused on creating and decomposing learning objectives, creating assessment items, and developing content (at a variety of targeted levels). Ultimately, one instructor became responsible for development of 8.5 hours of SONAR courses. *InTrain* allows for instructional method neutrality. The tool does not require one to build/create Sharable Content Objects/presentations in a particular manner, thereby allowing the developer complete freedom in content presentation and delivery. Sonalysts served as "consultants" to the instructor in charge of development. Media was reused from courseware previously authored for other topics, instructor-led training, and Submarine Officer On-Board Training (SOBT) courses.

The content developed using *InTrain*, was delivered to a class of 21 students that utilized the courseware during two four-hour dedicated periods, plus a one-hour wrap-up following the testing. The courseware was parsed into six topics that mimicked the training methodology of the material in instructor-led instruction. The CBT was deployed using options that permitted the student to learn the material and demonstrate mastery through assessment. Students were permitted two attempts at the assessments. If the student failed a second assessment, an instructor-led remediation was conducted.

Students were given the same amount of time to learn using the computer-based course as they were given to learn through the traditional methods. The reasons for this were two-fold: 1) Delivery of CBT was an emerging concept within NAVSUBSCOL. While computer-based training is available, the courses are self-paced auxiliary learning on Lessons Learned and Practice for defined skills. There was no model from which to build time/scheduling differences around this type of learning. 2) The SOAC/SOBC Associate Assistant Director of Officer Training maintained that it was important that an appropriate amount of time was scheduled for students to receive the training. The most efficient manner to achieve this was to "schedule" it in the same blocks of time as the traditional methods of delivery.

Upon completion of the material, students were able to review/return to the material at their convenience for follow-on study.

There were four measures by which results were garnered for this comparison study: Survey, Test, Historical Averages, and Development Time.

Survey – At the conclusion of the computer-based instruction (*InTrain Author!*), students and instructors were given a Level 1 evaluation. This survey consisted of both open-ended questions and Likert-scale questions.

Test – The paper-based test included 80 questions that were both multiple-choice and true/false. Both groups of students (CBT and instructor-led) were given the same test and graded using the same set of instructors.

Historical Averages – The historical averages used in the study are the averages of students who had gone through the instructor-led training in the past two years. The scores were from a slightly revised version of the test given to these students (The revision included the learning objectives but a few questions were changed).

Development Time – Development time for the *InTrain* course was measured.

Results

The results of both courseware development and actual "testing" of the courseware as indicated below show improved in results in both the authoring content and the student performance.

Survey

The results of the students' survey were interesting. A 5-point Likert scale was used for the 20 questions.

The areas that scored highest (4–4.5) were the presentation of the material and the way in which students interacted with the course. A score of 4.2 was given to the overall usefulness of the course within the curriculum in general.

The students' response to another set of questions (scoring 2.6–2.9) demonstrated that no additional instruction or assessment was necessary, lending credibility to the individualized component of the training which provides "just enough" instruction to achieve mastery of the learning objective. There were enough assessment and instruction to teach the topic without being overwhelmed by obscure materials. This method targets the learner to specific information to support specific concepts and objectives.

Test Results

Students' scores in both the instructor-led group and the *InTrain* group were measured and compared on the basis of results from the 80-question test.

	Instructor-Led Group (Last 2 classes of students)	***InTrain* Students (One class)**	**Historical[1] (Instructor-Led Group)**
Population	75	21	≥ 300
Student Mean[2]	88.5%	95%	84.5%
No. of Exam Failures[3]	3	0	N/A

Table 1. Evaluation Results

Courseware Development

No metrics exist to gauge the amount of development time required to prepare instructor-led courseware because the instructor-led materials are inherited from the original instructor and revised over several years.

Although CBT development ratios can vary widely, actual development time was compared to a benchmark of 200 hours per hour of CBT. For this effort, that would yield an approximate effort of 1600 hours of authoring time to design, storyboard, implement, and test the course.

In contrast to this benchwork, the Submarine School staff spent a total of 500 hours for the development effort. Sonalysts' instructional designers and subject matter experts spent an additional 150 hours providing feedback and guidance on effective CBT design and content presentation.

Discussion

The survey results yielded some interesting information. The open-ended questions asked throughout the survey indicated that the students were favorably impressed with and receptive to the CBT that was presented. Additionally, they liked the "individualized instruction" that was presented through *InTrain* allowing some of the students to finish quicker and more efficiently than others who required more time or instructor intervention. Some negative responses about the CBT included the need to have an instructor review session at the conclusion of training (before the test). Another negative comment was the length of time dedicated to each training session (taught via CBT) was too long. In both cases each comment can be resolved in a simple and effective manner.

NAVEDTRA 131 (Task Based Instruction), the controlling doctrine for the course in quesiton, requires that all instruction that results in a *bottleneck* be serially scheduled. That means, for a class of 12 students participating in a learning experience that takes 4 hours and has capacity for only 6 students, an entire training day must be scheduled against it. By its nature, CBT provides unparalleled flexibility to obviate bottleneck scheduling. Students learn at their own pace, on their own schedule. In an instant example, the other six students not in the learning experience can complete assigned CBT required for another part of the course. The time saved by removing bottleneck scheduling is approximately 24 hours.

If given proper integration into the NAVSUBSCOL curriculum scheduling process, students would proceed through the courses on an individualized basis. In fact, they would be assigned courses and a completion date and proceed at their own pace toward that completion date. This is the way that NAVSUBSCOL is moving with the integration of a Learning Management System (LMS) to create such assignments.

More CBT is undergoing development in other areas of the 10-week curriculum matrix. When more of the courses are converted to CBT and an entire curriculum can address scheduling, changes will be easier to implement. When timesaving is realized, an instructor-led review session can be addressed and implemented to quantify knowledge gained through the CBT.

Additionally, the study yielded anecdotal evidence that four hour training periods for the students were too long and resulted in student "burn-out," an assertion supported by student feedback following the training. A consensus of input suggests that a period of two hours at any given time/topic is the longest that should be scheduled. The artificiality introduced by the beta test (i.e., the test dictated two four-hour periods of study) required the student not study when they were ready to, but rather when the test required it. As such, student mastery and navigation through the material suffered at the end of the first training period due to student fatigue.

Finally, we address test scores. We can see that the scores on the test were higher for the *InTrain* classes than the traditional instructor-led method. Since both groups were achieving at a high-level, the observed results might actually understate the size or effect one would expect in other settings. Another factor that influenced the "ceiling effect" introduced by these scores is the high average among the students. If the tests were longer and students had been scoring in the 70%, we would have expected to see an even greater range of effectiveness defined.

CBT Benefits

The CBT in question does provide some benefits when measuring interaction time metrics: In the study, the students required an average of 8.2 hours to complete the 6 topics in the CBT. In comparison, instructors require 8.5 hours to teach the same material in an instructor-led lecture format. One would assume that the CBT seat time would be reduced about 50-60%. However, given the restrictions of the imposed time schedule this was not seen. One would assume that the deployment time would be less once a new scheduling system is implemented and appropriate time values are added to the scheduling matrix to accommodate Computer-Based Courses.

Additionally, there was a time-savings in terms of instructor remediation time. A total of 7 students required remediation by an instructor, yielding a total of approximately 1.5 man-hours of instructor time for student instruction (vice the nominal 8.5 hours required to teach the material *plus* any time spent in individual tutoring). For the beta test, Submarine School instructors attended all training sessions, but it is envisioned that once CBT is well entrenched in the SOBC curriculum and students understand how to use it, direct instructor supervision will not be required. Rather, CBT will be employed to teach basic theory and concepts, and instructor led seminars synthesizing material and covering more advanced concepts will be used to periodically ensure students have satisfactorily advanced through the material.

On its face, the integration of Sonalysts' tool represents a 59.3% savings in development time over a typical CBT effort. However, some elements in the study influence this apparent savings:

- The Topic Learning Objectives derived from course Personal Performance Profiles (PPP) tables already existed; hence the course was not built "from scratch."
- The Submarine School staff author had no training in CBT development. While this is a *de rigueur* requirement for any authoring tool fielded for Submarine School, it is also true that those same personnel will become more proficient in the use of the tool as more CBT is authored.
- A limited amount of media (3 graphics) was produced in support of this effort. For the remaining approximately 700 graphics and animations used, existing media and or local generation tools were leveraged for the media production. It is anticipated that during a typical CBT authoring effort, the existing media bank will not be quite as well populated.
- The purpose of the study was also to test *InTrain AUTHOR!* Several software problems were identified and corrected during the test. This resulted in an aggregate reduction in authoring capability for a period of about one week. *InTrain* has completed Beta testing and made changes, so this type of delay should no longer occur.

Conclusions

The entire authoring effort, deployment of the course, and post-CBT analysis spanned 3.5 months. Sonalysts, provided the IT, instructional design, and subject matter expertise in an effort to investigate the usefulness of *InTrain* CBT in an established, structured U.S. Navy curriculum. Submarine School provided exceptional dedication to the effort, including the combined work of the CBT author and testing team.

The *InTrain* CBT test provided valuable input to the product developers at Sonalysts, both in terms of performance and study recommendations. As part of the implementation of distance learning efforts at NAVSUBSCOL, Sonalysts will be involved with the integration of the submarine officer training curricula into the THINQ™ LMS (Training Server). This initial testing allowed the software engineering staff at Sonalysts to evaluate the requirements and use patterns of CBT (and specifically *InTrain*) in an enterprise LAN environment.

As part of the population of the LMS with content, Submarine School must develop and deploy a robust web-hosted CBT course structure to allow remote users access to training prerequisites and remediation to support both professional development and continuing training onboard submarines. This test provided the Submarine School staff some experience in CBT design and provided some metrics and recommendations about implementing CBT to maximize its benefits to the student population.

Summary

Based on student performance and feedback received, the following conclusions can be drawn from the test:

- The benefits of implementing adaptive CBT in the Submarine School range from possible timesavings in specific curricula to automated remediation and instruction. Manpower savings will permit Submarine School to pursue implementation of a Distance Learning support division comprised of experienced subject matter experts who have instructional expertise in front of a class and as CBT authors.
- CBT cannot replace the instructor completely. Students asserted uniformly that the face-to-face communications were at times critical for the understanding of particularly complex concepts. While not applicable to the material delivery in the Beta test, NAVSUBSCOL is planning on maintaining some instructor-led seminars to provide higher-level synthesis of read material.
- Training via CBT provides exceptional flexibility to both the schoolhouse (in terms of resource scheduling) and to the student (to learn at his convenience).

The potential to improve training efficiencies, effectiveness, and achieve Fleet readiness improvements with the infusion of advanced training methodology and technology is enormous and clearly measurable. This effort is not envisioned to replace the resident training experience but to enhance the level of professional development that can be achieved and to provide continuous training and maintenance of readiness to students and groups ashore or at sea. A substantial commitment to investing in information technology infrastructure has been made, but the return on investment will not be realized without a concomitant fielding of advanced learning methodology products. It is recognized that this vision in its many forms and variations cannot be achieved immediately; the first small steps will reflect changes in technology and processes.

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[1] Historical averages are based on exam results from the last year.

[2] The written examination included two topics that were not developed into CBT but were presented to the students in traditional lecture format. The average for those two questions was 79%. A corrected average for performance on just the InTrain instructed material was 96.2%. Removal of these two topics from the other tests did not change the historical or last 4 class means in any significant fashion (± 0.2%).

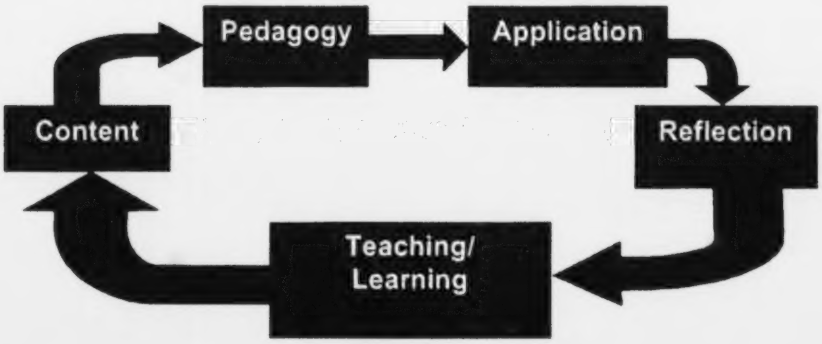
[3] Exam failures are counted in the student mean as 70%. Remediation and re-exam are conducted upon exam failure.

Collaborative Integrated Applications for Mathematics and Science Content and Pedagogy Among University Faculty and Public Schools

El Paso, Texas is a border community with a population of over two million people. The city is the fifth poorest city in the United States with a minority (Hispanic) population of about 78%. A collaborative effort among the Colleges of Science and Education and Public Schools was sponsored by the National Science Foundation (NSF) to improve mathematics and science education. This paper concludes the study of a six-year project. The goals of the project were:

1. To develop a working collaboration among Colleges of Science and Education and Public Schools
2. To improve pedagogical applications with content faculty and to increase content knowledge with pedagogical faculty
3. To bridge the gap between university theoretical learning and real world practice in classrooms
4. To develop a model of teaching that produces teachers capable of teaching mathematics and science to "high risk" students

No one would argue the need for teachers to know their content but content alone does not produce the results needed for all students to learn. This paper outlines a four step model of teacher training based on theories of Vygotsky and Piaget and the research resulting from the Partners for Excellence in Teacher Education (PETE), an NSF initiative project. The basic model is as follows.



Faculty from the Colleges of Science and Education team-teach integrated courses on-site in public schools. The courses are 1. Block I, The Property of Real Numbers, Curriculum, and Mathematics Pedagogy: 2. Block II, Physical Science and Science Pedagogy. The university classes are taught in schools and the Block Classes include a teaching segment in which the university students go directly from class to a classroom to practice teaching the university content using the pedagogy. University faculty and public school teachers provide immediate and written feedback concerning the teaching segment.

PETE was funded in 1996 to investigate ways to improve mathematics and science teaching in the United States. The first step was to develop trust and respect between faculty in the Colleges of Science and Education. Many hours were spent discussing theoretical and conceptual beliefs concerning learning. Major differences in the culture of these colleges were discovered concerning learning and teaching. Faculty worked to identify common ground, agree on theoretical approaches to learning, and determine plans to combine courses and implement an experimental approach to teacher training. The science pedagogy course moved to the school site in 1997. Three semesters later the Physics department joined the pedagogy course with the integrated Block course. Based on the success of this project the mathematical block united and moved to a school the next semester.

Multiple evaluation has been used during the course of the experiment. Content pre- and post- tests, attitudal surveys, video analysis of teaching tapes from actual classrooms, and cognitive interviews have been compiled and analyzed. ExCET test (the Texas qualifying exam for teachers) scores have been compared.

Implications could include a new model for training teachers, identifying the process for successful collaborations, and a research design for teacher assessment. Further studies of this model will be expanded to other classes at UTEP and need to be replicated at other sites.

Awareness and Cohesion as Key Factors for Interaction - Lessons Learned from the VFH

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Introduction

The federal flagship project "Virtual University of Applied Sciences for Technology, Computer Sciences and Business Administration" (VFH) predominantly employs "virtual" teaching methods which require a high level of interaction. Spontaneous, informal communication is emphasized, and is indeed necessary for Computer Supported Cooperative Learning (CSCL). Also, a "virtual community" is to be formed in which students can improve their communication skills. Awareness and cohesion are essential for both, CSCL and the virtual community, and their importance in communication will be explored, conceptualised and specified. We show the status quo and possibilities for optimisation, by means of the evaluation results of the pilot phases of the VFH.

Requests

Didactic requirements of the VFH are fulfilled through new and innovative learning forms. These forms, especially CSCL, require a sufficient level of interaction (i.e. cooperation, communication, coordination). Also, the cohesion of the group and, fundamentally the conscious awareness of other group members are important.

Group-cohesion and awareness are not only relevant for the CSCL-process. Cooperative processes in the VFH should not be limited to the syllabus. Under the view of lifelong learning, it is essential to support self-organised learning methods within the framework of the VFH. An example is a learning group in which students prepare for their exams. In such groups informal and spontaneous interaction is needed.

Communication without a mentor where students 'chat' about predetermined subjects is of paramount importance to the development of the VFH to a virtual community. Rheingold defines a virtual community as "social aggregations that emerge from the Internet when enough people carry on public discussions long enough and with sufficient human feeling to form webs of personal relationships in cyberspace" (Rheingold 2000). This should also pertain to the VFH. Without sufficient interaction the VFH remains a largely anonymous learning environment.

Cohesion

The quality and quantity of cooperation depends on the amount of cohesion occurring between those cooperating. This cohesion or commitment does not guarantee a better performance. Nevertheless, intense social cohesion within a group is a great motivating factor. Group members positively perceive this cohesion, and they behave in a "group-sense". The social cohesion perspective focuses on the fact that students want one another to succeed, and that is why they help one another in the learning process. The usual sanctions controls of a fixed-group norm can be partially avoided. The intensity of group-cohesion is dependent on a multiplicity of factors, like awareness, posibilities of interaction, task, group size, homogeneity, individual factors and time of cooperation.

But the explanation of the learning matter relates only slightly, or has no impact at all on the learning success of the recipient. The advantages lie rather clearly on the person who gives the explanations.

Thus, a structure needs to be created which makes explanation possible for all group members – independently from group status and individual competence. Within this context the main starting point is the creation of the task. If designed as a jigsaw, one can assume that explanatory processes, independent from the status, are to be stimulated.

Awareness

In order to develop social obligations and responsibilities within group cohesion, interaction must be promoted. The basis for interaction is perception of the participants as well as their actions. This "awareness" is fundamentally essential for effective performance in virtual groups.

Briefly viewed, awareness enables "*the individual to group the situation of his/ her current surroundings, and to accordingly adjust his/ her actions*" (Pankoke-Babatz 1998). In the area of CSCL, this means that one must be aware, even in an "electronic" surrounding, of various alterations in the atmosphere, its causes and effects, the actions of others and their effect, and other events occurring. Awareness is summarized as "*an understanding of the activities of the others as a context for its own activities*" (Dourish & Belotti 1992), or more succinctly "*knowing what is going on*" (Endsley 1995).

What is essential for the spontaneous, informal interaction and for cohesion? Primary is personal awareness that refers to a person. This comprises synchronous and asynchronous awareness information. Asynchronous awareness information is attainable for example through a homepage of the participants. Synchronous awareness information can be sub-divided. One essential aspect is the transmission of attention focus, e.g. usage of a telepointer on a shared whiteboard enables participants to follow others actions. The other aspect is the ability to facilitate contact. An example is the information about the availability of the participants in the learning environment.

An evaluation result of the pilot phase of the VFH was, that the main problem for groups was the lack of synchronous awareness information especially the missing ease of making contacts. The following remarks were expressed: "*I can't get into the work if I don't know who's sitting on the other end of the computer.*" The result was a preponderating asynchronous communication. The students were unhappy about "*being reliant, that the others constantly check E-mails, news or discussions. There is no 'wake up' alarm per telephone*". The lack of contact and the altogether defective personal awareness spawned the following remark: "*if the technical and personal working conditions aren't clarified, there is scarcely a chance to cooperate.*"

Spontaneous communication, which is an important success factor of CSCL and the establishment of a virtual community in the VFH is not possible in the framework of externally scheduled 'Chats' and with a learning space that provides asynchronous group communication but insufficient awareness support. Spontaneous contacts and communication must be improved. This requires, in addition to general didactical reflections, advanced support for awareness, especially personal awareness.

References

Dourish, P. & Belotti, V. (1992): Awareness and Coordination in Shared Workspaces. In: Proceedings of CSCW '92 (pp.107-114). Toronto: ACM Press.
Endsley, M. (1995): Toward a Theory of Situation Awareness in Dynamic Systems. In: Human Factors, 37(1), (32-64).
Pankoke-Babatz, U. (1998): Awareness – Spannungsfeld zwischen Beobachter und Beobachteten. Workshop der D-CSCW: Von Groupware zu GroupAware. (S.5-12). URL: http://orgwis.gmd.de/dcscw98-groupaware/groupaware.pdf [12.09.2000].
Rheingold, H. (2000): The Virtual Community. Cambridge, Mass, et. al: MIT Press.

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A Delivery Server Infrastructure for Multimedia Distance Learning Services

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Abstract: The distribution of content and applications over the Internet is one of the most demanding research topics. One challenge is to present and manage interactive multimedia services in different networks hosted on various servers with diverse operation systems and miscellaneous system configurations and conditions. In this paper, we present a delivery server infrastructure for sophisticated multimedia content. Comparable with the Application Service Providing concept, we introduce a platform independent framework to provide interactive distance learning services. The aspects of scalability and load balancing are a main part of this approach and will be treated respectively. High availability and security are also mentioned.

Introduction and Motivation

On the threshold of the information society to the knowledge community the learning and training habits have to be transformed to meet future challenges. Not only the implementation of new learning methods in traditional learning environments but also the necessity for lifelong learning increases the relevance of new information technologies for teaching and learning issues. In this context, several projects at the Institute of Communication Networks at the Munich University of Technology (Germany) deal with the development of new techniques. One emphasis is the implementation of the infrastructure because the supply of services via networks is becoming more and more important.

There is a lot of work going on in the area of Application Service Providing (ASP) and Content Management (CM). Other institutes and laboratories are doing research, and diverse companies offer their hardware or software solutions. A good overview of the roles and issues of ASP is described by [Durlacher Research (1999)] including some economical aspects. About content and knowledge management there are a multitude of sources in the Internet, see also "Contentworld" (www.contentmanagement.com).

From the technical point of view, we differentiate between hardware and network techniques (e.g. servers, switches) offered by enterprises like Cisco Systems, Nortel Networks, Hewlett-Packard, IBM and SUN Microsystems, and software solutions and application management systems, such as Microsoft, Citrix Systems, Oracle, SAP, Lotus Development and so on.

At universities and other learning centers different sorts of Web portals have been developed, but we consider that none of them is really suitable to form a modular and flexible framework to provide interactive distance learning services, like remote simulation services. In this context, it should be noted that we do not try to compete against the solutions mentioned above by implementing another software suite. We rather suggest a new tool architecture, which allows the integration of existing components in a more flexible manner. To our knowledge none of the developments pursue this distributed and service-oriented approach. Though we consider a diversity of multimedia services, we suggest using an integrated solution of centralized server system.

Application Service Providing for Distance Learning

Also in the educational environment effective provisioning of distance learning services is an important challenge. Therefore, we first discuss what the expression "ASP" means and we point out the benefits of the ASP-concept in TeleEducation scenarios.

Application Service Providing (ASP) stands for the management and the distribution of software-based services and solutions to customers across a wide area network from a central data center. Thereby an *application server* is frequently viewed as part of a three-tier application, consisting of a graphical user interface server, an application server and a database. The access is done via a web browser. Thus, the user only needs a thin client to execute the software. High availability and performance of the applications and the security of the user data are some of the advantages the ASP-concept has for business management. Expense, security and reliability may be some reasons to implement this concept at universities and other learning centers. For offering content and applications for TeleEducation issues, we distinguish between three different types of learning environments in the Internet: learning portals, e.g. the National Technological University (www.ntu.edu), learning platforms (www.virtual-learning.at) and enhanced learning delivery server infrastructures.

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The Delivery Server Infrastructure "KIARA"

At our institute we established a server system KIARA, which offers the features of a network portal, like search and linking functionalities (Fig. 1). The framework allows not only the ability to deliver some multimedia content but also to get access to different applications, which are hosted at the internal network computers. A main aspect of this architecture is the management system, which deals with file access, simulation demands and security requirements. Together with its billing and access right abilities, the management system presents some sort of ASP capabilities. At our institute the system is used to support simulation programs remotely for research work and educational purposes.

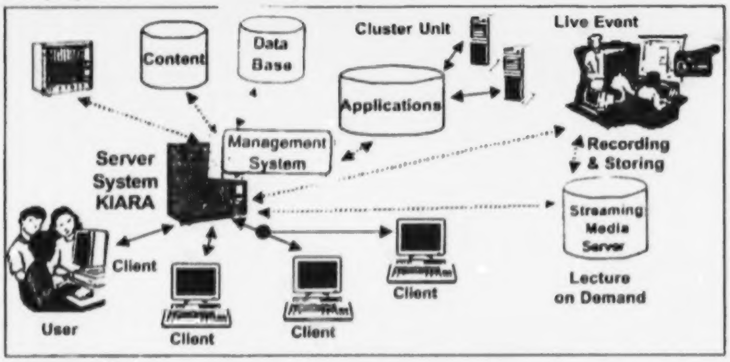

Figure 1: Scenario of a delivery server infrastructure

Further details on the hardware and basic software of the architecture are described in [Merz, Bör, 2000].

Application Management System

The outstanding benefit of the management system is its scalability. Also availability and mobility are obtained by storing relevant information in a database on the server-side. One main task of the server management is to allocate the application demands to different computers of the cluster unit for better load sharing. When the user starts to communicate with the system, the user-management checks the authentication. Subsequently, the user gets the possibility to configure the parameters for a requested application with the help of a graphical user interface (GUI) on the client-side. Afterwards, the application request is transmitted to the server. In addition to user-management the server provides a licensing system. With the help of a scheduling table, the applications can be executed in a time-controlled manner. The executions of different individual applications are distributed with the help of a load balancing system on different cluster computers for a better enhancement of computing performance. Further details about the implementation of the system are described in [Bör, Jost, 2001].

Conclusion

In this paper, we present a delivery server infrastructure, which supports not only standard ASP-software, but also other types of interactive multimedia applications, like sophisticated distance learning services. As a result, the system has to provide some sort of management architecture, which allows user management and other administrative tasks, for example billing. Furthermore, the server framework fulfills the following features:

- High scalability, availability, reliability, security and support of mobility aspects
- Good performance with regard to transfer rate, number of clients, bandwidth
- Integration of various applications (audio/video, text, graphics, interactive application programs, games...)

Although a prototypical implementation of the system has been developed, much needs to be done before the framework can be applied in a commercial environment. Further research should be done on the integration of other time-sensitive applications, for example interactive games, and performance aspects have to be evaluated.

References

Durlacher Research (1999) Application Service Providers, A Report by Durlacher Research.

Merz, T. & Bör, A. (2000). *Server Concept for a User Driven Management of Networked Multimedia Application.* In Proceedings Eunice 2000, 6th Open European Summer School on Innovative Internet Applications, Twente, Netherlands.

Bör, A. & Jost, J. (2001). *A new Framework for Enhanced Application Service Providing.* In Proceedings SoftCOM 2001, International Conference on Software, Telecommunications & Computer Networks, Split (Croatia).

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A Services-Based Architectural Model for E-learning

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Abstract: A multi-model services-based approach for modeling the reach functionality of a learning process is presented. It allows the functionality to be split in different layers that are functionally orthogonal. The handling of activities over each layer is mapped to a suite of protocols. This way a not purely hierarchical decomposition of functionality is achieved and it is closer bound to distributive nature of learning environments. Explored generic Streaming Learning Architectural Model is appropriate to cope with dynamic tasks in learning as are the bi-directional interactions and messaging, collaborative learning, learning forums and presentations in real-time.

Introduction

The major e-learning initiatives (ADL 2001, IEEE 2001, IMS 2001) model the e-learning via a set of end-users requirements and try to map them onto existing digital technologies that are represented by Web paradigm mainly. They are concentrating on learning content delivering first and foremost. In fact, the education process is more complex and needs more than the Web paradigm - and HTTP protocol behind it - could offer. The complexity of e-learning is arising from requirements on dynamism and entity semantics handling. The Web, even with its extensions as DHTML and scripting models, is not capable to map all functionalities that may occur in a collaborating learners class – bi-directional interactivity, events handling, learner behavior tracing and steering, system state preserving, etc. The Web is also suffering on lack of mechanisms for entities semantic handling. In our understanding the Web is just one of possible handlers that acts in a client/server model. The investigated architectural model is assuming that other handlers in a client/server environment could be used also and other than client/server paradigms could be applied like P2P model for instance.

The services-based architectural model

The e-learning architectural model under consideration is not assumed to be Web-centric one, although the Web is one of the major handlers used for content delivering and rendering of information still. The presented architectural model is built up around two main ideas. The first one is that learning is modeled after a set of services representing some pieces of functionalities from a subject perspective. On the other hand, from an IT perspective, the services are small entities that could be transferred over the network and programmatically handled. The second e-learning model idea focuses on what framework is needed for services processing and handling. A protocol framework is proposed for services handling over the distributed learning environment. The protocol framework is a suite of protocols each of which is responsible for a primary class of services. The protocols are acting in layers as is shown in the illustrative layers decomposition scheme (Fig. 1).

The learning activities are time-framed as they are to be performed in a finite interval in general. Performing of the learning activities is usually related with transition through different states and an initial and end state of this process could be differentiated. In most cases the time for activities is not crucial and it is important to follow a pre-programmable sequence of steps. That is why we are viewing the learning activities as sequence-framed. The execution of a learning sequence is considered as a stream of interchanges that are behind the sequencing. The carrier of encoded expertise is called *stream*. The stream could be a peer-to-peer communication, a multicast or a broadcast. A stream as a logical production consists of: learning services, instructions and a set of supervising agents all organized as a scenario, which is to be performed within a session.

The logical structure of a stream is embedded in a stack of layers represented by XML technologies (XML 2000). The functionalities of these layers are illustrated in (Fig.1). The investigated elearning architectural model is consequently named Streaming Learning Architecture Model (SLAM).

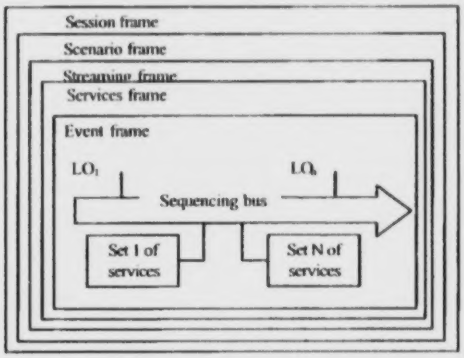

Figure 1: Streaming Learning Architecture Model

The sequencing could be triggered and/or redirected on the base of an event model. The streaming layer protocol is responsible for monitoring of the sequencing of learning content. Further it is supposed that the stream is carrying not directly the learning objects but aggregated entities called services. This way the learning is presented by a set of services. All learning activities could be decomposed into sub-groups like services, sequencing, events, etc. and these sub-groups form functionally orthogonal layers. A protocol is responsible for each layer realization that technically could be implemented as part of other layer protocol. As basic protocol could be considered the stream protocol but it is also embedded in two other layers - session and scenario layers.

Conclusions

A multi-model services-based approach for modeling the reach functionality of a learning process is presented. It allows the functionality to be split in different layers that are functionally orthogonal. The handling of activities over each layer is mapped to a suite of protocols. This way a not purely hierarchical decomposition of functionality is achieved and it is closer bound to distributive nature of learning environments.

Explored generic SLAM model is appropriate to cope with dynamic tasks in learning as are the bi-directional interactions and messaging, collaborative learning, learning forums etc. The anticipated base for model implementations is widely accepted and agreed for standardization XML platform.

The presented reference elearning model has been used for development of a set of specifications (Bogdanov 2001) defining a unified methodology for designing of distributed learning environments. The specifications are described in an IEEE LTSC format.

References

ADL SCORM Model (2001). http://www.adlnet.org/Scorm/scorm_index.cfm.

Bogdanov D. (2001). Learning Technologies Architectural Framework, *Prometeus EC Sig Design*, http://www.igd.fhg.de/~lindner/PROMETEUS/SIG-DESIGN/WG2/Discussion/LT –FRAMEWORKS_2.doc.

IEEE LTSC Specs (2001). http://ltsc.ieee.org/doc/index.html.

IMS Project (2001). http://www.imsproject.org/specifications.html.

XML Protocol Requirements (2000). W3C Working Draft, http://www.w3.org/.

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E-Learning in College and Corporate Settings: The Present State and Beyond

Abstract:
Who is making the decisions about e-learning? What tools, resources, and courseware do college instructors and corporate trainers favor? And what are some common experiences and trends in e-learning? Based on two extensive studies in the college and corporate markets, this session will document the incentives, support structures, skills, tool preferences, and experiences of both college faculty and corporate trainers. In effect, the presenter will summarize two comprehensive survey reports, one on e-learning in corporate training and one on e-learning in higher education.

Introduction:
During the past few years, it seems that every technology-related newsletter, magazine, conference, and institute has expressed at least some an interest in e-learning. Despite the high interest, countless questions surround this new training delivery mechanism. Are course completion rates as well as costs higher or lower than in conventional classroom training? What types of tools and instructional techniques are most prominent on the Web? And what evaluation methods are valued and increasingly common here? In effect, just why are different firms and organizations interested in placing their training programs on the Web and how are they allocating resources to support it? And what about the emergence of the cyber university and online courses? What are college faculty experiences, preferences, and attitudes toward e-learning?

In attempting to answering some of these questions, the presenter has just completed two fairly comprehensive reports, "Online Training in an Online World," and "Online Teaching in an Online World," co-sponsored by CourseShare.com and Jones Knowledge, Inc. (see: http://www.publicationshare.com/ or http://www.jonesknowledge.com/). These free reports (as well as briefer summary reports) detail the e-learning attitudes and preferences of college faculty as well as corporate trainers, training managers, and other human resource personnel.

These reports have many goals, including:

- Assessing the e-learning resources and tools that college instructors trainers currently use as well as desire,
- Documenting reasons for sharing course materials and resources on the Web,
- Determining the types of online learning tools currently used as well as needed,
- Discerning some of the pedagogical practices and motivational techniques supported by e-learning,
- Revealing the support structures for online learners, instructors, trainers, and course designers, and
- Pointing to the present state of e-learning as well as future trends and directions.

Importantly, these report addresses emerging topics such as online learning communities, reusable learning objects, and freelance instruction. In addition, there are findings and recommendations concerning e-learning tool development, time, organizational support, content development and outsourcing, and evaluation and assessment.

Across the findings, it is apparent that the Web is flourishing as a teaching and training delivery mechanism. As one might expect, the most common forms of online training are computer applications, technical skills, and job-related skills. In higher education, online training is more varied. In stride with recent reports on e-learning, respondent organizations tended to rely on blended or hybrid approaches wherein Web-based training supplemented and, hopefully, enhanced face-to-face instruction.

Despite the explosion of interest, the survey respondents noted significant organizational and cultural barriers to e-learning including perceptions of high cost and extensive instructor preparation time. In addition, there were technological problems related to bandwidth, firewalls, and limited technical support. Respondents also alluded to a need for more innovative e-learning tools that provide interactive feedback, multiple forms of collaboration, and enhanced learner evaluation and assessment. In terms of the latter, some firms are experimenting with alternative forms of evaluation that extend beyond the first two or three levels of the Kirkpatrick framework (i.e., reaction, learner achievement, and job performance). Nevertheless, when it comes to formal e-learning assessment, few instructors and institutions have made much progress.

Across the findings, there also appeared to be a need to train instructors and instructional designers in Web-based instructional approaches and opportunities. As this new learning format gains in reliability, acceptability, and interactivity, support structures are necessary for those building and refining their online courses, those administering and delivering them, and those taking them. In fact, innovative portals might provide expert guidance on purchasing decisions and vendor selection, content development, and the implementation of e-learning systems. And when high quality courses are developed, leased, or purchased, they need to be promoted by the university, company, or organization.

In the end, successful online training requires comprehensive support programs; if one aspect is nonfunctional (e.g., lack of student or employee access to e-learning), the new system will not succeed. Support might be live as well as online and intrinsic as well as extrinsic. The two reports will hopefully help sort out the choices and resolve some of the complexity. Specific information on these reports is provided below.

Report 1. "ONLINE TEACHING IN AN ONLINE WORLD"

CourseShare.com and JonesKnowledge announce the first of a series of joint survey research reports related to the use of the Internet in teaching and learning. This comprehensive report, "Online Teaching in an Online World," is available for free (see http://publicationshare.com/ or http://www.jonesknowledge.com/higher/index.php). The 75 page report addresses the use of the Internet by 222 college instructors, from both public and private institutions, who were early adopters of the Web. Instead of randomly surveying college instructors about their Web-based teaching needs and experiences, this research targeted those with some experience in using the Web as a teaching and learning resource, either in the World Lecture Hall or in MERLOT.org. Interesting findings are reported related to freelance instruction, student course attrition, and e-learning decision-making. Several key implications regarding instructor training, support, and resource exchange are also provided. In addition, there are recommendations concerning online learning policies, pedagogy, research, and courseware development.

- Bonk, C. J. (2001, May). *Online teaching in an online world.* Bloomington, IN: CourseShare.com. Retrieved March 12, 2002 from: PublicationShare.com and http://www.jonesknowledge.com/higher/index.php.

> Note: The Executive Summary of this report was published in January 2002 in USDLA Journal. http://www.usdla.org/html/journal/JAN02_Issue/article02.html.

Report 2. "ONLINE TRAINING IN AN ONLINE WORLD"

This January 2002 report, "Online Training in an Online World" is available for free at: http://publicationshare.com/ or http://www.jonesknowledge.com/corporate/index.php. The 143 page document (as well as a briefer summary report) details the e-learning attitudes and preferences of 201 trainers, training managers, and other human resource personnel. The final report explores a number of e-learning issues and future trends, such as the types of training offered online, the range of organizational commitment to e-learning, and the cultural and organizational factors limiting the adoption of e-learning. The report also addresses e-learning content development as well as outsourcing, instructional practices, motivation techniques and incentives, learner and instructor support mechanisms, and tool growth areas. Several key implications are noted related to the development of online trainer communities, reusable learning objects, e-learning partnerships, and freelance instruction. In addition, there are recommendations concerning tool and content development, pedagogical practices, organizational promotion and support policies, evaluation and assessment, and next steps in research related to e-learning.

- Bonk, C. J. (2002, January). *Online training in an online world.* Bloomington, IN: CourseShare.com. Retrieved March 12, 2002 from: PublicationShare.com and http://www.jonesknowledge.com/corporate/index.php.

    Note: The Executive Summary of this report was published in March 2002 in USDLA (United States Distance Learning Association) Journal. http://www.usdla.org/html/journal/MAR02_Issue/article02.html

An object based system for developing and delivering e-learning content

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Abstract: The Web as a medium for the delivery of learning content is totally different from printed text. Some of the major differences are in the way content is created, formatted and presented to learners. If traditional textbooks and study guides are simply converted to Web format using for example a word processor, we are misusing this new medium. In a Web based learning environment content should be fragmented into smaller chunks. There are many reasons for this fragmentation: readability, manageability, relevancy, etc. The fragmentation must be part of the content writing process and cannot be fabricated afterwards. We believe the fragmentation, structuring and linking of Web based content are very closely coupled to the content creation process itself. A LCMS was developed to address certain content authoring requirements.

Educational Issues

We are used to a sequential world: television and radio are all examples of pre-defined sequences of information. Although not constructed in a linear fashion, the result is a linear sequence of information blocks that cannot be re-arranged. The same is true for printed text. Physically a book starts at page one and is usually read in a linear fashion to the end. These sequences are fixed for all the readers. It is therefore "normal" to think that we should create and deliver E-learning content in the same linear fashion.

Information technology is making authors from all of us: it is quick and easy, and therefore I am an author. To make things even worse, authors and instructional designers are given traditional authoring tools like Word processors to create web-based content. Although tools like Dreamweaver and Frontpage are available, they are much too complex for most lectures. New software is required to enable structured and controlled content creation within a virtual learning environment by all team members (graphic designer, instructional designers, lectures, administrators). We strongly believe that Web based content should be developed in the same environment where it will be delivered. It should also be done by the lecturers themselves. If not, they should at least be able to update content. The authoring tools in the *Varsite* Learning Content Management System (LCMS) can address a lot of these issues through the implementation of learning objects in an object based system.

Previous work and background

Until recently, faculty (authors) at the PU for CHE made use of a Word processor to create web-based study content. Authors were given a template consisting of the required headings and sub-headings. This template contained the structured levels of the study guide. The structuring is important and must be done before any writing commences. A conversion is then made from the linear document to a web document using a commercial product. The converter generates an HTML document for each heading level of the original document. It also generates a tree-view table of contents for easy navigation with expandable sections.

This process worked quite well, except for one problem, the authors never get to know the medium that they are actually writing for. Even though the instructional design is for the Web, authors still tend to write in a style that is for printed text. Further more, they could only see their results after each conversion made by Academic Support Services.

The *Varsite* LCMS

The *Varsite* system is a so-called Learning Content Management System (LCMS). It differs from the traditional LMS in that it also includes an integrated content authoring system directly linked to a central database. All learning content is treated as learning objects with properties or attributes. Custom properties can be added to the standard properties according to specific standards e.g. IMS.

The system was not only developed to address the educational needs mentioned in this paper. After a thorough evaluation of a few learning management systems in 1998, the university decided to build its own. The reasons are beyond the scope of this paper. But it is worth mentioning that critical requirements like enterprise level integration, integrated authoring and offline functionality was key factors in the decision.

The object-based design forms the basis of the complete system. Therefore all data, whether learning content, user

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information, curricula information or management information, are stored as objects in the central data store.

Content management and authoring

Our requirements for web based authoring are stated below. All of these objectives were met by implementing the *Varsite* system. It must be kept in mind that we believe lectures must eventually be able to create their own Web-based content. This will mostly be used to enrich contact education on campus.

Objective one: Authoring in the medium

The main objective here is to enable authors to develop web-based content in the same medium in which it is delivered, but without the technical knowledge that is usually required to do this. This was achieved through the implementation of a full-text Web-based word processor. This enables full text formatting inside the Internet Explorer web browser. The content is saved directly to the object store on the *Varsite* server. Text from other Windows based applications can be copied and pasted into this editor. When a user is logged on as an author, an edit icon will appear next to all content.

Objective two: Fragmented authoring

The system enables the hierarchical creation of topics or pages to produce study guides. Each page is treated as an individual piece of content in the sense that it is individually seen and edited. There is no linear editable document. In a sense this enforces the basic design rules for the web for example manageable chunks, standalone content, single page topics etc. It also enables authors to focus on the specific topic without the distraction of other surrounding content, as would be the case with a traditional word processor. Authors see their content exactly as the learners would see it.

Objective three: Tagging en describing content

Since the object-based (and object orientated) model was implemented as a technical requirement for the whole system, the implementation of learning objects came natural and easy. Some basic object properties were implemented and these will later be extended to include some of the standards for example IMS. Each object is uniquely defined by a human readable name, in the same way as folder paths in the Windows environment. For example the object called RINL111:\BOOKS\COMPUTER_SKILLS\UNIT3\INTRO is an introduction page of study unit 3 in the computer skills study guide in the RINL111 course.

Objective four: Storing all information in a central database.

Institutions cannot afford to have their intellectual property distributed as files on hard disks, network drives and web servers. A Central database is a must for backup, security, copyright issues, property rights, re-use, searching etc. This repository will eventually enable the creation of brand new modules from existing content.

About learning objects

Potentially, the implementation of learning objects has a lot of advantages for authors, learners and administrators. Some of these are already visible as indicated in the content design objectives. As time goes by and the need arises, we will implement it further. Future development will include (a) real reusability between lecturers, university departments and between universities, (b) adaptive learning paths for study guides and assessment and (c) custom study guides according the learner profiles.

Results and feedback from authors

In 2001 a complete Web-based course was developed over a period of about 6 months. Once the structure of the course content was designed, each of the four authors was able to create their own content simultaneously in the system. This shortened the development time drastically. Since the developed content was immediately visible on the Web, the project leader and quality control members could monitor the project continuously. The overall feedback from the authors was positive.

References

IMS Global Learning Consortium, Inc. [http://www.imsproject.org/]

IEEE P1484.12 Learning Object Metadata Working Group [http://ltsc.ieee.org/wg12]

Nielsen, J. (2002). The Alertbox: Current Issues in Web Usability [http://www.useit.com/alertbox]

Porter, D. (2001). Object Lessons from the Web: Implications for Instructional Development [http://www.col.org/virtualed/virtual2pdfs/V2_chapter4.pdf]

Wiley, D. et al (2000). The Instructional Use of Learning Objects, Online version [http://www.reusability.org/read]

The Use of WebCT as a Course Component of the "Teaching and Music Technology" Undergraduate Course

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Abstract: This paper is a report on the findings of a two years study conducted on the undergraduate course "Teaching and Music Technology". First, the components of the WebCT content developed for the first year of use are described. Then, the results of the assessment by the students of the usefulness of each of these components are presented. Findings indicate that many where not assessed as useful. The redesign of the whole components is explained and the second year WebCT components are described. Again, the results of the assessment by the students of the usefulness of each of the components are presented. The results allow us to provide more meaningful definitions of several design criteria for Web-based courses proposed in the literature.

Introduction

"WebCT (short for Web Course Tools) is an integrated set of tools for developing and delivering interactive course or course components over the Web" (Friesen, 2000, p.3). The lack of equipments available to the students forced the professor to use WebCT to deliver the course components of the undergraduate course MUS-19673 Teaching and Music Technology, instead of developing a fully interactive course. As the author was aware that the adding of a Web tool does not mean any enhancement of the course because, as mentioned by Heines (2000), "... the determination of what really works is so difficult", she used what we will call several "content prescriptions" found in the literature (such as Dwyer and Baker, 2000; Friesen, 2000). She also integrated what was said, during the so numerous sessions and workshops she followed, as being "obviously helpful even if not empirical evidence found".

The First Year Study

There were 30 students using the first release of the course "MUS-19673 Teaching and Music Technology". The following are criteria found in the literature. As can be seen, they refer to what Gagné (1977) calls a defined concept. The main problem is that their definitions are not given:

The pictorial information is presented clearly.
The courseware provides information that accurately represents the topic.
The courseware screen layout is easy to understand.
The courseware content is presented clearly.
The text information is presented clearly.
The graphical information is presented clearly.

Findings From the First Year Study

In accordance with the first criteria listed, and because the professor wanted to have icons nearest of the students interest, being the music, the icons used in the main window were "musical" ones. This design choice was assessed by the student as being a very important one. The different parts of the course notes, the course plan, the description of the exercises to perform, etc., were put on the web. Students found it was not convenient because as they are often on the road to present concerts, they don't have any access to computer equipments. Students did not like the "book-like" table of contents presentation of what will be cover during each meeting with the group. They would have preferred a more "mnemonic" style. Students did not like at all the quizz options mostly because it did not correspond to anything they will have to use later in their career. They also found the email option integrated within WebCT not pertaining. They all wanted to keep their current email account and did not even check their mail inside WebCT. Students suggested to put several banks of examples and counterexamples that would complement, in a dynamic way, several aspects of the course content (For example, the principles of interface design or evaluation of a CAI tool in music).

The Second Year Study

There were 26 students using the second release of the course. As suggested, we added a large amount of examples, analogies, simulations, etc. We suppressed all the features students found not useful. We replaced the wordy table of contents by mnemonic one.

Findings From the Second Year Study

The adding of examples was assessed as being very useful. For example, in the course notebook, there is a section dedicated to the choice of colours for the interface of any computer product. Several recommended combinations are listed, i.e., the ones that does not cause damage to the retinal of the eyes. Visual examples of each combination mentioned in the notebook can be seen on WebCT. Another example is as follows: within the course notebook, the students learn that 8% of men and 4% of women have difficulties with viewing colours (colour blind) so, the learners is at risk to not see the very important infomation if it is coded with colours. Examples of screens that uses colour to present very important information are shown.

Conclusions

In this paper we have explained how a two years experimentation of our WebCT allows us to refine the definition of words such as "accurately", "clearly", and "easy" used in the literature when stating criteria of Web design. At first, when answering to the question "Does the courseware provide information that accurately represent the topic?", we were believing that linking the course notebook content to the table presenting what will be done during each unit was accurate. It was not find accurate by the students. It would rather be something that shows examples of what can be read in a printed course notebook, i.e., something dynamic. In the same way, we modified the meaning we first gave at the criteria "The text information is presented clearly". We found that students do not want to have wordy titles, but more mnemonic words that aim at helping them to make the link with the printed course notebook.

References

Dwyer, F., & Baker, R. (2000). A systemic mata-analysis assessment of the instructional effects of varied visuals on different types of educational objectives. *Exploring the Visual Future: Art Design, Science & Technology Selected Readings from IVLA '2000*. Iowa. 129-133.

Friesen, N. (2000). *The McGraw-Hill Guide to WebCT: Design, Development and Delivery*. Toronto: McGraw-Hill Ryerson.

Gagné, R.M. (1977). *The conditions of learning*. NY: McGraw-Hill.

Heines, J.M. (2000). Evaluating the effect of a course web site on student performance. Journal of Computing in Higher Education. 12(1). 57-83.

A Semi-Automatic Tool for the Indexation of Learning Objects

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Abstract: The aim of this paper is to present a tool designed to help teachers (or other users) to describe their learning objects with IEEE Learning Object Metadata. This semi-automatic tool proposes default values based on the user profile for some descriptors and uses relations between documents to infer other descriptors.

Introduction

Metadata are necessary for retrieving learning resources and RDF is a good way to implement them, as we said in [3] and [4].

At the moment a learning object is created, it must be described by metada (in the same way as a programmer comments the code that he writes, and if he does not do that immediately, he will never do it). Existing learning objects (with many possible file formats like pdf, word, power-point, java programs, latex, html and so on) have also to be described if we want to retrieve them. But an important problem is that, if we consider the IEEE LOM set of metadata, for example, we find about 80 descriptors. Some of them may be produced automatically for new learning objects (like "general.title") or for old ones (like "technical.format") but there are so few of them that the time spent to describe a learning object may be discouraging.

We propose a solution (a semi-automatic tool) based on both the profile of the person indexing resources and on the fact that resources are linked to each others by relations allowing to index a set of resources instead of a unique one.

Using the user profile

We consider that, when a user is indexing a document (a new or an old one), many descriptors, for that user, do not change from one document to another (like "lifecycle.contribute"). Furthermore, for a subset of that descriptors, some values remain more often identical for teachers coming from the same institution (like "rights, "educational.context" or "general.language"). So, for each user, we keep trace, in a database, of the values he or she prefers. These values can be edited either for a particular document or for the next ones. First, the user needs to be referenced and to obtain a login name and a password to access the tool. The values kept for an institution are the values preferred by the teachers of that institution. On the first access, the values of the institution (or default values for the first user of the institution) are proposed to the user, an initial but still editable choice.

Using relations between documents

It is really uncommon to create a unique new learning object and index it (or index a unique old one). In fact, an educational resource is made up of several connected learning objects. The idea is to take advantage of that fact and to use the meaning of the relations between resources to index them. When a teacher creates an educational resource, the learning objective is quite clear, the intended public is known and some descriptors are very close for all the composing objects. This is not always true may be, but this is a semi-automatic tool and it is always possible to change the values. Furthermore, the descriptor "general.AggregationLevel" can be deduced from the relations "IspartOf", from example, and the "LifeCycle.Version" from the relations "IsVersionOf".

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For the indexation of a new learning object, the tool asks the user to enter the relation descriptor. If it is missing or meaningless, the tool retrieves the default values for the user's profile changing some descriptors like "title" or "date". A resource may be linked to more than one. So we propose the kinds of possible relations and for each kind we perform a specific task. We offer the user to enter the relations in a specific order ("IsVersionOf", "Replaces", "IsFormatOf",...) and the tool retrieves the descriptors values from the first met. If we meet a "IsVErsionOf" relation, the tool changes the version descriptor. If we meet a "IsPartOf" relation, the tool changes the granularity. If the learning object has several "References" relations, the tool performs the union of the keywords.

Therefore, our tool tries to guess the maximum of descriptors values. After that, all these values are proposed to the user allowing him to destroy or to update them or to entry new ones.

Furthermore, our tool enables the user to add some metadata to linked learning objects. If the learning object being actually indexed has a "IsPartOfRelation" with an existing indexed one, the tool adds a "HasPart" relation to it.

For existing resources connected to indexed ones, the tool performs the same way.

For existing resources, if these are HTML files with meta tags implementing Dublin Core metadata, the tool takes them and add the default values from the user profile for the descriptors not included. But this case is very uncommon (in our experience, we have never found that kind of resources in our institution).

So, we propose the user to index a first learning object, with default values and we let him changing their contents. After that, we ask the user to enter the descriptors about relations. For each linked resource, the tool proposes to the user to index it using all the possible deductions due to the type of the relation.

A problem, not yet solved, is what to do when the deductions the tool made are not coherent (like two "HasPart" relations with two different granularities).

Our Goal

Actually, we are developing the described tool to help teachers to index their documents (with IEEE LOM metadata) based on the user profile and the use of relations.

In the first step, default values are suggested, assumed to be pertinent, for a large number of descriptors letting the user verifying their relevance and entry some of them (like "educational.difficulty" or "educational.TypicalLearningTime" with less meaning default values).

In the second step, more useful, the user is helped to index a set of connected documents with default and common values. Then, the user may edit and modify the values retated to the whole set of documents or to a specific one.

As learning objects cost a lot of time to produce them, their re-usability must be improved. For such a goal, they have to be indexed by metadata. Our tool reduces indexing time and permits a better re-use and consequently a cut of the developing costs of learning objects.

References

[1] : IEEE P1484.12 Learning Objects Metadata Working Group, *on the Web*, http://grouper.ieee.org/p1484/wg-c.htm

[2] : O. Lassila, *Web Metadata: A Matter of Semantics*, IEEE Internet Computing, July-August 1998, volume 2, number 4, pages 30-37,

[3] : Yolaine Bourda and Marc Hélier, *Applying IEEE Learning Object Metadata to Publishing Teaching Programs*, ED-MEDIA 1999 Seattle

[4] : Walid Kekhia and Yolaine Bourda, *Implementing Learning Object Metadata using RDF*, ED-MEDIA 2001 Tampere

Supporting The Development Of Learning Communities In Online Settings

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Abstract: This paper discusses the notion of community as an outcome of working within an online environment. In particular the paper explores the concept of users' development of a sense of community as an outcome of working within an online environment designed to support the professional and personal development of its users. The paper discusses previous research which has explored the development of a sense of community and reports a study that sought to investigate the development of a sense of community among users of a community-oriented site supporting teachers' professional development.

Introduction

The social phenomenon of community can be put to good use in the support of learning through the development of learning communities. Although difficult to define it is evident that community is a central component of the lives of all individuals. People have always and will always form communities at one level or another as part of their existence. Indeed, community is such a central part of our lives that "if the sense of living in, belonging to, and having some commitment to, a particular community is threatened then the prospect of living rewarding lives is diminished" (Puddifoot, 1996, p. 327). The power of community to support learning rests with its centrality to our daily lives and an unexplained phenomenon where the sum of the parts of a community is in some way greater than the whole.

Virtual learning communities and their role in supporting learning

As we begin to explore the concept of community and its potential to support learning it is important to acknowledge that a positive sense of community can have many referents ranging from "family, fellow workers, friends, neighbours, religious and fraternal bodies" (Sarason, 1974, p. 153). It is equally important to acknowledge that community exists in both a geographic and relational sense and that the two are not mutually exclusive (eg. Worsley 1991). The online environment provides for the development of the relational community where members may never meet face to face. These communities have been dubbed virtual communities and have been identified as 'real' communities in a sociological sense (Surratt, 1998).

In the online learning environment the desired community is known as a *virtual learning community.* Maxwell (1998) recognizes the value of a learning community reporting on the positive influence learning communities have on both socialization and learning outcomes. Similarly Kellogg (1999) argues that learning communities promote more active and increased intellectual interaction and a sense of common purpose and Palloff and Pratt (1999) posit that the creation of a learning community supports knowledge acquisition. These communities are considered to be of such value in the support of learning that researchers believe the formation of virtual learning communities is central to the success of online learning (Hiltz, 1997; Palloff and Pratt, 1999).

Learning communities and learning

Learning communities support learning by promoting the benefits of collaborative learning environments. Socio-constructivist approaches to learning clearly provide evidence that when students work together their cognitive development can be enhanced (eg. Glasssman, 2001). In collaborative learning environments students can become actively involved in the construction of new ideas and concepts and in this way student learning moves beyond the information presented to them (eg. Bruner, 2001). Johnson (1991) asserts "that collaborative learning methods are more effective than traditional methods in promoting learning and achievement" and Benbunan-Fich (1997) concludes that "working in groups, instead of alone, significantly increases motivation, perception of skill development and solution satisfaction". The benefits are not limited to the cognitive domain. Panitz (1997) identified 67 benefits spanning the academic, social and psychological domains. And Slavin (1990) posits that collaborative learning environments promote higher levels of motivation as well as social and attitudinal benefits concluding that the effect of collaborative learning on achievement is clearly positive.

In addition to the promotion of collaborative learning principles, learning communities promote a positive environment created by members who actively seek participation from others, valuing all members and sharing the results of their efforts (Moore & Brooks, 2001). This positive environment and members' preparedness to work collaboratively are indicative of virtual learning communities and fundamental in the support of learning.

Strategies that support community development

Unfortunately little scientific research exists to guide the development of a virtual learning community although some strategies have been identified through anecdotal records (Palloff & Pratt, 1999). Combining these strategies with knowledge of community gleaned from the social sciences provides initial support in the development of virtual communities.

Establishing a welcoming personal environment is an important strategy in constructing the 'human' elements of community (Hiltz, 1998; Palloff & Pratt, 1999). And facilitating regular and meaningful communications where members can interact and share their ideas and concerns (Moore & Brooks, 2001), is central to the functioning of a community. An additional strategy is to provide an initiating reason which may be a disorientating dilemma, an issue, a concern, a contentious discussion or a particular community problem (Moore & Brooks, 2001). Further impetus can be gained by emphasising the benefits associated with becoming a community member. These benefits could include an increase in intellectual capital (Stewart, 1997), reciprocity or an increase in social capital (Putnam, 2000). Further support is found in the seven basic steps outlined by Palloff and Pratt (1999) (Table 1).

Table 1: Seven Basic Steps in the Development of an Online Community

1. Clearly define the purpose of the group
2. Create a distinctive gathering place for the group
3. Promote effective leadership from within
4. Define norms and a clear code of conduct
5. Allow for a range of member roles
6. Allow for and facilitate sub-groups
7. Allow members to resolve their own conflict

Determinations of the development of a sense of community

Prior to engaging in the measurement of community it is important to understand that community is a sense rather than a tangible entity and it is members' sense of community (SOC) that should be identified and measured. McMillan and Chavis (1986) define SOC as a "feeling that members have a belonging, members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together" (p. 9). McMillan and Chavis further developed a four-dimensional model of SOC arguing the presence of four discrete entities in members' sense of community, membership; influence; integration and fulfillments of needs; and a shared emotional connection.

The model provides a mechanism for understanding SOC but not for measuring the experience. This can be achieved via the Sense of Community Index (Chavis, Hogge, McMillan & Wandersman, 1986) based on the McMillan and Chavis (1986) four dimensional model of SOC. A measurement tool that has been shown to adequately assess SOC having validity across contexts (Chipuer & Perry, 1999).

Learnscope Virtual Learning Community

The dearth of empirical information describing the essence of community development and our interest in exploring how communities can be developed and maintained in online settings prompted the inquiry we report here. As part of a Web site evaluation project, we undertook to explore the degree to which users of the site sensed themselves within a community of users.

The Learnscope Virtual Learning Community is a Web site within Australia that has been designed to assist in meeting the professional needs of people within the Australian Vocational Education and Training (VET) sector (Fig. 1.). The VLC is a dynamic and interactive Web-based support system that seeks to support the development of a critical mass of VET staff who are able to use flexible learning approaches to accelerate Australia's transition to the information economy. The VLC is supported by, and works within the Australian Flexible Learning Framework and represents one of a number of activities undertaken in the Framework to achieve the goal of providing *Creative, Capable People* (Australian Flexible Framework, 2001).

Fig 1: The Learnscope Virtual Learning Community Home Page (www.learnscope.anta.gov.au)

The LearnScope Virtual Learning Community consists of 3 main elements: the Community Hub, supporting interaction and communication between the various members. Includes a login area, a personal space, discussion forums; Go Learn, an area providing access to a variety of resources to support members' professional development; and a Resource Centre, access to information and content about flexible delivery.

Since an important aim of the Web site was to facilitate professional development, the form of community which the site sought to develop was based on learning and personal development. We organized an inquiry process that would provide some information on the capacity of the site to create a sense of community among the users and we also sought to explore factors that might influence the scope and extent of the community development. The purpose of this inquiry was to explore the development of users' sense of community obtained from use of the site. Users of the VLC were asked to complete an online questionnaire which probed aspects of their use of the site. One component of the questionnaire asked users to respond to a series of questions that probed their perceptions about:

- Their sense of membership of the VCL community;
- The sense of influence they had within the community as a consequence of their involvement;
- Their sense of the extent to which the VLC facilitated integration and fulfilment of needs
- The users' sense of a shared emotional connection with other users.

The series of questions was based on the questionnaire developed by Chavis, Hogge, McMillan and Wandersman, (1986), and included the items shown in Table 2 below. The online questionnaire was completed by 121 participants who considered themselves as more than casual users of the site.

Table 2: Member's Sense of Community

statement	scale	true %	false %
I think VLC is very helpful in meeting my needs in flexible delivery	integration and fulfillment of needs	76	24
People using the VLC seem to share the same values	integration and fulfillment of needs	78	22
Other members and I want the same things from VLC	integration and fulfillment of needs	63	37
I think the VLC has an appropriate scope in what it tries to do	Integration and fulfillment of needs	94	6
I can recognize most of the people who participate in the VLC	sense of membership	29	71
I feel at home in VLC	sense of membership	53	47
Many of the other people who use the VLC know me	sense of membership	28	72
Existing members of the VLC welcome new members documents etc.	sense of membership	68	32
I care about what other members think of my actions when using the VLC	sense of influence	75	25
I feel I have influence over what happens in the VLC	sense of influence	46	54
I feel that other people in the VLC would help me if I requested help	sense of influence	99	1
I feel my opinions and ideas are welcomed by others in the VLC	sense of influence	83	17
It is very important to me to participate in the VLC	shared emotional connection	42	58
People in the VLC seem generally to get along with each other	shared emotional connection	93	7
I expect to continue to participate in VLC into the future	shared emotional connection	89	11
People in the VLC seem to have similar understandings and interests	shared emotional connection	84	16

Sense of Community

The feedback provided strong support for the supposition that the site did provide users with the support and connection required to give individuals a sense of participation within a community. Users' responses for the scale exploring their sense of the extent to which the VLC facilitated integration and fulfillment of needs indicated a strongly positive response. The questions exploring users' sense of membership tended to return the least positive responses. It was evident that within the large user base that while many users were comfortable with the interactions and connection, the size of the user base precluded any personal relationships and the ensuing sense of membership which is usually associated with such connections.

The users seemed to gain a relatively strong sense of shared emotional connection from their experiences. The item with the lowest rating was that which sought to determine the value of the VLC to users. While the users appeared happy to participate in the community and felt that they were dealing with people with similar interests, there was a sense among many that the community was not overly important to them in the big picture.

Users reported quite positive responses to items that sought to establish their sense of influence within the community. The responses indicated that users generally felt well supported by others but it appeared that many felt that their contributions were not perhaps that significant in the overall community. Given the large numbers of users and the diverse nature of their backgrounds and previous experiences, the responses provided relatively strong evidence of the site giving users a sense of community among those participating.

Factors influencing sense of community

The inquiry sought to establish factors which appeared to influence the SOC experienced by users of the VLC.

a. Level of expertise wiuth ICT: Users provided an indication of their perceived level of expertise with learning technologies using a scale ranging from 1 low through to 4, very high. An inspection of the means scores achieved by students reporting the different levels of expertise showed very consisted scores (Figure 1). It appeared that background knowledge of the subject matter on offer was not a factor overly influencing users' sense of community development. A one factor analysis of variance was used to test for differences among users sense of community based on perceived levels of LT expertise (Figure 1). The results did not indicate any significant differences in sense of community against this factor (F (3,99) = 0.388, ns).

b. Level of experience with ICT: A second test was carried out to explore whether users' perceived levels of ICT experience was a factor influencing the development of a sense of community. Users were asked to report their levels of expertise with information and communications technologies (ICT). Their responses varied from score of 1, low levels to scores of 4, very high levels. Once again, the means scores achieved by students reporting the different levels of expertise were very consistent. A one factor analysis of variance was used to test for differences among users' sense of community based on perceived levels of LT expertise. The results did not indicate any significant differences in sense of community against this factor (F (3,99) = 1.008, ns).

c. Level of access to ICT: A third test was carried out to explore whether users' levels of access to ICT was a factor influencing development of a sense of community. Users were asked to report their levels of ICT access using responses of 1 (limited access) or 2 (access not limited). A one factor analysis of variance was used to test for differences among users' sense of community based on access to ICT. The results did not indicate any significant differences in sense of community against this factor (F (1,101) = 1.192, ns).

d. Level of use of the VLC: Another test was carried out to explore whether users' levels of use of the Community Hub was a factor influencing development of a sense of community. Users were asked to report their levels of use of the Community Hub using responses of 1 (limited use) through to 4 (regular use). A one factor analysis of variance was used to test for differences among users sense of community based on use of the Community Hub (Figure 4). The results indicated a significant difference at the .05 level (F (3,99) = 2.94, $p < 0.05$). This finding was in accord with expectations and supportive of the notion that the interaction was an important factor in building the sense of community within users.

e. Level of use of the Resource Centre: A further test was carried out to explore whether users' levels of use of the Resource Centre was a factor influencing development of a sense of community. Users were asked to report their levels of use of the Resource Centre using responses of 1 (limited use) through to 4 (regular use). A one factor analysis of variance was used to test for differences among users sense of community based on usage of the Resource Centre. The results indicated a significant difference at the .05 level (F (3,99) = 5.46, $p < 0.05$). This finding could be interpreted in much the same way as we interpreted the finding that use of the Hub was a contributing factor to the development of a sense of community. It might well be however, that this finding shows that users who made a high level of use of the Hub also made a high level of use of the Resource Centre. When the levels of usage of the Hub and resource Centre were compared, there was a significant correlation (r^2=.33).

These findings are quite interesting in light of the nature of learning communities supported by online environments. It is difficult to speculate too much with the results. They suggest that the development of a sense of community by users of the Learnscope VLC was not influenced by such features as their levels of experience and ICT access. The findings suggest that the sense of community is developed very much by use of the site and that all users appear capable of developing community membership through use of the site. We have taken this finding as evidence that the Learnscope sight is in fact returning in some way, the forms of outcomes that it was developed for.

Summary and Conclusions

The use of online facilities to support and sustain the development of communities of learners is becoming quite common among many educational groups. In this paper we have discussed the notion of a learning community and possible ways by which the development of communities might be determined. An exploration among users of the Learnscope Virtual Community, suggested that this site did in fact provide learners with a sense of community. A further exploration of factors that might have been likely to influence learners' sense of community revealed that aspects such as ICT expertise, levels of access and previous experience had no discernible impact on the development of SOC among learners. What was found to be important, and as might be expected, was the level of use of the site. Interestingly we were unable to demonstrate which sorts of activities had the greatest impact on the development of SOC and this arises as a possible line of inquiry for further work.

The findings from this paper appear to support the need for more research and inquiry into the development of community sense among users of online sites that aim to promote users personal development through such processes as interaction and communication with others. The data gathered in this inquiry provided evidence that the users of the Learnscope site did in fact establish senses of community of varying degrees and suggest the need for more work to more fully investigate what sorts of online activities hold the best prospects for community development.

References

Australian Flexible Learning Framework (2001). Available: http://www.flexiblelearning.net.au [Retrieved, 2001].

Benbunan-Fich, R.(1997). *Effects of Computer-Mediated Communication Systems on Learning, Performance and Satisfaction: A Comparison of Groups and Individuals Solving Ethical Case Scenarios.* Unpublished Discertation, Rutgers University - NJIT.

Bruner, J. *Constructivist Theory,* [WWW]. Available: http://tip.psychology.org/bruner.html [Retrieved 2001, May 10].

Chavis, D. M., Hogge, J., McMIllan, D., and Wandersman, A. (1986). Sense of community through Brunswick's lens: A first look. *Journal of Community Psychology,* 14, 24-40.

Chipuer, H. M. and Perry, G. M. H. (1999). A review of the sense of community Index: current uses, factor structure, reliability and further development. Journal of Community Psychology, Vol.27 (No.6), pp. 643 - 658.

Glassman, M. (2001). Dewey and Vygotsky; society experience and inquiry in education practice. *Educational Researcher, 30*(4), 3-14.

Hiltz, S. R. (1997). *Impacts of college courses via Asynchronous Learning Networks: some preliminary results.* Available: http://eies.njit.edu/~hiltz[Retrieved 2001, March].

Hiltz, S. R. (1998). *Collaborative Learning in Asynchronous Learning Environments: Building Learning Communities.* Paper presented at the WebNet 98 World Conference of the WWW, Internet and Intranet Proceedings, Orlando, Florida.

Johnson, W. D. (1991). Student-student interaction: The neglected variable in education. *Educational Research, 10*(1), 5-10.

Kellogg, K. (1999). *Learning Communities,* ERIC Digest. ERIC Clearinghouse [Retrieved 2001, March 19].

Maxwell, W., E. (1998). *Supplemental instruction, Learning Communities and students studying together.* FindArticles.com. Available: http://www.findarticles.com/cf_0/m0HCZ/2_26/53420232/p1/article.jhtml [Retrieved 2001, March 19].

McMillan, D. W. and Chavis D., M. (1986). Sense of Community: A Definition and Theory. *Journal of Community Psychology, 14,* 6 - 23.

Moore, A., B. and Brooks, R. (2001). Learning Communities and Community Development: Describing the process. *International Journal of Adult and Vocational Learning.*

Palloff, R., and Pratt, K. (1999). *Building Learning Communities in Cyberspace.* San Francisco: Josey-Bass Publishers.

Panitz, T. (1997). T*he Case for Student Centered Instruction Via Collaborative Learning Paradigms.* Available: http://home.capecod.net/~tpanitz/tedsarticles/coopbenefits.htm [Retrieved 2001, November 29].

Puddiffot, J. E. (1996). Some Initial Considerations in the Measurement of Community Identity. *The Journal of Community Psychology, 24*(4), pp. 327 - 334.

Putnam, R. D. (2000). *Bowling Alone.* New York: Simon and Schuster.

Sarason, S., B. (1974). *The Psychological Sense of Community.* San Francisco: Jossey-Bass Publishers.

Slavin, R. E. (1990). *Cooperative Learning Theory, Research and Practice.* Needham Heights, Massachusetts: Allyn and Bacon.

Stewart, T. A. (1997). *Intellectual capital.* New York: Doubleday/Currency.

Surratt, C. G. (1998). *Internet Citizens and Their Communities.* New York: Nova Science Publishing Inc.

Worsley, P. (1991). *The New Modern Sociology Readings* (second ed.). New York: Penguin Books Ltd.

Web-based Interactive Visualization in an Information Retrieval Course

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Abstract: Interactive visualization is a powerful educational tool. It has been used to enhance the teaching of various subjects from computer science to chemistry to engineering. Surprisingly enough, in computer science education, this powerful tool is used almost exclusively in programming and data structure courses. This paper suggests that visualization could be very helpful in teaching a larger variety of computer science courses and also presents several visualization tools that have been used in the context of an information retrieval course.

Introduction

Interactive visualization is a powerful educational tool. Visualization can provide a clear visual metaphor for understanding complicated concepts and uncovering the dynamics of important processes that are usually hidden from the student's eye. Visualization has been used to enhance the teaching of various subjects ranging from chemistry (Yaron et al., 2001) to mechanics (Hampel, Keil-Slawik & Ferber, 1999) to physics (McKenna & Agogino, 1997). Computer science is one of the most active application areas for educational visualization research. In computer and information science (CIS) education, visualization is used almost exclusively in programming and data structure courses. We can name dozens of papers devoted to visualization of program execution on several levels from machine-level languages (Butler & Brockman, 2001) to high-level languages (Domingue & Mulholland, 1998; Haajanen et al., 1997; Tung, 1998) to algorithms and data structures (Brown & Najork, 1997). Our claim is that a number of other traditional CIS courses could benefit from this powerful technology.

This paper explores the opportunities for using interactive visualization in the context of an information retrieval course. Information retrieval has been in the program of many computer, information, and library science departments for more than 30 years. With the maturity of the World Wide Web, information retrieval became an important practical subject. Elements of information retrieval are now taught to students of many different specialties. We think, that information retrieval provides an interesting and important application area for exploring the power of interactive visualization. In the following sections we discuss the use of visualization in teaching information retrieval and present several visualization tools developed at the University of Pittsburgh.

Visualization for Information Retrieval

The core of a traditional information retrieval (IR) course is a set of models, algorithms and technologies for processing, storing and retrieving textual information. This core has been already explored by now and placed on a solid mathematical foundation. Traditional presentation of this core usually starts with several IR models (such as Boolean, vector, probabilistic and several variations of them) and then follows by explaining how the information is organized and retrieved in each of these models (Baeza-Yates & Ribeiro-Neto, 1999; Korfhage, 1997).

The process of retrieving the information in different models is one of the hardest topics in an IR course. Despite being formalized and well understood by the IR research community, it is still very hard for students to grasp. We have observed that even the Boolean information retrieval, the simplest of the models, is difficult for students. At the same time, traditional educational tools – research or commercial IR systems - offer little educational help. The process of retrieving the information has several steps, from getting the query in to matching the query to the documents to prioritizing the results. In an IR system all these steps are hidden from a user – the only thing that a user can observe are the final results – a list of ordered documents. In that sense it is similar to a non-visualized execution of a computer program. A user can see input data and observe final results, but it offers no help in understanding how these results were computed.

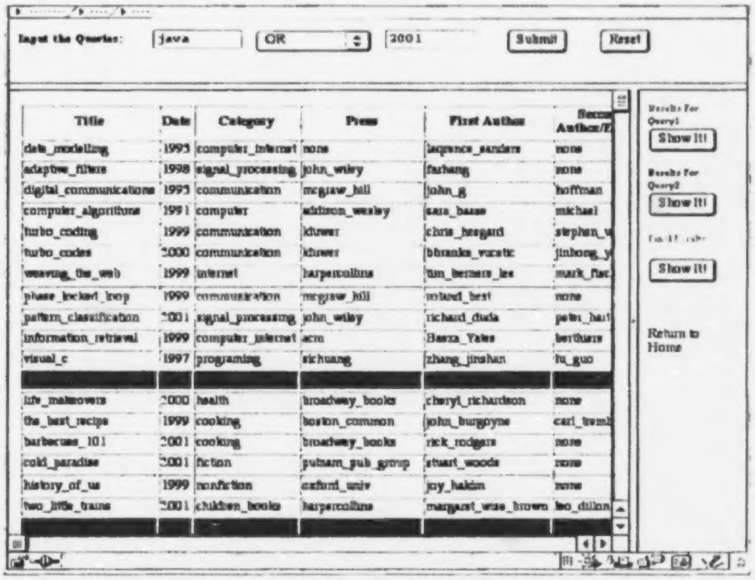
Naturally, similar contexts encourage the use of similar remedies. So, the first thing we have decided to visualize is the process of retrieving the information in several known models. For the moment, we have developed and explored interactive visualization environments for several models – Boolean, fuzzy, vector, and extended Boolean (see (Baeza-Yates & Ribeiro-Neto, 1999; Korfhage, 1997) for the description of these classic models). Since space is limited and our environments are reasonably similar we present here in more details the one for exploring Boolean IR.

Interactive Visualization of Boolean Information Retrieval Model

The Boolean IR model is the oldest and the simplest of known IR models. In this model, a query is written as a set of elementary queries (usually *keywords*) connected by Boolean operators such as OR, AND, NOT. The mechanism of this model is set theoretical. Every query is associated with a set of *matching documents*. For an elementary query such as a keyword the set of matching documents is simply all documents indexed by this keyword. To obtain the set of matching documents for two queries connected by a Boolean operator one has simply to perform the corresponding set operation on their matching sets (i.e., set intersection for AND, complement for NOT, etc.). Thus in several steps, a matching set for any complex Boolean query can be found.

While it all sounds quite simple and clear, we have found that many of our students have problems understanding how the Boolean matching works. Our talks with students have indicated that one of the sources of their troubles is the failure to perceive Boolean operators as operations on sets of matching documents. Naturally, our students have good programming background and have been routinely using Boolean operators for writing conditional expression in their programs. Still, many of them have problems transferring their knowledge of these operators to the set context.

In developing an interactive visualization environment for the Boolean IR model we were trying to achieve two goals: to provide a helpful visual metaphor and to visualize the process of Boolean IR step by step. Figure 1 presents an interface of our environment. The core of this interface is a set of all documents visualized in a table (one document per row). Note that in our system, documents are textbooks since it is one of the most traditional kinds of documents.


Input the Queries: java OR 2001

Title	Date	Category	Press	First Author	Secon Author/E
data_modelling	1995	computer_internet	none	laqrence_sanders	none
adaptive_filters	1998	signal_processing	john_wiley	farhang	none
digital_communications	1995	communication	mcgraw_hill	john_g	hoffman
computer_algorithms	1991	computer	addison_wesley	sara_basse	michael
turbo_coding	1999	communication	kluwer	chris_heegard	stephen_w
turbo_codes	2000	communication	kluwer	bbranka_vucetic	jinhong_y
weaving_the_web	1999	internet	harpercollins	tim_berners_lee	mark_fisc
phase_locked_loop	1999	communication	mcgraw_hill	roland_best	none
pattern_classification	2001	signal_processing	john_wiley	richard_duda	peter_hart
information_retrieval	1999	computer_internet	acm	Baeza_Yates	berthiere
visual_c	1997	programing	sichuang	zhang_jinshan	fu_guo
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
life_makeovers	2000	health	broadway_books	cheryl_richardson	none
the_best_recipe	1999	cooking	boston_common	john_burgoyne	carl_tremb
barbecues_101	2001	cooking	broadway_books	rick_rodgers	none
cold_paradise	2001	fiction	putnam_pub_group	stuart_woods	none
history_of_us	1999	nonfiction	oxford_univ	joy_hakim	none
two_little_trains	2001	children_books	harpercollins	margaret_wise_brown	leo_dillon
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 1: Boolean Model Environment. Visualization of matching for a simple Boolean OR query. Documents matching the first elementary query are highlighted.

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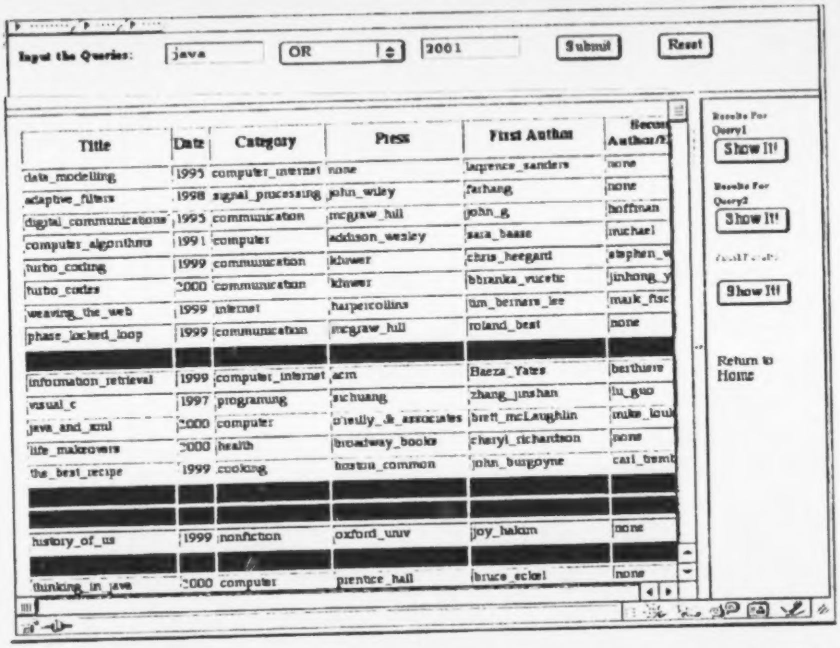

Input the Queries: java OR 2001

Title	Date	Category	Press	First Author	Secon Author/E
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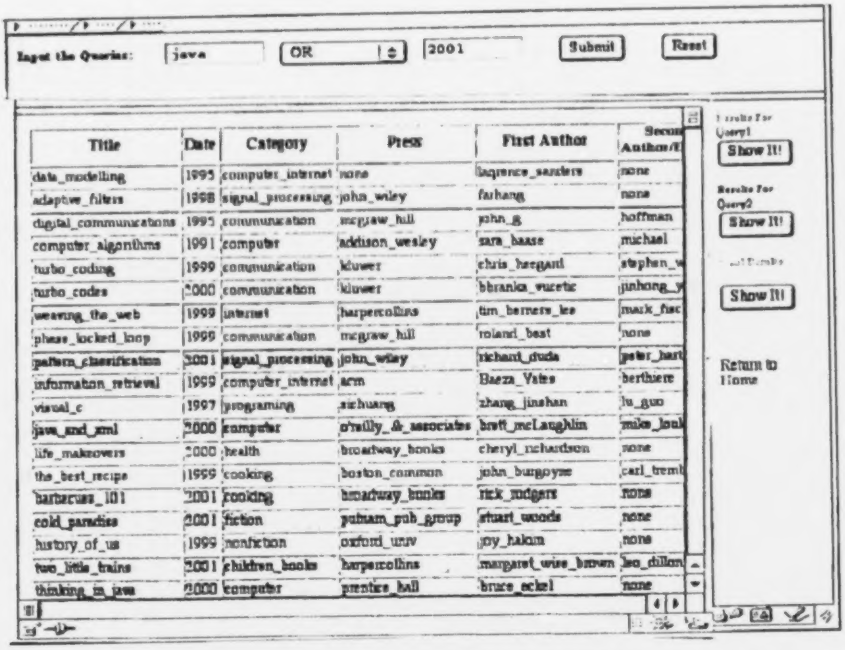
digital_communications	1995	communication	mcgraw_hill	john_g	hoffman
computer_algorithms	1991	computer	addison_wesley	sara_baase	michael
turbo_coding	1999	communication	kluwer	chris_heegard	stephen_w
turbo_codes	2000	communication	kluwer	bbranka_vucetic	jinhong_y
weaving_the_web	1999	internet	harpercollins	tim_berners_lee	mark_fisc
phase_locked_loop	1999	communication	mcgraw_hill	roland_best	none
information_retrieval	1999	computer_internet	acm	Baeza_Yates	berthiere
visual_c	1997	programing	sichuang	zhang_jinshan	lu_guo
java_and_xml	2000	computer	o'reilly_&_associates	brett_mcLaughlin	mike_louk
life_makeovers	2000	health	broadway_books	cheryl_richardson	none
the_best_recipe	1999	cooking	boston_common	john_burgoyne	carl_tremb
history_of_us	1999	nonfiction	oxford_univ	joy_hakim	none
thinking_in_java	2000	computer	prentice_hall	bruce_eckel	none

Figure 2: Visualization of matching for a simple Boolean OR query. Documents matching the second elementary query are highlighted.



Input the Queries: java OR 2001

Title	Date	Category	Press	First Author	Secon Author/E
data_modelling	1995	computer_internet	none	laqrence_sanders	none
adaptive_filters	1998	signal_processing	john_wiley	farhang	none
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turbo_coding	1999	communication	kluwer	chris_heegard	stephen_w
turbo_codes	2000	communication	kluwer	bbranka_vucetic	jinhong_y
weaving_the_web	1999	internet	harpercollins	tim_berners_lee	mark_fisc
phase_locked_loop	1999	communication	mcgraw_hill	roland_best	none
pattern_classification	2001	signal_processing	john_wiley	richard_duda	peter_hart
information_retrieval	1999	computer_internet	acm	Baeza_Yates	berthiere
visual_c	1997	programing	sichuang	zhang_jinshan	lu_guo
java_and_xml	2000	computer	o'reilly_&_associates	brett_mcLaughlin	mike_louk
life_makeovers	2000	health	broadway_books	cheryl_richardson	none
the_best_recipe	1999	cooking	boston_common	john_burgoyne	carl_tremb
barbecues_101	2001	cooking	broadway_books	rick_rodgers	none
cold_paradise	2001	fiction	putnam_pub_group	stuart_woods	none
history_of_us	1999	nonfiction	oxford_univ	joy_hakim	none
two_little_trains	2001	children_books	harpercollins	margaret_wise_brown	leo_dillon
thinking_in_java	2000	computer	prentice_hall	bruce_eckel	none

Figure 3: Visualization of matching for a simple Boolean OR query. Documents matching the whole Boolean OR query are highlighted.

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The goal of this representation is to help the student to understand the core principle of this model – every query is associated with a particular *subset* of all documents. Showing the set of all documents on the screen makes it easy to demonstrate different subsets of the whole set as sets of differently colored table rows. The goal of the whole environment is to help the student to understand (a) the process of matching an elementary query to the set of the documents and (b) how different set theoretic operations work in obtaining a new subset from contributing sets.

The student can explore Boolean matching by writing simple Boolean queries (two terms connected by one or two operators) and observing the matching process in these steps by clicking on each of the three buttons on the right panel.

The first button highlights the subset of documents matching the first elementary query (Figure 1), the second highlights the subset matching the second query (Figure 2) and the third, the results of the chosen set operation on the contributing sets (Figure 3). We choose to have three buttons to enable the student to explore the matching process several times forwards and backwards.

Beyond the component shown on Figures 1-3 the Boolean IR environment has several other components. In particular, to help the student transfer the understanding of Boolean IR from classic IR to the database context, we have provided a very similar exploration interface where elementary queries are constructed not from keywords as in classic IR but from restrictions on various fields of a database record (i.e., year = 2000 and publisher != kluwer). There is also a registration screen and an interface for a teacher to edit the collection of documents. The environment works on the Web and is implemented as a set of CGI scripts.

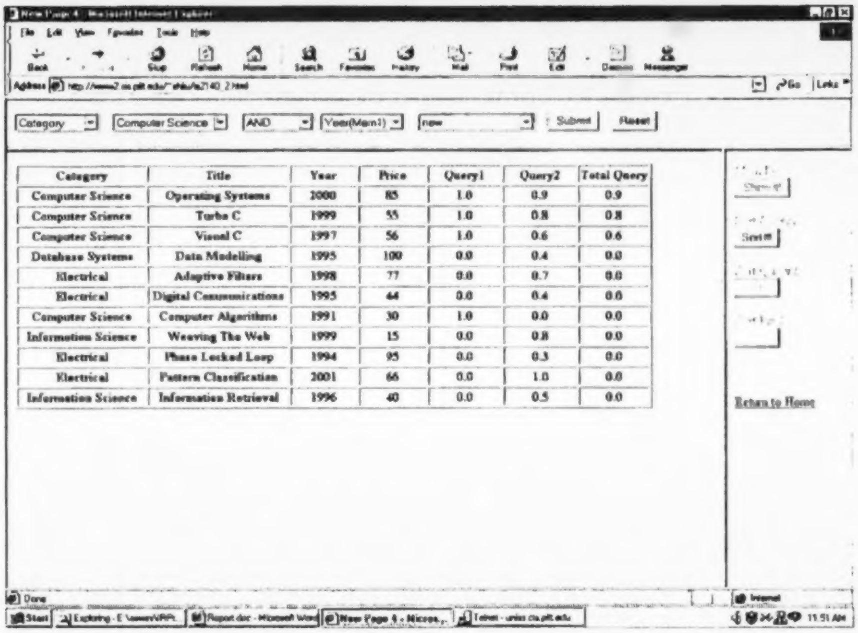
Other Learning Environments

As we have mentioned, the Boolean matching environment is just one of several interactive visualization environments that we have developed and explored. The environments for other models are reasonably similar. In all of them we have tried to center the visualization of the matching process on a visual representation of the whole set of documents in some form. The environments for other models are a bit more complicated (since the models themselves are more complicated) but they also provide the students with more opportunities for interactive exploration. For example, in the fuzzy matching model, an elementary query corresponds to a fuzzy subset. A fuzzy subset can not be shown by simply highlighting its documents – we need to show the "membership" of each document in a set. Thus an environment for fuzzy matching (Figure 4) has to provide extra fields for every document to show their memberships in all contributing queries (three rightmost columns on Figure 4) and provide the student an opportunity to re-sort the documents in the set by the value of each of these memberships.

Altogether our environments provide a very useful suite of tools for teaching information retrieval. We anticipate the use of these environments as both teaching and learning tools. First, we have found that these environments provide an excellent tool for a teacher to explain complex topics of IR models. Yes, it assumes that a teacher uses a computer and a projector in the classroom, but this is currently the standard context in most Computer and Information Science Departments. Still, computer projectors are most often used in classes to show the same static slides as in the age of overhead projectors and blackboards. By using the power of interactive visualization, our environments go well beyond traditional whiteboard and slides. At the same time, their use requires almost zero preparation time (just to plan which examples to show in order to cover the main set of ideas). The teacher can easily accommodate very different audiences by adjusting the number of examples to show, the speed, and the granularity of presentation. Even in a department with "computerless classes" the environments can serve as a powerful teaching tool to handle the questions and the problems of a troubled student in a one-to-one "office" context.

Using these environments as learning tools provides even better value. They let the students to switch from passive learning-by-reading to active and interactive exploratory learning. By exploring a number of different examples with an interactive visualization environment they should be able to achieve a better understanding of complex IR topics.

We have already performed an informal evaluation of several environments as teaching and learning tools in Summer 2001 semester and have got a very positive feedback from our students. Now we are planning an extensive formal evaluation during the Summer and Fall 2002 semesters.



Category	Title	Year	Price	Query1	Query2	Total Query
Computer Science	Operating Systems	2000	85	1.0	0.9	0.9
Computer Science	Turbo C	1999	55	1.0	0.8	0.8
Computer Science	Visual C	1997	56	1.0	0.6	0.6
Database Systems	Data Modelling	1995	100	0.0	0.4	0.0
Electrical	Adaptive Filters	1998	77	0.0	0.7	0.0
Electrical	Digital Communications	1995	44	0.0	0.4	0.0
Computer Science	Computer Algorithms	1991	30	1.0	0.0	0.0
Information Science	Weaving The Web	1999	15	0.0	0.8	0.0
Electrical	Phase Locked Loop	1994	95	0.0	0.3	0.0
Electrical	Pattern Classification	2001	66	0.0	1.0	0.0
Information Science	Information Retrieval	1996	40	0.0	0.5	0.0

Figure 4: Fuzzy Model Environment. Visualization of matching and ordering for a fuzzy AND query. The documents are sorted according to the value of the membership function of the compound query.

Implementation Issues

It was a critical design decision for us to implement all environments as Web-based tools. Web interface ensures that our tools can be accessed anytime anywhere. It lets us forget about platform differences and avoid troublesome process of installation. This is very important in the context of college education where neither teachers nor students have full control over the computers used in the classrooms and labs. Besides, it offers an extra benefit in the context of Web-based and distance education enriching the learning experience of a remote student.

In fact, most of our environments were implemented with server-side CGI scripts. In the age of Java this choice is harder to advocate. Indeed, the first "pure Web" learning environments for computer science subjects were developed with CGI technology. Examples include both algorithm animation (Campbell et al., 1995; Ibrahim, 1994), and program visualization (Brusilovsky, Schwarz & Weber, 1996). However nowadays, Java is becoming a dominant technology for developing Web-based interactive learning environments.

We also use Java when it is necessary due to the highly graphical interface demands (for example, for set diagrams), however we were trying to avoid it when it is not necessary for several reasons. First, we have found that Java applets are not always working on the browsers installed on various campus computers. Second, one of our projects involves wireless access to learning tools using handheld computers (that have browsers with no Java support). Third, a CGI-based tool provides an easier platform for centralized collection of interaction logs, which provide the most useful source of data for our educational research. Fourth, we are working on adaptive interactive visualization (Brusilovsky, 1994) that requires the presence of a centralized server-side student model. Overall, we think that in the cases when advanced graphics or smooth visualization is not important the old CGI-based technology is simply better.

We should add that the suite of our tools for teaching information retrieval is available for teachers and students of any IR courses. The home page of this project is http://www2.sis.pitt.edu/~ir/Projects/. Currently, all tools are running on our servers and could be used by anyone who is interested to teach or learn information retrieval and have access to the Internet. We are also working on packaging these tools as public domain software to be installed wherever someone wants to use it.

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Currently we are working on developing several other environments to support teaching and learning of IR. In these environments we were exploring different visualization metaphors (such as set diagrams) to demonstrate matching process as well as the use of interactive visualization to support other traditionally hard topics of an information retrieval course.

References

Baeza-Yates, R. and Ribeiro-Neto, B. (1999) Modern information retrieval. N.Y.: ACM Press.

Brown, M. H. and Najork, M. A. (1997) Collaborative Active Textbooks. *Journal of Visual Languages and Computing* 8 (4), 453-486.

Brusilovsky, P. (1994) Explanatory visualization in an educational programming environment: connecting examples with general knowledge. In: B. Blumenthal, J. Gornostaev and C. Unger (eds.) *Human-Computer Interaction*. Lecture Notes in Computer Science, Vol. 876, (Proceedings of 4th International Conference on Human-Computer Interaction, EWHCI'94, St. Petersburg, Russia, August 2-5, 1994) Berlin: Springer-Verlag, pp. 202-212.

Brusilovsky, P., Schwarz, E., and Weber, G. (1996) ELM-ART: An intelligent tutoring system on World Wide Web. In: C. Frasson, G. Gauthier and A. Lesgold (eds.) *Intelligent Tutoring Systems*. Lecture Notes in Computer Science, Vol. 1086, (Proceedings of Third International Conference on Intelligent Tutoring Systems, ITS-96, Montreal, June 12-14, 1996) Berlin: Springer Verlag, pp. 261-269.

Butler, J. E. and Brockman, J. B. (2001) A Web-based learning tool that simulates a simple computer architecture. *SIGCSE Bulletin - inroads* 33 (2), 47-50.

Campbell, J. K., Hurley, S., Jones, S. B., and Stephens, N. M. (1995) Constructing educational courseware using NCSA Mosaic and the World-Wide Web. *Computer Networks and ISDN Systems* (Proceedings of Third World-Wide Web Conference, Darmstadt, 10-14 April, 1995) 27 (6), 887-895.

Domingue, J. and Mulholland, P. (1998) An Effective Web Based Software Visualization Learning Environment. *Journal of Visual Languages and Computing* 9 (5), 485-508.

Haajanen, J., Pesonius, M., Sutinen, E., Tarhio, J., Teräsvirta, T., and Vanninen, P. (1997) Animation of user algorithms on the Web. In: Proceedings of VL '97, IEEE Symposium on Visual Languages, , IEEE, pp. 360-367, also available at http://www.cs.helsinki.fi/research/aaps/Jeliot/vl.ps.gz.

Hampel, T., Keil-Slawik, R., and Ferber, F. (1999) Explorations - A New Form of Highly Interactive Learning Materials. In: P. D. Bra and J. Leggett (eds.) Proceedings of WebNet'99, World Conference of the WWW and Internet, Honolulu, HI, Oct. 24-30, 1999, AACE, pp. 463-468.

Ibrahim, B. (1994) World-Wide Algorithm Animation. *Computer Networks and ISDN Systems* (Proceedings of First World-Wide Web Conference) 27 (2), 255-265.

Korfhage, R. R. (1997) Information storage and retrieval. N.Y.: Wiley Computer Publishing.

McKenna, A. and Agogino, A. (1997) Engineering for middle schools: A Web-based module for learning and designing with simple machines. In: Proceedings of FIE'97, Frontiers in Education Conference, Pittsburgh, PA, November 5-8, 1997, Stipes Publishing L.L.C., pp. 1496-1501.

Tung, S.-H. S. (1998) Visualizing Evaluation in Scheme. *Lisp and Symbolic Computation* 10 (3), 201-222, ftp://140.125.81.71/pub/tungsh/lasc.ps.Z.

Yaron, D., Freeland, R., Lange, D., and Milton, D. J. (2001) Using Simulations to Transform the Nature of Chemistry Homework, Carnegie Mellon University, Pittsburgh. http://www.ched-ccce.org/confchem/2000/b/yaron/Default.htm

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Group members' Cooperative Orientation and Academic Achievement as Determinants of Perceived Quality of Group Functioning

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Abstract: Assuming that learning within project groups requires both cognitive skills and a cooperative orientation of the students involved it is hypothesized that groups describing themselves as 'functional' consist of both more 'higher achieving' students and more 'cooperatively oriented' students as compared to groups describing themselves as 'dysfunctional'. Based on questionnaire-responses, 14 groups of about 10 students each could be categorized as either 'very functional', 'functional' and 'dysfunctional'. As hypothesized, moving from the 'dysfunctional' over the 'functional' to the 'very functional' category, group members' academic achievement increases. Opposite to expectations however, moving from the 'dysfunctional' over the 'functional' to the 'very functional' category, group member's cooperative orientation decreases.

Introduction

Small-group projects are often promoted as potentially powerful educational vehicles (e.g. Slavin, 1996). Interacting with peers might provide ample opportunity for the learner to engage in activities that facilitate long-lasting, firmly rooted understanding. Examples of such learner activities are "putting material into one's own words", "explaining own opinions and questioning those of others", "revealing misconceptions that show up during group-discussions", "clearing up confusion" and "summarizing or recapitulating ideas".

In order to accomplish these activities learners should possess the necessary cognitive skills and maturity to do so. Next to cognitive abilities however, one might hypothesize that peer learning draws upon the learners' interpersonal skills to sustain and maintain a cooperative working relationship within the group. Learners should possess the competency to deliver feedback in a non-threatening and supportive way, asking for and actually taking into account suggestions of other group members and attaching importance to collective group-successes rather than being bent on personal victory.

Hypothesis

It was hypothesized that groups describing themselves as 'functional' consist of students with both a better 'academic achievement' and a more distinct 'cooperative orientation' as compared to students that belong to 'dysfunctional' groups.

Method

Subjects were 139 sociology freshmen. One (small) part of the study program required them to work on a group project covering the full academic year. There were 14 project groups of about 10 students each.

Questionnaire Research

During the final collective session (at the end of the academic year) students were asked to fill in a questionnaire. The questionnaire consists of two parts. One part comprised 10 existing scales measuring different aspects of the quality of group functioning (Bond and Shiu, 1997; Bradshaw and Stasson, 1998; Freeman,1996; Kramer et al., 1997; Watson et al., 1991; Gaertner and Schopler, 1998; Wheeless et al. ,1982). A second part measures students' 'cooperative orientation' on the basis of Van Lange's (1997a) 'social value questionnaire'. Both parts of the questionnaire were contra-balanced.

Part A: Quality of Group Functioning

For every group 10 scores (one for each scale) were calculated by averaging its members scores on that scale. On the resulting matrix (14 groups by 10 scale-scores) a cluster analysis was performed. Three clusters of groups appeared and were labeled 'very functional' (4 groups) ; 'functional' (9 groups) and 'dysfunctional' (one group). Members of 'very functional' groups (upper line in figure 1) perceived their group as a coherent and solidary entity, said they performed more efficient than if there were no groups, and believed their interactions resulted in decisions of good quality. Group-work was not perceived as a waste of time and one was satisfied with both the final result of the group work and the way group members interacted with each other. Although all members contributed evenly, some members were more dominant than others. Group scores on all scales were about one standard deviation lower for the 'functional' cluster and about two standard deviations lower for the remaining 'dysfunctional' group (lower line in figure 1).

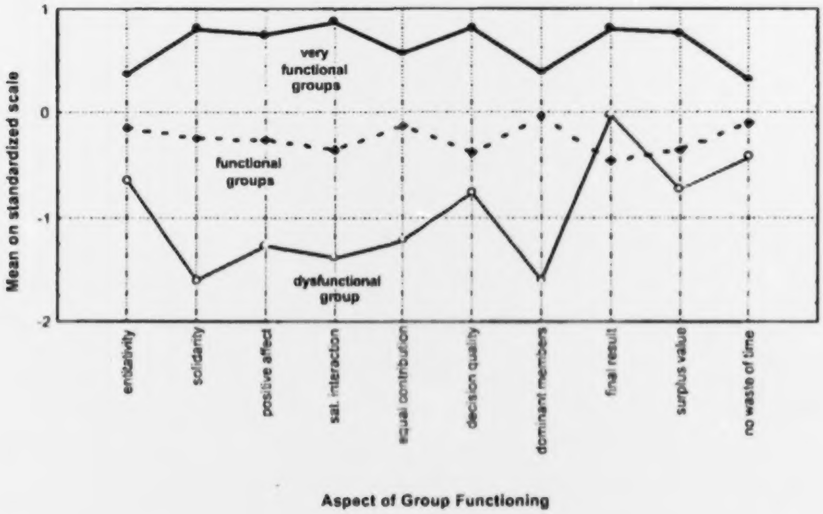

Figure 1 Perceived quality of group functioning for 'very functional groups', 'functional groups' and one 'dysfunctional group'.

Part B: Social Value orientation

Van Lange's measurement of social value orientation (Van Lange et al., 1997) consists of nine 'decomposed games'. On every 'game' the subject can opt for either a 'cooperative' an 'individualistic' and a 'competitive' alternative.
The number of 'cooperative' choices was used as an index of a subjects' cooperative orientation. The mean score was 6.19 (with a standard deviation of 3.4).

Academic achievement

Students' global exam result (minimum=0; maximum = 100) was taken as an index of 'academic achievement'. The mean score was 57.1 (with a standard deviation of 8.95).

Quality of group functioning according to the project-groups' instructors

Additionally, the two instructors who coached the project groups during the academic year were asked (together) to categorize the 14 project groups according to their 'functionality'. Although instructors judged it a difficult task, their (collectively reached) solution matches quite well with the categorization based on students' self-reportings. Instructors classified three out of the four groups in the 'very functional' cluster as 'relative superior'. The one group classified as 'dysfunctional' was also the only group identified by instructors as posing 'severe problems'.

Results

A MANOVA with both subjects' 'cooperative orientation' and 'academic achievement' as the dependent variables, and 'group functioning' as the independent variable (containing three levels: 'very functional', 'functional' and 'dysfunctional') reveals a multivariate effect of 'group functioning' (λ =.90, F(4,270) = 3.8, p = .005). The between-subject test reveals that the multivariate effect is accounted for by both a univariate effect for 'academic achievement' (F(2,136) = 416, p = .02) and 'cooperative orientation' (F(2,136) = 3.15, p = .05). Students global exam results in the 'dysfunctional', 'functional' and 'very functional' groups were 54.8, 55.7 and 60.1 respectively. Students' cooperative orientation decreased moving from the 'dysfunctional' over the 'functional' to the 'very functional' groups. Means were 8.7, 6.25 and 5.6 respectively. Planned comparisons indicate that 'very functional groups' consist of students obtaining better academic results as compared to 'functional' and 'dysfunctional' groups combined [F(1,136)=5,96; p<.02]. Additionally, students in 'very functional groups' are significantly *less* cooperatively oriented as compared to students in 'functional' and 'dysfunctional' groups combined F(1,136)=5,78; p<.021]. The dysfunctional group on the other hand distinguishes itself from 'functional' and 'very functional' groups combined only by its members outspoken cooperative orientation [F(1,136)=5,56; p<.02].

Discussion

A first result of the research reported refers to the correspondence between students' self-reportings on the one hand and the instructors' opinion about the quality of group functioning on the other hand. According to the instructors it is but until the end of the academic year they obtain a rough picture about the way the different project-groups are functioning. Instructors said they nearly always remain uninformed about how student-groups are functioning during the initial stages of the project. Even when explicitly asked for, students often remain reluctant to report problems within their group, thereby preventing instructors to timely intervene. Having demonstrated however that dysfunctional groups can be detected using questionnaires measuring different aspects of group functioning, a hopeful perspective is offered. Currently we are investigating if and to what extent group (dys)functioning can be mapped at the very early stages of group work.

A second result refers to the generalization (and the qualifying antecedents) of the benefits of project-based peer learning as put forward in educational research (e.g. Slavin, 1996). On the one hand, it seems that relatively large groups of learners are not necessarily dysfunctional, at least on condition they are composed of 'high achieving' and (relatively) 'noncooperatively oriented' students. On the other hand –and in strong contrast with our hypothesis - large groups that merely consist of extreme cooperatively oriented students perhaps run the risk to become dysfunctional. Asking students in the dysfunctional group to try and give a reason for the severe problems encountered, they indeed refer to explanations that can be linked up with a 'cooperative' or 'pro-social oriented' social orientation. For example, one subject described "*the extreme frustration that resulted from writing, re-writing and writing again texts in order to take into account all group members' opinions ..... and how everybody seemed to hesitate cutting knots for the same reason.*" Additionally, knowledge of both learners' social orientations and their level of academic achievement, might direct both anticipatory and supportive actions of instructors coaching learners working together in (large) project groups.

Finally, from the point of view of social psychologist, the reported findings might question the unconditional generalization of the benefits of a pro-social orientation. Social psychologists have stressed the benefits of a cooperative social orientation in a very broad range of social settings (e.g. Van Lange et al., 1997b; Van Vugt et al. 1997). Without putting too heavy a weight on our findings (based on a limited sample it surely needs to be replicated) we however will suggest to further investigate the boundary conditions of the presumed benefits of a cooperative social orientation. Perhaps in the context of project groups, the absence of at least one non-cooperative group member (or someone that can fulfill the role of a leader?) is detrimental for the functioning of that group.

References

Bond, M.H. and Shiu, W.Y.F. (1997) The relationship between a group's personality resources and the two dimensions of its group process. *Small Group Research*, 28 (2), 194-217.

Freeman, K.A. (1996) Attitudes toward work in project groups as predictors of academic performance. *Small Group Research*, 27 (2), 265-282.

Kramer, M.W., Kuo, C.L. and Dailey, J.C.(1997) The impact of brainstorming techniques on subsequent group processes: Beyond generating ideas. *Small Group Research*, 28, 218-242.

Watson, W., Michaelsen L.K. and Sharp, W. (1991) Member competence, group interaction, and group decision making: A longitudinal study. *Journal of Applied Psychology*, 76 (6), 803-809.

Gaertner, L. & Schopler, J. (1998) Perceived Ingroup Entitativity and intergroup bias: an interconnection of self and others., *European Journal of Social Psychology*, 28, 963-980.

Slavin, R.E. (1996) Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary Educational Psychology* 21, 43-69.

Van Lange, P.A.M., De Bruin, E.M.N., Otten, W. and Joireman, J.A. (1997a) Development of prosocial, individualistic, and competitive orientations: Theory and preliminary evidence. *Journal of Personality and Social Psychology* 73 (4), 733-746.

Van Lange, P.A.M., Agnew, C.R., Harinck, F. & Steemers, G. (1997b). From game theory to real life: How social value orientation affects willingness to sacrifice in ongoing close relationships. *Journal of Personality and Social Psychology* 73, 1330-1344.

Van Vugth, M., Van Lange, P.A.M., & Meertens, R.M. (1996). Commuting by car or public transportation? A social dilemma analysis of travel mode judgements. *European Journal of Social Psychology* 26, 373-395.

Wheeless, L.R., Wheeless, V.E. and Dickson-Markman, F. (1982). A research note: The relations among social and task perceptions in small groups. *Small Group Behavior*, 13 (3), 373-384.

Interacting with Interactive Papers: A Situated Evaluation of a Computer-Supported Collaboration Tool

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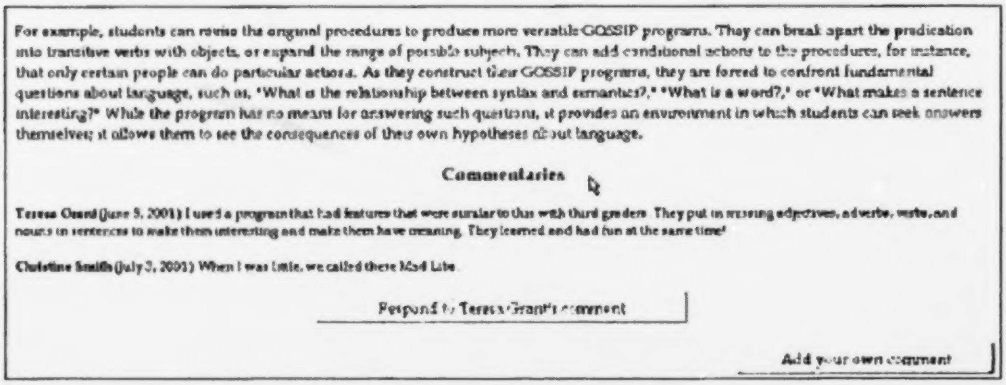
Abstract: This study, currently in progress, examines how several groups of users have made use of our Interactive Paper Project (IPP) online resource (Buell & Levin, 1999; McCollum, 1999) in varied academic settings. Situated evaluations (Bruce & Peyton, 1993) involve analysis of three essential elements: the idealization of the innovation, the settings in which it appears, and the realizations within each setting. The study explores IPP use in five mini-cases, involving cross-classroom, conference and journal-editing implementations.

Introduction

The Interactive Paper Project resource (Buell & Levin, 1999; McCollum, 1999) is a web-enabled database that permits authors of papers to upload them to the web and allows readers to submit written comments at specific points in the body of the paper. These comments are immediately available for viewing as part of the paper itself. A two-level commentary structure allows for both comments linked to various segments of the paper, and responses to those comments. Figure 1 shows part of an IPP text, with comments and responses interspersed.



For example, students can revise the original procedures to produce more versatile GOSSIP programs. They can break apart the predication into transitive verbs with objects, or expand the range of possible subjects. They can add conditional actions to the procedures, for instance, that only certain people can do particular actions. As they construct their GOSSIP programs, they are forced to confront fundamental questions about language, such as, "What is the relationship between syntax and semantics?," "What is a word?," or "What makes a sentence interesting?" While the program has no means for answering such questions, it provides an environment in which students can seek answers themselves; it allows them to see the consequences of their own hypotheses about language.

Commentaries

Teresa Grant (June 5, 2001) I used a program that had features that were similar to this with third graders. They put in missing adjectives, adverbs, verbs, and nouns in sentences to make them interesting and make them have meaning. They learned and had fun at the same time!

Christine Smith (July 3, 2001) When I was little, we called these Mad Libs.

Figure 1: Portion of an Interactive Paper, with a comment and a response displayed 'inline.'

The IPP is one of a variety of types of online resources allowing readers to add to or comment on an internet-accessible document. Others include usenet newsgroups, bulletin boards such as WebBoard (www.webboard.com), and weblogs, or "blogs" (www.blogger.com). The IPP structure places more emphasis on the original document than these other alternatives; different "views" allow the reader to view only the original text, to view the text with comments rendered "inline" (interspersed with the original text), or to view the comments as "linked" via a pulldown menu.

Interactive Papers were initially developed as an online version of academic "in-progress papers," draft documents passed from one colleague to another for comments and advice. While this has been one

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major use to which the IPP has been put, a review of the documents created by IPP users over the past two years shows many more uses as well.

The Study

Our study examines the IPP from the viewpoint of Situated Evaluation (Bruce & Peyton, 1993), an analytical framework devised to evaluate "innovations in use" across in different settings. Situated evaluations involve analysis of three essential elements: the idealization of the innovation, the settings in which it appears, and the realizations within each setting.

In the case of the IPP, an innovation originally idealized as an online white-paper delivery system has been used not only for that purpose, but also as a formal journal-editing mechanism, an avenue for informal communications between individual students and professors, an adjunct to a national conference, and a launching platform for segmented streaming video files. It has served audiences ranging from individuals sharing an office or classroom, to distance education students in the same course, to academic professionals on different campuses around the country. In several instances, developers have modified the basic IPP mechanism to better serve those interests and audiences; some modifications have afterward been applied to the basic IPP, while others have not.

Several mini-cases make up our situated evaluation if the IPP. One involves a single paper that has garnered more than 300 comments, mostly from students in classes taught by one of that paper's co-authors. A second case involves thirteen different papers presented at a national conference in Fall, 2000; these papers were made available in IPP format to conference attendees beforehand, and readers entered several hundred comments and responses. A third case looks at how the IPP has been adapted to serve as the primary means by which an online journal prepares articles for publication; article drafts are made available to reviewers for their comments in a two-phase process which initially keeps comments private, then makes them available to article authors and fellow reviewers. A fourth case examines how members of a cross-institutional research group are making use of the IPP as one of several mechanisms for promoting multi-site collaboration. A fifth case describes how the IPP structure has been modified to construct "interactive multimedia papers," by adding features for selecting and segmenting streamed video files so that these can be viewed and commented upon.

Implications

Our ongoing situated evaluation of the IPP is helping us understand better how the tool is being defined in use, and guiding us toward further revisions and improvements.

References

Bruce, B. C., & Peyton, J. K. (1993). A situated evaluation of ENFI. In B. C. Bruce, J. K. Peyton, & T. Batson (Eds.), *Network-based classrooms: Promises and realities* (pp. 33-49). New York: Cambridge University Press.

Buell, J. G., & Levin, J. A. (1999). Computer-Supported Collaborative Review: The Interactive Paper Project. Poster presented at *Computer Support for Collaborative Learning Conference*, Dec. 12-15, Palo Alto, Calif.

McCollum, K. (1999). An on-line format for scholarly papers lets critics aim their barbs precisely. *Chronicle of Higher Education*, June 4, p. A34.

A framework for the instructional design of multi-structured educational applications

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Abstract:

An instructional application consists of a set of resources and activities that implement interacting, interrelated and structured experiences oriented towards achieving specific educational objectives. Computer-based instructional applications have to be faced as any other development activity following a well defined process. With this purpose some design methods for computer-based instructional applications have been proposed. However most of them are focused on "on-line" courseware structures which are quite rigid as far as they have serious shortcomings to deal with courses structured in multiple ways. Moreover, these methods usually lack a specific mechanism to model instructional concepts and strategies. This work proposes a design framework to develop multi-structured instructional applications combining a didactic model with a software engineering approach to deal with educational and technical requirements. The underlying model extends knowledge structures, such as those involved in the Merrill's Transaction Instruction Theory, adding them didactic information. It also considers the functional aspects of these structures. An XML-based notation is proposed to represent such structures and their management.

1. Introduction

An instructional application can be defined as a set of resources and activities which implement interacting, interrelated, structured experiences that are designed to achieve specific educational objectives. Instructional applications are usually structured by means of static patterns which are based on a sequence of book-like electronic pages. They are designed using courseware methodologies that focus on presentation and navigation issues but lack a didactic basis. The resultant products are mostly "pretty-printing" on-line courses but didactic aspects are hardly considered. The current work proposes a design framework which is independent from computer-based delivery technologies and it allows the representation of multiple didactic structures from an instructional point of view. Such a framework requires a model to deal, on one hand, with instructional design topics and, on the other hand, with the design of computer-based applications.

Instructional design can be defined as the discipline that connects descriptive theories with instructional practice. Among the different instructional theories proposed in the literature, we will assume the Instructional Transaction Theory (Merrill 1996) since it makes possible to figure out the relationships between educational and technical components. Merrill's mental models consist of two major components: knowledge structures (schema) and processes for using this knowledge (mental operations). The Merrill's hypothesis states that adequate instruction would require multiple types of knowledge structures to be identified and made explicit to the learner. Thus, the Instructional Transaction theory provides a powerful tool to structure the knowledge about a given topic and to define the procedures for accessing it. In the framework proposed in this paper, Merril's model is extended to add didactic information to knowledge objects and structures. A Didactic model is built using the previous entities as the basis and assigning them attributes whose values suggest how they can be used or even adapted in a specific learning or teaching scenario.

On the other hand, the proposed framework deals with the design of educational computer-based applications. Most of the existing methodologies are addressed to author courseware using formats such as HTML documents. They seem adequate for presenting and accessing information in a open environment like the Web but lack a data structuring capability. Another option is using proprietary multimedia authoring tools like Authorware™ or

Tooolbook™ that provide a more powerful data model but they bound the reuse and exchange of content module (Wiest, 2001). In this sense, an important effort has been made to organize and to manage educational data using metadata (Duval 2001). However, standard metadata proposals mainly aim at the reuse and exchange of learning material and they are not directly involved in the context of instructional application design. In the current work, notational systems based on metadata are used to represent instructional and didactic entities. The proposal consists of defining an XML-based notation which specifies the Merrill's Instructional Transaction Theory entities and their extension introduced in our Didactic model. Such notation will allow an instructor to define his own didactic structures which can be built from a common repository of instructional objects.

The remainder of the paper is organized as follows. Second section revises some related works. Third section introduces the design framework proposed in the current work. Such framework is based on a didactic model whose structural components are presented in fourth section. Fifth section complements this model with its functional view. An application example is described in section 6. Finally, section 7 presents some remarking conclusions.

2. Related work

There are several technology-based educational initiatives that propose a separation between didactic aspects and content related issues. In this context, the Multibook project (Steinacker et al. 1999) considers two domain spaces: the Concept Space and the Media Brick Space. The first one contains a network of knowledge topics which are connected via semantic relations. The second one contains information units of various multimedia formats. Media Brick elements are linked to the Concept entities and instructional mechanisms such as "example", "deepen" or "explain" are setup between these elements. A similar approach is proposed in LMML (Süß et al 2000) which differentiates Pedagogical and Instructional properties from the Module and Content objects. However, only strategy attributes with possible constant values "beh" (behaviouristic) or "con" (constructivistic) can be specified. Other proposals such as the Targeteam project (Teege 2000) or the Palo language (Rodriguez et al 1999) are also constrained to relations or mechanisms such as motivation, illustration, exercise or explanation without an additional didactic value.

In metadata contexts, there are Educational Modeling Languages (EML) which allow the specification of many kinds of educational data. These data can be implemented using notations which take advantage of standard proposals on one hand, or particular and specific proposals on the other hand. The first option is used in the Multibook project to define the Media Brick elements from IEEE Learning Objects or the Chameleon project and its TeachML (Wehner 2001) notation that is based on IMS standards. These standard formats are useful for exchanging them in different learning contexts but their didactic attributes are very restrictive. In the second category, there are formats such as LMML that defines instructional ContentObjects which contain media units such as tables, lists, images or text. The problem is that these units are strongly coupled with instructional objects and it prevents to assign them with different media objects. Similar problems are found on other EML proposals such as Targeteam contents, EML learning objects (Koper 2001) or Palo elements.

3. Design of Instructional Applications

Figure 1 shows the global architecture in the proposed instructional application design framework. The upper level deals with Instructional Design Theory which manages entities such as "knowledge objects", "knowledge structures" and "transaction shells". According to Merrill, a knowledge object is defined as "a precise way to describe the content to be taught". Knowledge objects can be combined into knowledge structures. Knowledge structures are external representations of knowledge that are parallel with mental models that in turn are internal (cognitive) representations of models. Transaction shells consist of rules for selecting and sequencing knowledge objects. The entities defined in the Merrill's model are the basis for the next level (Instructional Design Modeling). This central level is characterized by a Didactic Model whose components extend the previous entities with didactic information. They are divided in two categories that represent the structural and functional model, respectively. Structural model is composed by instructional objects, derived from knowledge objects, and didactic structures which extend knowledge structures. Functional model is based on instructional tasks and learning scenarios. An EML notation is being designed to specify both structural and functional components. Next section will describe them in depth. The lower two levels deal with the computational implementation of instructional applications. The first one is based on a hypermedia model to represent the instructional entities and their relationships in an formal and abstract notation (Buendia et al 2001). The second level is related to the technology involved in the delivery of instructional applications using an e-learning environment.

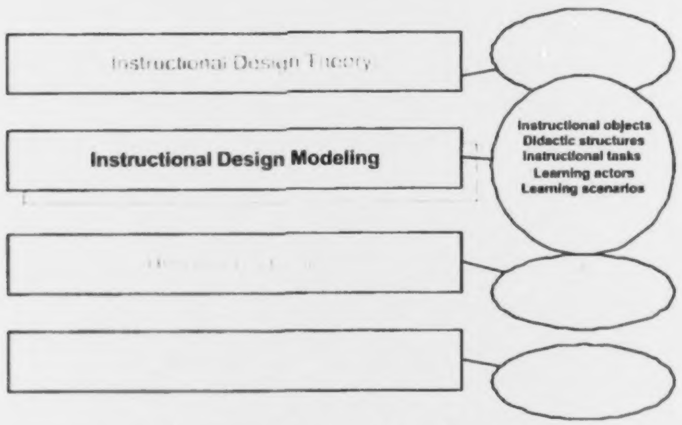

Figure 1. Instructional Application Design Architecture.

4. Structural model

This section focuses on the structural components of the Didactic Model proposed in this paper. The simplest element of the current model is the *Instructional Object* (IO) which is used to manage Merrill's knowledge objects from a learning point of view. Instructional Transaction Theory describes knowledge in terms of three types of knowledge objects: entities, activities and processes. When an entity, activity or process is addressed in a learning context, there are multiple aspects that differ depending on the learning conditions around the knowledge object. The main goal of IO elements is to represent such aspects. If the learning target is an entity, IOs such as definitions, statements or examples can be used to describe it. Activity knowledge items can be characterized using IOs such as exercises, questions, analogies, hints an so on, and finally, processes are also qualified with simulations, feedback elements, or animations.

IOs are not only isolated information units such as definitions or exercises but they are also concerned with the way these units are used in a learning context. For instance, an entity definition is assigned with a difficulty level, a statement declares a property value assigning it a relevance index and an example displays the entity with a specific portrayal (text, audio, image, and so on). Therefore, IOs must consider the multiple possibilities for a knowledge object to be learned in order to deal with different learning styles and needs.

The model presented in this paper provides a flexible framework to incorporate multiple kinds of didactic information which can be added to IOs. The instructor has to decide the different difficulty or abstraction levels assigned to each object, its relevance in a certain learning context or the portrayal that requires a given user profile. This design process is highly related to the features of a subject domain and it becomes a manual and laborious process. Tools as metadata notations have been used to support this process.

In this work, there is a simple XML notation proposal and the definition of IOs is adapted according to the subject domain. This means that they can be defined on top of other entities such as Merrill's knowledge objects or IEEE learning objects, extending them with didactic elements as those referred in Figure 2. In this example, a *Description* IO is used to teach the "magnetic disk structure" (knowledge object). The "ObjectDescription" shows that an image representation has been selected in the current teaching context. Didactic parameters as the portrayal configuration or the abstraction type indicate how this image is displayed and the level of abstraction it represents. EML notations usually also include information about the organization of the educational contents in different structures. In some cases like the Multibook project this information is mixed with the own instructional objects. In our model, there is a strong separation between both types of information.

Instructional objects are organized using *Didactic Structures* (DS) which can be managed as independent entities. These entities are addressed to capture the didactic relationships between those objects. There are two kinds of didactic relationships in the current model: explicit and implicit. Explicit relationships link IOs using a specific action, for instance, "an example *illustrates* a concept definition" or "a question *evaluates* an explanation". Implicit relationships are derived from the way knowledge items are organized.

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```
<ComponentValue DidacticRef="Image reference">
        <ObjectRef>Magnetic Disk Structure reference (storage area).</ObjectRef>
        <InstructionalObject ObjectID="IO-404" ObjectName="Description" ObjectDescription="Bi-dimensional image">
                <Portrayal Dimension="2" Background="false" Position="center"/>
                <Abstraction Type="structural" Depth="0"/>
        </InstructionalObject>
</ComponentValue>
```

Figure 2.- Instructional object example.

In this case, we are interested in knowledge structures coming from the Instructional Transaction Theory which are used in the current work to model DSs. Merrill mentions different types of knowledge structures such as lists, taxonomies, dependencies, algorithms and causal nets. A DS can be built on top of one or more knowledge structures. For instance, the description of a magnetic disk in a computer system can be based on identifying its components and assigning them a portrayal configuration. It can also include an algorithm representation to show the access to a specific component (e.g. a cylinder). The DS connections with other model entities are represented on Figure 3 It shows a simplified UML diagram which specifies that DSs are entities aggregated from instructional objects (IO) and knowledge structures (KS). Both IO and KS entities are based on knowledge objects (KO) which are composed by elements such as *Identif, Portrayal* and *Properties*. DS entities also extend the basic information coming from IO and KS, using didactic attributes such as the portrayal selection.

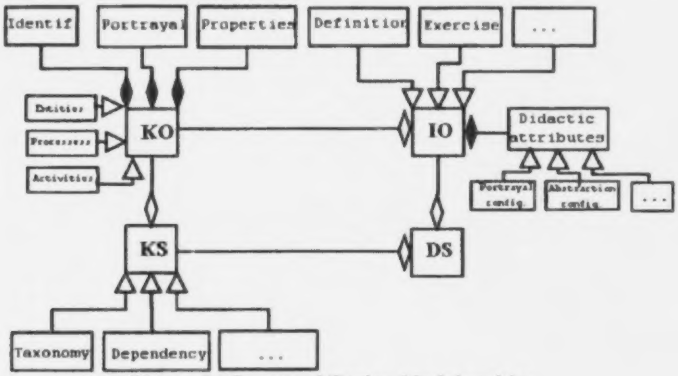

Figure 3.- Structural Design Model entities.

The current work is closer to the IMSDL proposal (Silberhorn & Gaede 1999) which defines instructional strategies, responsible for structuring the information units to be learned but independent from the subject domain. However, these structures are addressed mainly for courseware. Nevertheless, we do not know any proposal focused on generating structure templates which can be applied in specific didactic contexts in a reusable and modular way. We are developing XML Schemas to represent a wide range of didactic structures from basic knowledge structures.

5. Functional model

The functional model describes the entities that allow a user (student or instructor) to interact with DSs. DS entities are the nexus with the other structural elements. Figure 4 shows a simplified UML diagram that represents the main functional entities and their relationships with the remainder entities. These entities are learning scenarios and instructional tasks, respectively.

Learning scenarios (LS) are defined as the set of terms and conditions that characterize the user learning. Each individual user or group of them is assigned with one or more LSs. Instructors have to configure the LS entities, assigning features such as learning modes, timing schedules, instructional methods and learning goals. Each LS aggregates one or more *Instructional Tasks* (IT). They are defined as the operations a user has to perform to achieve a specific learning goal. IT entities model the functions associated to the didactic structure interface. They can access to one or more didactic structures and a certain DS can be attached to multiple ITs.

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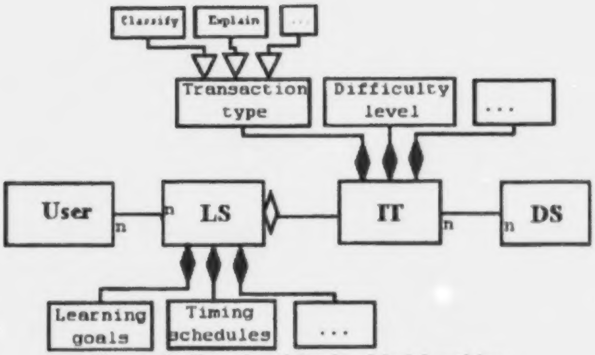

Figure 4.- Functional Design Model entities.

ITs are related to the Merrill's concept of "transaction shell" which consists of rules for selecting and sequencing knowledge objects. In the current model, IT entities do not access directly to IOs which are encapsulated into the didactic structures. This feature eases the design process because the instructor deals with IOs in a more abstract way. For instance, in a dependency DS, the IO components are all considered as chain elements without differentiating them. An IT like *Explain* specifies the navigational operations through the branches of the Dependency structure. A navigational operation can consist in the selection of a given branch and it could depend on learning modes such as "learning by examples", "by doing" or by "exploration and experimentation". In the first case, the *Explain* task is based on revising *Example* IOs while the other cases involve the working with *Activity* IOs. One of the main instructor responsibilities is to define the ITs attached to each DS. This definition is also a manual and laborious task and an EML notation is being developed to assist the instructor in this process.

6. Application example.

In this section, an example is used to show the application of the proposed Didactic model. The example consists of a Didactic Guide called "Learning XML basics" which is based on a Dependency structure. Figure 5 shows a diagram of top-down dependency. The root node represents the main learning goal described as "Learning XML". The descendent node has assigned a *Definition* IO which intends to answer the "What is XML" question. The didactic relationship between the *Goal* and *Definition* IOs is an *IsBasedOn* relationship type and it means that the knowledge about the XML notion (current node) is required to meet the goal defined in the previous node. From the current node, there are several branches which represent extensions (*IsExtendedBy* relationships) of the current definition node. These branches store requirements in order to understand the previous node and each one has assigned a specific competency (difficulty) level. According to this assignment, a different IT can be attached to each branch. These competency levels are based on the learning modes cited previously. Learning by examples can involve identifying instances of a concept, e.g. an XML document (left branch) or a DTD document (central branch). Moreover, each XML document example can be assigned with a certain difficulty level which is used as parameter by the IT. It causes that the structure branches can be navigated-accessed in different ways. A *Predict* IT can check a specific process, e.g. the validation of an input XML document using a DTD syntax. This validation process is based on an *Activity* IO which is related to a previous *Example* object by means of an *IsCheckedBy* didactic relationship. In a higher level learning mode, the *Predict* task could include additional activities such as the DTD configuration.

7. Conclusions

A design framework has been proposed for developing instructional applications beyond the rigid courseware structures that underlie the typical Web-based courses. The proposed framework is based on a didactic model which provides a gateway between instructional theories and concepts, and hypermedia and Web application engineering. This model considers two issues: a structural view based on instructional objects and didactic structures, and a functional view that manages the previous entities using instructional tasks and learning scenarios. The didactic model is supported by an XML-based notation which eases its translation to computing environments.

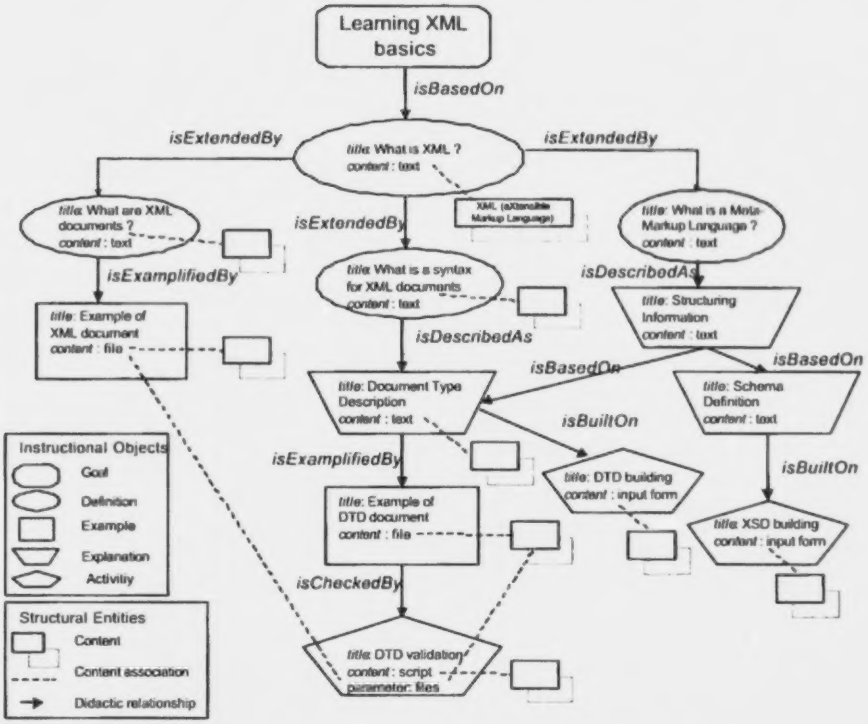
Learning XML basics
isBasedOn
isExtendedBy
title: What is XML ?
content : text
isExtendedBy
XML (eXtensible Markup Language)
title: What are XML documents ?
content : text
isExtendedBy
title: What is a Meta-Markup Language ?
content : text
isExamplifiedBy
title: What is a syntax for XML documents
content : text
isDescribedAs
title: Example of XML document
content : file
title: Structuring Information
content : text
isDescribedAs
isBasedOn
isBasedOn
title: Document Type Description
content : text
title: Schema Definition
content : text
isBuiltOn
Instructional Objects
Goal
Definition
Example
Explanation
Activitiy
isExamplifiedBy
title: DTD building
content : input form
isBuiltOn
title: Example of DTD document
content : file
title: XSD building
content : input form
isCheckedBy
Structural Entities
Content
Content association
Didactic relationship
title: DTD validation
content : script
parameter: files

Figure 5.- Didactic Structure example.

This notation has been applied to represent taxonomy-like didactic structures. It provides the possibility to organize available educational resources in a way closer to the instructor teaching requirements. We have also planned to extend the XML-based specification to other didactic structures based on dependencies and algorithms. Further works include their usage in specific learning contexts such as Electric and Information Engineering areas. We are also developing a tool to allow the access to these structures in a Web-based environment.

References

Merrill M. D., & ID2 Research Team (1996). *Instructional Transaction Theory: Instructional Design based on Knowledge Objects.* Educational Technology, 36(3), 30-37.

Wiest, S, Zell A. (2001) *Improving Web-Based Training Using an XML Content Base.* Proceedings of ED-MEDIA 2001, Tampere, Finland, pp-2045-2050.

Duval, E (2001). *Standardized Metadata for Education: a Status Report.* Proceedings of ED-MEDIA 2001, Tampere, Finland, pp-458-463.

Steinacker,A., Seeberg, C., Reichenberger, K., Fischer, S., Steinmetz, R. (1999) *Dynamically Generated Tables of Contents as Guided Tours inAdaptive Hypermedia Systems.* Proceedings of ED-MEDIA June 1999.

Süß,C., Kammerl, R., Freitag, B.A (2000). *Teachware Management Framework for Multiple Teaching Strategies.* Proceedings of ED-MEDIA 2000, World Conference on Educational Multimedia, Hypermedia & Telecommunications, Montreal, Quebec.

Teege, G. (2000) *Targeteam, TArgeted Reuse and GEneration of TEAching Materials.* http://www11.informatik.tu muenchen.de/forschung/projekte/targeteam/index.html.en

Rodriguez-Artacho, M., Verdejo, M.F., Mayorga, J.I., Calero M.Y. (1999) *Using a High-Level Language to Describe and Create Web-Based Learning Scenarios* Frontiers In Education Conference FIE '99 IEEE Computer Society San Juan, Puerto Rico.

Wehner, F., Lorz, (2001) A. *Developing Modular and Adaptable Courseware Using TeachML* Proceedings of ED-MEDIA 2001, Tampere, Finland, pp-2013-2018.

Koper, R. (2001) *Modeling Units of Study from a Pedagogical Perspective: the pedagogical meta-model behind EML.* http://eml.ou.nl/introduction/docs/ped-metamodel.pdf

Buendía, F., Diaz, P., Sahuquillo, J., Benlloch, J., Gil, J.A., Agustí, M. (2001) *XEDU, a Framework for Developing XML-based Didactic Resources.* EuroMicro'01, pp427-434.

Silberhorn, H., & Gaede, B. (1999). *IMSDL: Instructional Material Structure Description Language*, 7 th BOBCATSSS Symposium on Learning Society, Learning Organisation, Lifelong Learning, Bratislava.

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The Construction Kit Metaphor for a Software Engineering Design of an E-Learning System

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Abstract: In this paper we propose a construction kit approach that could be used as an abstract model to implement modular defined e-learning systems. The metaphor *construction kit* results from the math-kit project, that provides students and lecturers with multimedia support for central topics in undergraduate mathematics. The lecturers can combine different learning units into individual courses as easily as bricks of a construction kit can be used to build a model. Thus, a learning unit which is developed by one author could be used by a number of other authors as well. Furthermore, learning objects must be defined independent of style and format, because the definition of design and style makes it impossible to integrate them into different courses. Therefore, we are using XML as the description language to define learning content in a structural manner. Our modular concept is based on the *Sharable Content Object Reference Model* (SCORM).

Introduction

When teaching mathematics to undergraduates and non-mathematical students, most lecturers agree that the use of computers in education is very helpful. Despite this, most of them don't use computers in their standard lectures. The reason for this is that they lack the necessary technical knowledge to develop and integrate computer based learning units to their lectures. Hence, we are developing a multimedia construction kit, called "math-kit", that supports lecturers and students with mathematical and technical content (Unger et al. 2002). Math-Kit is a joint project, which is being developed at the German universities of Hamburg, Bayreuth, Hagen and Paderborn. The developed system provides a simple mechanism to find and combine different learning objects to compose them to learning units and courses. These learning units are able to be used by lecturers for presentation as well as by students for exploration.

In a joint project the creation of uniform learning content is very difficult to achieve. Often different developers produce learning objects which are based on varying description languages such as HTML or PDF. Integrating learning objects into existing courses requires a lot of revision work to achieve consistency of appearance and content. To find an optimal solution, several learning platforms and authoring tools were evaluated but none of these met our requirements.

The Construction Kit

Nowadays, object oriented software engineering is a popular programming paradigm and provides objects as units of modeling. Regrettably, this level of modeling is insufficient for the development of complex software systems with human interaction. To bridge the gap between object and technical models, we use the metaphor concept in our project. A *metaphor* is a linguistical term which uses a figurative meaning in a different context. This helps both the development team and the user. The developer team can gain better understanding of the concrete problem which is to be solved by a software system. When the system is finished, the user benefits from a intuitive usage model. For math-kit, we introduce the *construction kit* term as metaphor for our e-learning system.

To get a better understanding of this metaphor, think of a LEGO construction kit with all contained bricks. Mostly, the construction kit contains a construction plan for several models which can be built with the same bricks. But the special characteristic of the bricks is the patented stud-and-tube coupling system. This coupling principle allows stable models and a multitude of combinations -— no matter how the bricks are colored, shaped, or sized. Hence, it is also possible to combine bricks of different construction kits in one model. Thus, the contained construction plan is a tiny subset of unlimited possibilities.

To make a connection between metaphor and planned software system we describe the demands and external circumstances. The main goal is the creation of a system that helps both students and lecturers to improve their work. Lecturers need pedagogic concepts and human intelligence to create reasonable content. The software market provides a lot of solutions which support content creation e.g. Adobe Framemaker, Microsoft PowerPoint, and Macromedia Flash. Most of these programs provide special functionality for specific problems and have weaknesses in other tasks. It makes sense to combine the strengths of all text, graphic, sound and multimedia tools. Therefore, we use the *Sharable Content Object Reference Model* (SCORM) (Dodds 2001) which defines a *Sharable Content Object* (SCO) as the atomic entity of a *Learning Management System* (LMS). Information about the contents of the SCO is defined in extra data called *Learning Object Meta-Data*. The SCO wraps any kind of files, called assets, and can communicate with the LMS via a specified API. The SCO fits into our metaphor as the brick in our construction kit. The combination of several bricks or SCOs is realized through a separate mechanism called *Content Packaging*. The backbone of a content package is a *manifest* which defines the paths to the SCOs, additional meta-data and one or more structures of the built course. In contrast to the LEGO bricks, which include their own coupling system, the SCOs need the manifest as additional "glue". Hence, in view of our metaphor, a built model or course is described by a content package. Every LMS that complies to the SCORM standard should be able to process the produced packages. The metaphor of the construction kit helps us to understand how course development, implementation and management should be handled by a technical system. Two cases still remain that are not covered. One problem is the design and implementation of well structured SCOs. As already mentioned, math-kit is a joint project and needs a strict separation of content and presentation to produce courses with a uniform appearance. The use of the *Extensible Markup Language* (XML) and the *Extensible Stylesheet Language Transformations* (XSLT) can help to force the wished separation (Farinetti et al. 2000). XML allows the definition of a specialized markup language with tags for mathematical content like formulas, definitions, and proofs. Such a restricted language helps the authors to concentrate on the content and hides unnecessary style details. The complete XML document can be transformed by XSLT into a wide spread output format like HTML or PDF. This approach has the benefit of a consistent and individual style of the whole course, even if foreign content is used.

Another problem not covered by the metaphor is the publishing of complete courses. A construction kit doesn't support the replication and distribution of built models. Although, the LMS couldn't fit into the construction kit metaphor, math-kit is a complete system for the distribution of mathematical content. However, our main focus lies on the development of an authoring tool for e-learning.

The Roles

We introduce roles to model the different views of our e-learning system. It is important to comprehend that one person can appear in several roles. The roles help us to model the static and dynamic behavior of our system with use cases and sequential diagrams (Bergner et al. 1998). This allows us to have a stringent and controllable development process. Math-Kit comprises six different roles: lecturer, student, composer, learning object developer, publisher, and administrator.

The *lecturer* uses single blocks or complete courses to extend his own slides or to create new ones. Individuals in the role *student* want to learn and can explore the entire database to use learning objects and courses of interest. These two roles don't depend directly on the construction kit metaphor, because they work with their favorite LMS. Nevertheless, the construction kit is the foundation of the created content. The *composer* uses math-kit to combine existing learning objects to complete courses. In relation to the construction kit metaphor the composer defines the construction plan. The *learning object developer* designs and implements new learning objects. In view of the metaphor, the learning object developer creates the several bricks. In context of math-kit, the learning content is coded in XML with a structure for mathematics. This XML code has to be translated into a readable format by the role *publisher*. The last role *administrator* installs basic packages and software for the construction-kit.

Assessment and Outlook

The use of the construction kit metaphor and roles should support us in planning and developing an e-learning system for the creation and distribution of mathematical and technical content. The benefit of this approach is the natural connection between well known terms and a technical system. This makes the further development of the math-kit project easier. Despite this, one metaphor cannot cover all parts of such a complex software system. Hence, the metaphor has to be extended to meet the requirements. The next step will be a description of the system by use cases, sequential diagrams and an object model which paves the way for a later implementation.

References

Dodds, P. (2001). Advanced Distributing Learning Sharable Content Object Reference Model. http://www.adlnet.org/.

Bergner, K.;Rausch, A.; & Sihling, M. (1998). A critical look upon UML 1.0. *The Unified Modeling Language – Technical Aspects and Applications*, Heidelberg, 79–92

Farinetti, L.; Bota, F.; & Rarau, A. (2000). An Authoring Tool for Building Flexible On-Line Courses Using XML, *XML Europe 2000 Conference*, Paris

Unger, L.; Oevel, G.; & Mertsching, B. (2002). Web-based teaching and learning with math-kit.. *2th International Conference on the Teaching of Mathematics*, Crete.

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Collaboration by Design: Creating a Course Explicitly for a Collaborative Environment

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Abstract: In response to feedback obtained from recent graduates during a departmental program review, Dr. Janet M. Kelly, Assoc. Professor in Political Science at the University of Tennessee redesigned an upper division Urban Policy class explicitly on a technology enhanced collaborative education model. Taking advantage of a wireless laptop pilot project sponsored and supported by the Innovative Technology Center, Dr. Kelly used laptop computers, a versatile suite of software tools, and a customized course web site to create a technology-enhanced, collaborative Urban Policy course that addressed specific alumni recommendations for increased use of computing and communications technologies and team-based projects.

Introduction

"Our students are entering a world in which 60% of the jobs will require technological competency...[w]e must take advantage of the capacity of technology to...engage our students in active learning." (Morrison, 1997). Transformations in business, social and educational institutions generated by technological evolution require that we address the demands for increased technological competency, collaborative working skills, critical thinking and rapid problem solving. This will require changes in the ways we prepare our students. "[T]oday's world demands critical thinking and on-the-fly problem solving. To meet these demands, our graduates require significantly different knowledge, skills, and abilities than our educational systems typically provide." (Ellsworth, 1997) We need to provide problem-based learning opportunities that are both constructivist and collaborative. "[W]hat we should foster are academic environments in which students are free to explore and express their own ideas...to make explicit and elaborate on their own tacit knowledge." (Watts, 1997)

The Case

Recent graduates in the Political Science program indicated that their initial experiences in the workplace revealed two significant weaknesses in their preparation, a lack of experience working with common computing and communications technologies, and a lack of experience working in project-based teams, Dr. Kelly set out to design a project-based course that would be collaborative in design, and would rely heavily on the use of computer-based productivity, communication and presentation applications. Dr. Kelly redesigned Urban Policy 410 to simulate a work environment in which students worked in teams to study actual urban problems, formulate policy statements and share their recommendations in a formal presentation. In addition to the expected discipline specific content learning objectives, she developed explicit objectives, assignments and assessment instruments for technology skill acquisition, written and oral communication, and group process skill development.

To meet each objective, Kelly used a variety of collaborative activities. All course materials, with the exception of the two required texts, were available online through the course website. These included the syllabus and general course information, course documents (including class lecture notes, a sample policy report and student policy reports, sample presentation and group presentations, evaluation guidelines and documents, supplemental reading materials, and case study files), course assignments, group communication tools (chat room, discussion board, file sharing and email), and links to guides, tutorials, and university resources.

Dr. Kelly grouped students into teams from the outset, and provided a set of guidelines and definitions for the roles to be performed within the teams. Each person in the group was required to assume a specific role within the group. Individuals had to 'apply' for their roles, and the group had some flexibility in role assignments and definitions within the guidelines provided. Each team was responsible for researching a specific urban policy area (housing, immigration, poverty, crime and transportation), developing a comprehensive written report, and presenting their findings to the class in a live PowerPoint lecture format. Research, writing and presentation skills were developed using guidelines and examples provided by the instructor. In addition, each student was required to use the specified evaluation criteria to evaluate the products (paper and presentation) of each group, as well as the process (group performance) of their own group.

In an interview at the conclusion of the semester, Dr. Kelly made the following comments:

"(During the program review) the graduates said that the biggest disparity in the graduate training in Public Administration …was that when they got to the workplace, they worked with technology and they worked in groups. And that was the one way that we didn't teach, we didn't teach with technology and we taught everything on the basis of individual effort. And they had the hardest time trying to manage the assignments that they got in groups, without ever having developed any skills for working in groups, and especially working with technology. I built [the] course, integrating those two concepts, use of technology and group process to teach two skills that were very critical, but were not content related."

"Developing everything in advance, the assignments, the examples, the evaluation guidelines, everything, then putting it on the website is critical. The only way for this to work is that the answer to everything has got to be 'it's on the website.'"

"I would never go back to the old way of teaching this course, using only readings, lecture and individualized assessment. The quality of the products these students produced, the papers and the presentations…was spectacular…it was so clearly superior to anything I had ever seen from previous students in this course that I wouldn't even consider going back to the old way of doing things."

Conclusions

The experiences with PS 410, including the design and implementation of the course website, collaborative activities, and assessment instruments provide inspiration and guidance to faculty and instructional designers in a variety of disciplines and educational settings. The careful application of collaborative learning methods, along with the integration of contemporary technologies, provide the foundation for more meaningful, relevant, and engaging learning opportunities for students regardless of their academic discipline or career aspirations.

References

Morrison, James L. (1997) Introduction. *Technology Tools for Today's Campuses*. CD-ROM (Out of print) Articles available at: http://horizon.unc.edu/projects/monograph/CD/)

Watts, Margit Misangyi. (1997) COllaboratory. In Morrison (Ed.) *Technology Tools for Today's Campuses*. CD-ROM (Out of print) Articles available at: http://horizon.unc.edu/projects/monograph/CD/)

Ellsworth, James B. (1997) Technology and Change for the Information Age. In Morrison (Ed.) *Technology Tools for Today's Campuses*. CD-ROM (Out of print) Articles available at: http://horizon.unc.edu/projects/monograph/CD/)

Assessing the Use of Technology Resources in the College Classroom: Student Responses

In order to investigate the impact of technology resources for teaching and learning in an undergraduate classroom, a research project was conducted at Springfield College. Springfield College is a small four-year college located in Springfield, Massachusetts. For this study, two Elementary Spanish undergraduate classes were selected. One used technology to complete activities, homework, and expand on the aspects of culture studied in the class, while the other class used traditional textbook methods. Data collected demonstrates that technology is a suitable tool to increase motivation, participation and learning.

Implementation Method

This research study was conducted during Fall 2001 and a second study is being repeated this semester to strengthen and adjust findings, conclusions, and results. The classes were taught by the same instructor, using the same syllabus but one of the classes each semester was randomly selected to use technology as a means of academic instructional support. Approximately 20 students enroll in these first level Spanish courses; a foreign language course is a graduation requirement. Most of the students -- 80 percent --, have a fragile commitment to the class.

Students in the class using technology interacted with the worldwide web, email and chat rooms to complete activities and homework assignments. For each project, throughout the semester, students in the traditional class completed the homework activities in the exercise manual that accompanies the book. Each chapter in the book has a corresponding set of activities supplemented by the manual. The selection of web activities was designed to match the activities of the traditional class. The homework activities of both classes -- the traditional and technology class-- required similar amounts of time to be completed and they corresponded to the themes studies in class.

The students in the technology-enhanced class had access tocourse management software, the Manhattan Pilot, to check their grades, assignments and lectures, while the instructor kept a manual record and reported to the traditional class.

Assessment Method

Different assessment methods were used to understand the impact of technology in the classrooms. The percentage of completed homework was utilized as an indicator of student commitment to the class. To assess the effect of technology on learning outcomes, students' grades were compared. A questionnaire was developed to measure students' perceptions of homework activities. Open-ended questions were also added for students using technology about their impressions and reactions towards the activities.

Results

Learning Outcomes: Data reflect higher learning outcomes in the class using technology. (class average)

Learning Outcomes	Homework	Quizzes	Exam
Traditional	72 %	80 %	84 %
Technology	98 %	84 %	90 %

Completed Homework Assignments: Data results show students from the technology class completed more homework assignments than students from the traditional classroom.

	Ex. Book	Web	Book	Average
Traditional	N/A	98 %	96 %	97 %
Technology	63 %	N/A	74 %	68.5 %

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Overall Impressions on Homework Activities:

- Question 1: I believe homework assignments enhanced my learning of the material.
- Question 2: Homework assignments were good indicators of my learning throughout the semester.
- Question 3: Overall, I had a positive learning experience doing homework.

	Question 1		Question 2		Question 3	
Spring 2002	Agree	Disagree	Agree	Disagree	Agree	Disagree
Traditional	16 %	79 %	19 %	76 %	16 %	79 %
Technology	84 %	12 %	86 %	10 %	84 %	12 %

Students' Impressions and Reactions Towards Technology

The narrative responses indicated that many students were exited by the fast feedback they received from the web activities and felt that it was an important supplement to the course. Technical problems such as a slow internet connection caused the most dissatisfaction but in general students were able to deal with occasional technical glitches.

Many students preferred the ACE Tests to the Web Search Activities. They mentioned that many of the Web Search activities were ambiguous and not as useful as the ACE Tests Activities. Two students recommended discontinuing them. Students were positive about the chat room activities. They mentioned that they usually turned to English while working in face-to-face activities but in the chat rooms they were forced to communicate in Spanish constantly.

Findings, Conclusions and Recommendations

The focus of many studies has been to analyze the impact of technology in terms of student achievement. When adopting technology to enhance the learning process there are many factors to consider. For this project, the courses were taught simultaneously. If course content, instructor and student population were all the same in theory, any differences should be attributable to the different teaching method utilized.

Students in the two classes using technology performed better than the students in the traditional classroom; for them, homework assignments were a positive experience. Students in the technology class pointed out that they benefited the most from the ACE Self Tests homework assignments because these web tests provided them with immediate feedback information on their performance.

ACE Tests – short for "A Cyber Evaluation" is a self-testing program that allows students to test their knowledge of topics covered in each chapter. Student answers are scored immediately, allowing students to correct their mistakes while working on the task. The complete activity and scores are submitted to the instructor. The strength of the activity is in its capacity for making self-assessment an ongoing and integral part of the curriculum. It reinforces instruction and guides students in reflecting upon their work. Even though the instructor kept manual records of the assignments for the traditional classes, there was a minimum of two days before feedback occurred. Students from this class declared that the feedback was never relevant for their learning. According to these findings, technology is a suitable tool to increase motivational learning.

For a practical matter, the traditional method was used as a base for comparison in this study. It is not the intention of this researcher to suggest the implementation of technology should replace traditional teaching methods. Rather it is my intention to suggest that technology's main role should be to complement and further effective learning methods in ways not possible using only traditional methodologies.

The implementation of technology in the classroom requires time and effort from faculty who need to learn the new technology and design effective ways to integrate its use. With the incorporation of technology, traditional courses get redesigned. Under these new circumstances, teaching and learning is explored and innovatively re-created.

First Year of Technology Mentoring for Teachers and Faculty: Lessons Learned

Shirley Campbell and Songül Özgül

Introduction:

Rapid changes in the available computer hardware and software applications along with continuous new releases of software applications have created a constant challenge for teachers who are trying to keep up with new technological improvements. In other words, in order to teach and facilitate their students' learning with the support of the available computer software applications as well as tools, teachers have to update their technology skills constantly.

Many schools acquired technology tools and software application to catch up the current technology applications in educational field, however, without proper in-service training of teachers, the use of these technology cannot be optimized. The current related to teachers' effective technology integration may be divided into following sections:

a) On-going training with rehearsal time: The teachers' technology training should include learning experiences that give them opportunities to practice the currently learned skills. Without practice, it should not be expected that teachers will go to their classrooms and will apply those skills.

b) Curricular approaches to increased technology use: The technology training offered to the teachers should include the situations that they will be using in their professional lives. Especially for novice technology learners, it is hard to make connections between the skills they are learning and how to integrate those skills into their teaching practice. Therefore, showing examples in some teaching related situations will inspire teachers and will lead them to think of more innovative ways to use those skills in their teaching practices.

c) Increasing comfort with the technology: Having an opportunity to practice the skills they have learned will increase teachers comfort level significantly. Once they have gained experience with new skills, they will be more comfortable sharing those skills with their colleagues and students while integrating them into their teaching.

d) Continuous technical support related to learning and using hardware and software: It is always frustrating for users to be stuck on a computer related problem and not be able to resolve it promptly. In such circumstances, if it is possible to get technical support in reasonably enough time, frustration will be diminished and the teacher dealing with the problem can productively continue his/her work. Prompt technical support is especially very important if the technical troubles arise in a classroom during the learning process. Unfortunately, this kind of prompt technical support is not usually available in many schools and settings. Anticipation of problems that won't be resolved in time to complete instruction reduces the likelihood that teachers will attempt to use it in their teaching. It creates frustration from the both the students' and teachers' perspective. Sometimes teachers even have to prepare the instructional materials in another format just incase any technical problem arises, so it doubles the work of teacher preparation. Available technical support offered to the teachers is a crucial factor in their decisions to use technology in the classroom.

The PT3 Project: Preparing Tomorrow's Teachers to Use Technology

The Preparing Tomorrow's Teachers to Use Technology Project was created by the U.S. Department of Education to address the need for newly certified teachers to be able to integrate technology in their first years of teaching. The U.S. Education Department's PT3 Program has provided funding for projects nationwide. At the School of Education at the University of Pittsburgh, a funded project is underway and is designed to address the issues of technology use and instruction for pre-service teachers.

The PT3 Project at the University of Pittsburgh focuses in part on the faculty and teachers who work closely with students who are working toward teaching certification. It involves increasing the integration of technology into the training offered to these teachers and faculty. The University of Pittsburgh received two separate grants: a Capacity Building Grant in 1999 to serve as a pilot, and an Implementation Grant to fund 3 years of implementation of the successful pilot beginning in 2000.

The PT3 Project at the University of Pittsburgh was designed to help teachers become users of each of four types of technology applications that are regularly implemented by teachers who are considered successful technology integrators. These four types are:

- Personal Use refers to using technology to increase personal productivity. The first application of the technology that teachers are likely to use usually related to technology training for their "personal use" of the technology. This refers to the idea that teachers' experience with technology tools and applications that produce results useful outside of the professional arena will help teachers significantly transfer those knowledge and skills into their professional needs.

- Classroom Management refers to the use of computer tools and applications to organize classroom information, record keeping, and to create professional looking products.

- Teaching Technology Skills to Students implies that before students can become involved in the activities that technology provides that promote higher order thinking skills, they have to be able to use the tools, and teachers have to know how to teach the necessary skills. Students' computer experiences vary from novice to expert in the same classroom because of their different backgrounds and exposure to technology. Teachers sometimes report difficulties providing satisfying answers to the technology related questions their students' ask.

- Integration to Curriculum refers to the application of the use of technology to teaching in ways that increase learning and frequently require students to use higher order thinking skills. "Integration to curriculum" is significantly important in terms of teachers' teaching experiences in the classrooms. Being comfortable using the available educational and commercial software programs and integrating them effectively into their teaching, teachers will be able to create more innovative and up to date as well as interesting learning experiences for their students that will facilitate student learning in more unique and resourceful ways.

The professional development package created for technology training for teachers attempted to expose teachers to all of these areas of technology use, but was also devised to prevent the difficulties that teachers often have when making attempts to use technology in the classroom. More traditional professional development strategies often are not as effective as expected in improving the implementation of classroom technology. Some components of the support developed within this PT3 Project include: collaboration and community that includes all school personnel, technology learning support in addition to technical support; cognitive strategies for technology learning; and the building of comfort and confidence. Within each of these components, several additional issues are addressed.

Features of the PT3 Project at University of Pittsburgh

This PT3 Project was constructed of a number of features, each expected to promote increased technology use by building skills and community. These features include On-Site Support Staff support, individually chosen projects, and whole group community activities with community building activities imbedded into each. Each of these features includes many activities to provide technology learning support.

On-Site Support Staff

Each teacher and faculty member participating in the PT3 Project at University of Pittsburgh was supported as they learned to use technology by On-Site Support Staff members. Teachers and faculty were provided very individualized support as they learned new skills and worked toward their own technology use goals. On-site Support Staff identified the types of skills participants needed to learn in order to complete the projects they chose, and adapted training very specifically to the needs of the learners. Also, keeping constant contact by e-mail and phone to remind the scheduled weekly appointments as well as the monthly meetings, had promoted teachers participation in these appointments and meetings.

The Support Staff also held mini-workshops that participants were invited to attend. These workshops were non-traditional, in that they were expected to serve fewer than ten attended at a time, and the covered only specific skills during the one to one and a half hour meetings. Support Staff often focused the workshops specifically to the needs of the individuals attending, and invited those individuals who would benefit from a specific skill areas. The Support Staff were skillful in finding different ways of presenting the same instruction including supporting handouts, examples and hands-on practice until the teachers became comfortable doing the tasks alone. They used these techniques when working with individuals as well as in workshops. Many of the workshops were scheduled at times when the Support Staff felt that a number of individuals would benefit from learning the same skills.

In the on site training sessions, teachers from two schools were initially provided support individually with plans to work as small groups later on. In the third school, teachers' on-site support was provided in a small group format from the start. The teachers who were being helped individually were resistant to joining together with other teachers when meeting with Support Staff, and tended to want to continue to work individually. Based on this difficulty in community building, On-Site small group support is recommended instead of solely individual assistance.

Individually Chosen Project

Each participating teacher and faculty member in the PT3 Project was required to choose a realistic project, called the individually chosen project, that could be applied in their own classroom. The projects were required to meet two guidelines: they had to be related to classroom work, and they had to be projects that required the teacher to add to their own technology skills in order to complete them. Depending on the skill level of the teachers at the onset of PT3 Participation (which ranged from none to quite proficient), the individually chosen projects could be well integrated curriculum enhancement projects to be implemented by students, or they could require that only the teacher use the computer, while becoming more comfortable with their own technology skills. Allowing each individual to choose a project rather than assigning projects gave each individual ownership of their own learning, and allowed them to choose a project that they felt would be useful.

One of the most difficult aspects of the individually chosen projects for the participants was committing to a project that they did not have the skills to complete. Much reassurance was required on the part of the On-Site Support Staff that projects were expected to be revised over time, as participants became more familiar with the technology and its implementation. As a result, many projects changed between the time that they were chosen at the beginning of the school year, and at time that they were implemented.

Another result was the reaction of pilot year participants to the discomfort of new participants in the first full year of the grant. Experienced participants reassured the newcomers that they should chose a project that they found exciting, and not concern themselves with how they would eventually produce it: there was enough support and flexibility to make it happen. Also, their technical support person would be helping them to achieve their goals and providing them with the required technical skills so that they would be able to complete their project.

The teachers were encouraged, but not required, to work collaboratively with other teachers on these projects. The On-Site Support Staff who assisted the teachers at times suggested matches between teachers with similar interests or complimentary skills, with the expectation that these teachers would eventually begin to see one another as resources. Although no teachers chose to work collaboratively on a project during the first year, a number of collaborative projects emerged during planning for the second year. The On-Site Support Staff encouraged collaborative projects with expectations that these efforts would help to increase problem solving and promote an increase in confidence for participants. Long term effectiveness of the PT3 Project is also based on the building of strong and supportive learning communities among peers, allowing growth to continue long after funding is finished.

Whole Group Community Activities

All participants of the project were required to take part in activities that were intended to bring the group together, with the expectation that sharing would support the likelihood of the formation of a community of technology users. Several different types of meetings were held. Monthly meetings were held on Saturday mornings, and activities promoted interaction between participants related to technology use and education of students. Participants were given opportunities to talk about successes as well as difficulties, and were involved in activities that promoted discussion among individuals. Many expressed appreciation for opportunities to become familiar with teachers from other schools.

Two other whole group activities promoted through this PT3 Project included Summer Camp, and Celebration of Successes. During Summer Camp, participants were involved in community building activities alternated with technical skill building and activities to develop skills in technology integration. As often as possible, sharing was expected and encouraged. Summer Camp was held at the beginning of grant activities, and Celebration of Successes was the culminating activity of the PT3 Project for the school year. During the Celebration of Successes, each participant was asked to present the individually chosen project that they completed during the school year. Presentations were to include not only descriptions of the projects and impact of implementation, but also barriers faced and solutions found, and personal successes involved. All participants expressed appreciation for the opportunity to present their own work, and see the work of others. "And the project[s] demonstrated at the Celebration of Successes on the final day of the program [were] fashioned from hard work, cooperation, innovative ideas, comfort with manipulation of the technology, and effective implementation the technology in their classrooms" (Campbell & Özgül, 2001).

Our findings at the end of the first year of the project period showed that teachers and faculty members preferred to plan and work on their projects alone. However, on celebration day when they were presenting, sharing and discussing their projects with the others we have observed that teachers from different schools came up with different ways of using their colleagues' projects in their schools or they came up with combining their experiences together in order to create new, innovative, and collaborative projects to be accomplished in the second year of the project. Because of their improved technology skills level as well as the satisfaction of what they had already accomplished, they were more confident, enthusiastic, and creative and also willing to share and work collaboratively with the other teachers to create better products.

During the planning of the PT3 Project, district level administrators were involved in planning project structure and activities. They were responsible for informing administrators at all school levels, and PT3 Project staff contacted school-level administrators only individually prior to an administrator's meeting arranged several months later. This was a golden opportunity for the PT3 project staff to present and discuss the goals and possibilities of the project with these administrators. Until this meeting, administrators were aware of the PT3 Project and were encouraging their teachers to participate, but this communication between the administrators and project staff as well as among the administrators gave everyone a chance to grasp the scope of the project in detail as well as gain realistic views of seizing the opportunities given by the project.

An administrative meeting was not only beneficial for opening communication with Project Staff as well as among administrators themselves, but also beneficial in resolving several issues which their teachers were encountering in their attempts at effective use of technology. First of all, administrators showed sensitivity to allocate time to project participants to work with their support person on technology training activities, especially weekly meetings at either their school or at the PT3 Project community gatherings. Also, administrators addressed some hardware and software limitations and problems that teachers encountered in their schools. Administrators were also better able to affect teachers' success because reports made available to them by the PT3 Staff provided more information about difficulties teachers had in implementing technology uses. Consequently, having better understanding of teachers' problems with technology, then sharing and discussing these issues with the other schools administrators, inspired them to deal with their teachers' difficulties.

In addition, once the school level administrators were fully aware of the possible impact of the PT3 Project in their schools, they encouraged the teachers in their schools who were not already participating to become active in the project. Participating schools then welcomed PT3 activities in their buildings.

Findings

During the course of the pilot year of the PT3 Project at University of Pittsburgh, several strategies for increasing technology learning and community building were tested, and results were noted. Promising strategies and components identified by teachers as most effective in helping them to reach their technology goals are noted.

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Journaling (Learning Log)

Participant teachers were required to keep a reflective journal whenever they used technology applications. The reasons behind the requirement of journaling were two fold. Journaling was beneficial to both the project staff and the participants. Journaling was seen by Project Staff as an opportunity to gain feedback about the provided training as well as track the progress of participants. Feedback gathered from participant journals was used revise the design and implement the training according to entries.

While many of the participants did not enjoy journaling, those who did described it as a reflective tool, providing them an opportunity to reflect on their experiences in using technology. It was also served as a means for participants to document their experiences with technology.

Journaling was also a requirement for the Project Staff. At the end of the first year of the project, Project Staff reported that journaling was a very effective tool for both keeping track of the progress of several teachers that they were assigned to work with, and also preparing for teachers' different training needs. They were also able to use their journals as logs, to identify practices that they use that were particularly effective, and to document their own growth over time.

As a result, journaling was considered as an important tool that contributed to following the progress of the training and adapting it as needed. Because of its benefits to the overall project, it was required of participants in the following years of the PT3 project as well with some modifications. During the pilot year, journaling was done on a notebook and these reflections were copied and given to the their onsite Support Staff. In the following year, journaling was planned to be done on-line.

Note Taking

Note taking plays a very essential role in teachers learning technology skills, especially novice teachers. If these newly learned skills are not practiced frequently, they could easily be forgotten. To prevent that, the teachers and the faculty members were provided with handouts about the instruction. Many times the teachers and faculty personalize the steps by adding notes to the given handouts, and using these notes increased the likelihood that they would be able to practice the same skills successfully on their own. When they had difficulty recalling the skills they had learned, the personalized notes served to refresh their memories. When applications shared similar sets of keystrokes or menu options, creation of handouts that repeated the same formatting for such items served to jog the memory and helped to make connections that transferred application of the skills.

Concept Mapping

Sometimes it is very difficult for teachers and faculty who were novice computer users to understand how the skills they have been learning are related to their final projects. Using concept mapping as a cognitive strategy gave them a visual tool for conceptualizing the relationship between the each group of skills needed to be learned and the relationship of those skills to the main goal. Therefore, the opportunity of seeing visually which skills are required to reach the goal, what they have already learned, and what still needs to be learned helped both the Support Staff as well as the teachers to plan the best sequence of learning activities.

Comfort and Confidence

Teachers were supported in many ways to reach their goals for the end of the first year of the PT3 project. For example, flexible technical support, opportunities to gather the projects participants in workshops as well as monthly meetings, and having the flexibility to alter the final projects were important key elements in increasing the teachers' comfort level with working for their goals and with project staff. Additionally, seeing the final projects of the previous years' participants, as well as listening to their experiences, increased the confidence level of the teachers participating in the project in the second year. Therefore, it was assumed that the anxiety and the disappointment that the first year participants encountered would be somewhat reduced for participants entering in the second year.

Technology Learning Support

Much of the success of the first year of implementation of the PT3 project was attributed to the availability, flexibility, technical skills, and knowledge of good tutoring practices of the technical Support Staff. A number of teachers had difficulty scheduling meeting times during their busy daily work routine. The flexibility of the technology Support Staff made it possible to schedule time slots that meet the schedules of the teachers. As state earlier, it was very important to maintain contact with participants between meetings, by email or phone.

Participating teachers mentioned in their evaluation forms that one of the greatest assets of the project was the On-Site Support Staff members' enormous patience. They were willing to repeat the same instruction many times when teachers needed them to do so. As mentioned earlier, the On-Site Support Staff were very creative in finding ways to present the same information in multiple ways.

Individual Classroom Projects

Participating teachers and faculty members were required to choose an individual project at the beginning of PT3 Project participation. They were expected plan it, including modifications, then present it at the end of the year. These chosen projects could reflect any subject area(s). Projects required that participants learn new skills as they created the projects, but the only software and hardware restrictions were those imposed at their schools sites, usually based on availability. Their anxiety and disappointment were resolved by comforting them that the final project requirement was meant to have them to experience from the beginning of the project how to plan, develop and design, evaluate and redesign their final projects and support them along the way. Also, their technical support person would be helping them to achieve their goals and would be providing them with support to learn the necessary technical skills to complete their projects.

Summary

From the implementation of the PT3 Project, many lessons were learned that can be used to increase the technology learning of teachers and faculty. The following list summarizes the discoveries described here. In this section, the term learners refers to the educator who is attempting to learn new technology skills and increase technology integration.

- On-going training should be provided, both technical and technology learning support, and should be flexible and individualized.
- Support provided for long term learning should include regular follow up and contact with learners - via email or phone when not in person.
- Manuals and reference documents should be provided when learners are working independently
- Note taking done while learning to use hardware and software is often useful for learners when working independently.
- Learners should be provided concept mapping tools, and taught to use concept maps and other visual tools for project planning, time management and for setting and achieving goals.
- Learners should be provided opportunities and encouragement to work in groups right from the start, and be discouraged from remaining separate, even during informal training.
- Maintain contact with building and district level administrators to get them involved and excited, and keep them informed.
- Experienced participants should be encouraged to share their successes with new group members.
- All projects that learners are expected to undertake should be relevant to them.
- If taught to write reflectively, learning logs can be very useful.

Any professional development project should look closely at the needs of its community members, and consider which items can be applied most successfully. In the creation and implementation of University of Pittsburgh's PT3 Project professional development program for teachers, discoveries were made that could be useful in helping to avoid difficulties and identify areas of potential weaknesses. They can also be used to identify strengths that can increase probability of success.

Bibliography

Blumenfeld, P. C., J. S. Krajcik, et al. (1994). "Lessons Learned: How collaboration helped middle grade science teachers learn project-based instruction." *The Elementary School Journal* 94(54): 539-551.

Brown, J. S., A. Collins, et al. (1989). "Situated Cognition and the Culture of learning." *Educational Researcher* 18(1 (Jan-Feb)): 32-42.

Campbell, S., (2002). Dissertation: *Experiences of school of education faculty members in learning to use computer technology: Positive supports as well as barriers.* University of Pittsburgh.

Campbell & Özgül, 2002. *Intensive Technology Teacher Training Project: Lessons Learned.* Submitted Manuscript.

Galloway, Jerry P., *Technology integration: Training, education, indoctrination.* ICTE, 1999. [online: ww2.netnitco.net/users/jpgtma/icte99.htm]

Hall, G. E. and S. M. Hord (1987). *Change in schools: Facilitating the process.* Albany, NY, State University of New York Press.

Hazari, Sunil, I., (1992). Faculty Computer Needs Assessment in Third World Countries. *Journal of Educational Technology Systems,.* vol. 20(4), p. 321-326.

Milken Exchange. (1999) *Professional Competency Continuum: Professional skills for the digital age classroom.* Santa Monica, CA. [online: www.milkenexchange.org]

Resnick, L. B. (1987). "Learning in school and out." *Educational Researcher* 16(9): 12-20.

SCANS - *Secretary's Commission on Achieving Necessary Skills* (1991). What work requires of schools: A SCANS report for America 2000. Washington, D.C., U.S. Department of Labor.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action.* New York, NY, Basic Books.

Seels, B. and Z. Glasgow (1998). *Making Instructional Design Decisions.* Columbus, OH, Prentice/Merril: 231-257.

Smith, Karen L., (2001). *Preparing Faculty for Instructional Technology: From Education to Development to Creative Independence.* [online: www.msg.ucr.edu/it/preparen.html]

Computer Mediated Collaboration in an Academic Setting. An Experience on Web Business Models at the University of Lugano (Switzerland)

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Abstract. A teaching experience merging many collaboration strategies and e-learning activities is presented. It has taken place at the University of Lugano (Switzerland), and involved 33 undergraduate students attending the course "Advanced Enterprise Applications of Information and Communication Technologies" in the Faculty of Communication Sciences. The experience - actually, a role-play - consisted in developing an online course on business models on the web (a course freely available online), and showed how an hybrid approach can help integrate online activities and other academic teaching strategies. The results of this activity are discussed, as well as some ideas for future experiences.

Setting the scene

The Lugano University (USI) was born in 1996 and is the most recent Swiss University and the only one in the Italian speaking part of Switzerland (Koenig 2001).

USI hosts a Faculty of Communication Sciences that offers four different curricula: Mass and new Media Communication, Corporate and Institutional Communication; Technologies for Communication and, since 2000, Communication in Educational Settings. While, at first, degrees were awarded after four years, the University has adopted the 3+2+3 model following the European Union standards (since the academic year 2001-2002). Students come from Switzerland, Italy, and many other countries; their mother tongues are mainly Italian, German, French and English, and courses are taught in Italian as well as in other languages.

This paper presents an experience done during the first semester of the academic year 2000-2001, with students of the fourth year (from the curricula Corporate and Institutional Communication and Technologies for Communication) attending a course called "Advanced Enterprise Applications of Information and Communication Technologies"[3].

Students were supposed to attend lectures and to work in small groups at different projects concerned with the course topic: 11 groups were involved in the project that is now to be presented.

The roles and the play

The exercise consisted in a role play: students pretended to be members of an international consulting agency (one of the top ten in its field), and had to build up an online course for their colleagues junior consultants, in order to make them aware of the many possibilities for (as well as constraints and shortcomings of) online business. Junior consultants attending the course had not to become experts in the field – the company already had those experts: namely all the people involved in the role-play – but only to become capable of understanding, when doing their consulting activity, if there was any room for online business.

The course had to be in Italian, for self study, and all the materials should be covered in not more than 24 hours (three working days). The platform for course delivery had to be WebCT[4], while all the involved groups had to collaborate also using the University's intranet and a tool for online discussions (WebBoard[5]).

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[1] Institute for Communication and Education and Doctoral School NewMinE: New Media in education – www.lu.unisi.ch/newmine.

[2] TEC lab: Technology Enhanced Communication Laboratory – www.lu.unisi.ch/tec-lab.

[3] The course was held by professor Paolo Paolini assisted by Lorenzo Cantoni, who designed and led the experience, and Davide Bolchini.

[4] WebCT Version 3.6 Standard Edition (www.webct.com, last visit: October 2001).

Course developers were divided into three different types of groups: **a.** *management and reporting*: one group of three students, randomly chosen; **b.** *pedagogical design and technical implementation*: two groups of two students each, selected because they were more expert in the use of technologies and had previously attended a course on how to use the WebCT platform; **c.** *content development*: eight groups of three students (randomly chosen) were assigned a different business model according to a taxonomy of Internet business models proposed by Mike Rappa (2000): **1.** Brokerage, **2.** Advertising, **3.** Infomediary, **4.** Merchant, **5.** Manufacturer, **6.** Affiliate, **7.** Community, **8.** Subscription and Utility.

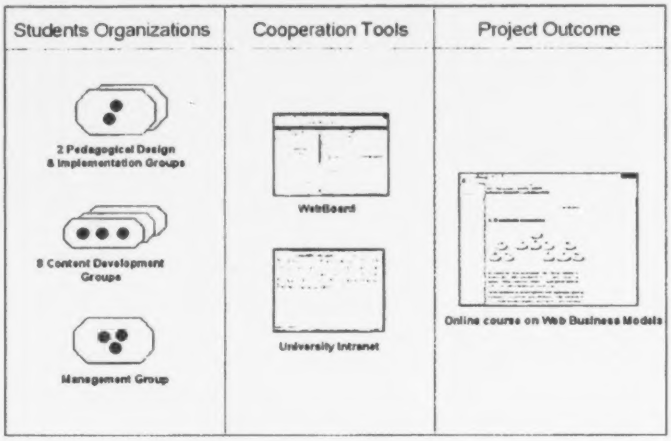

Figure 1: Synoptic of the role-play

Students were briefed during a lecture, they were also given a detailed printed timetable of the exercise, with all the group assignments[6]:

Group/week	week 1	week 2	week 3	week 4	week 5	week 6	week 7	week 8	week 9
Man. & reporting	start	reporting	reporting	reporting	reporting	reporting	reporting	reporting	reporting
ped. design & tech. implem. (1)	start		format guidelines		implementing	implementing	implementing	implementing	prototype
ped. design & tech. implem. (2)	start		format guidelines		implementing	implementing	implementing	implementing	prototype
Content dev. (1)	start			output 1		output 2		output 3	
Content dev. (2)	start			output 1		output 2		output 3	
Content dev. (3)	start			output 1		output 2		output 3	
Content dev. (4)	start			output 1		output 2		output 3	
Content dev. (5)	start			output 1		output 2		output 3	
Content dev. (6)	start			output 1		output 2		output 3	
Content dev. (7)	start			output 1		output 2		output 3	
Content dev. (8)	start			output 1		output 2		output 3	

Group a. was in charge of: supervising and monitoring all the other groups' activities, promoting them, reporting to the *role-play master*, being an interface between him and all the other groups, doing a weekly report of about 5 minutes during course's lectures, defining a suitable conference structure for online communication via WebBoard. The group had also to write a short introduction to the online module, in which the course and Business Models were defined and introduced. Group a. had periodical (usually once a week) meetings with the role-play master.

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[5] WebBoard 4.2, Web Forums & Chat Software (www.chatspace.com/products/webboard/index.cfm, last visit: October 2001).

[6] The exercise started the 30th November 2000 and ended the 8th February 2001; only working weeks are considered in the table.

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Groups b. had to firstly define guidelines for all the content development groups on how to package the materials they had to prepare (e.g. document length, format and style), and to design, implement and test the prototype course.

Groups c. had first to research their specific topics (starting from Rappa's website and looking for relevant literature, both online and offline). Students were asked to perform their research as a kind of webquest (Clarke 1990; Dodge 2001), and select relevant references from the results. Moreover, groups c. had to write a suitable text explaining the features of the assigned business model (output 1). Groups c. had also to deliver a slide show to briefly present the subject, and to write two case studies of online applications implementing the business model (output 2); in addition to that they had to create a self-assessed test that could enable the learners to test their understanding of the contents covered by the module (output 3). All the three outputs were, in turn, input for groups b. All the materials had to be written taking into account that an average learner (a junior consultant, with an experience similar to that of the students) should cover every module in no more than three hours. Each content development group was introduced to the key features of the assigned business models by the *role-play master* in a kick-off meeting. The meeting allowed the group members to acquire the conceptual elements to interpret the large amount of literature available on the theme.

Rehearsing and performing

All the groups worked hard, and produced their output on time. Group a. organized – after some trials – 13 different online conferences on WebBoard: 11 devoted to every group, and used by its members for their internal communication as well as by the management group to post messages to the single groups. The remaining two conferences were titled "General" and "FAQ" and were used by group a. to give general instructions and information, and to sum up organisational topics of common interest. Except for the FAQ conference, with 5 messages, all the others got from 16 to 45 messages (mean value: 28). The number of messages posted on the WebBoard for each conference is shown in Figure 2. Groups b. and c. had to post and update a "state of the art" message on their own conferences, where they summarized weekly what they did *(acta)*, what they were going to do the following week *(agenda)*, and if they needed anything from group a. *(quaerenda)*. The weekly state of the art reported the essential information needed by the management team in order to have an overview on the state of the project and to coordinate and plan the work in parallel of the nine groups. As any of the groups failed to publish the state of the art (or it was too vague and generic), the managers posted a message in the group conference to eagerly solicit to deliver the expected report. People of groups c. interacted very well in each group, but did not show much interest in what the others were doing (anyway, they were informed regularly by group a.). Rich communication flows were established between group a. and all the others, and between groups b. and groups c. Figure 2 shows the number of messages posted within each conference on the WebBoard.

Many communication exchanges took place in the real world: students met almost every day in the university, but at the same time a lot of communication was also carried out via the WebBoard, sometime just summarising what was already said/discussed/decided in face to face communication exchanges (hence making group members sure that they all shared the same knowledge and the same decisions). Besides WebBoard, also email was used for coordination and communication among group members. For file exchanging the university intranet was used: so there were not any upload/download problem for groups b. that implemented and tested all the course.

The online modules showed that students had learned quite a lot, and were able to communicate their knowledge in a format suitable for an online course. Not all students delivered the same quality: some modules were better than others in terms of content accuracy, wording style and rhetoric effectiveness. However, the overall quality of the course was good.

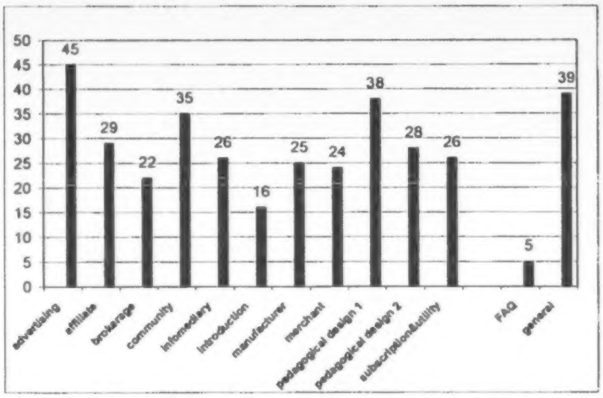
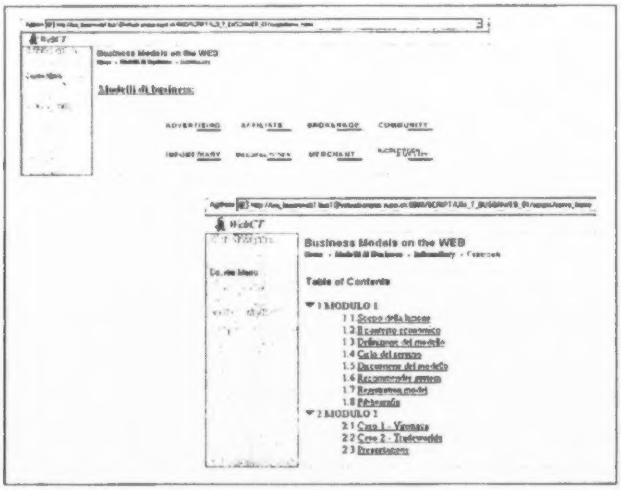


Figure 2: Number of messages posted on the WebBoard for each conference.

Due to the quality of the product, it has been later made freely available online at the following location: www.lu.unisi.ch/tec-lab/courseware.htm. The facility of having the module content both in textual form and in slide-style format turned out to be very fruitful. In fact, the course modules have been effectively reused later for other courses and workshops organized within the Faculty (about online business models and electronic commerce), which needed both slide presentations and text handouts.

The flexible structure of the module allows to learn a business model from different perspectives and according to different levels of depth: the text explains in details the roles and the relations defining an online business model (with its variants and sub-models) pointing out benefits and drawbacks; the case studies illustrated practical implementation of the model in a current web application; the slide show serves mainly for revision.



Business Models on the WEB

Modelli di business

ADVERTISING AFFILIATE BROKERAGE COMMUNITY

INFOMEDIARY [illegible] MERCHANT SUBSCRIPTION

Business Models on the WEB

Table of Contents

1 MODULO 1
1.1 [illegible]
1.2 Il contesto economico
1.3 Definizione del modello
1.4 [illegible]
1.5 Descrizione del modello
1.6 Recommender system
1.7 [illegible]
1.8 Bibliografia
2 MODULO 2
2.1 Caso 1 - [illegible]
2.2 Caso 2 - [illegible]
2.3 Presentazione

Figure 3: Each course module designed by the students is made by four components: the explanation of the business model, a set of references, two case studies and a slide presentation.

Pedagogical considerations and ideas for future experiences

The project allowed the students to learn about online business models by designing and creating an online course on that topic: this was a sort of *loop-input*, i.e. the actual correspondence between the content taught (advanced applications of ICT) and the way it was learned by the students (designing an e-learning activity). The main benefit of the described loop-input strategy is that students could live two kinds of experiences at the same time (collaborating in creating the online modules and learning about online

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business models), both strongly relevant to the core topics of the academic course. The two experiences are strongly correlated and support each other, enhancing the effectiveness of the overall learning experience.

Moreover, this experience helped combine a number of collaboration strategies and technology assisted learning activities: 1. *computer assisted collaboration* (communication exchanges between work groups mainly by means of WebBoard and University intranet); 2. *web-based distributed learning* (the online modules delivered); 3. *meetings and lectures* (between the role-play master and each work group; between work groups and the managers; between work groups and the design groups); 4. *webquests* (for searching the relevant material to be put in the references of the module); 5. *classroom discussions and presentations* (at the end of the project each group presented the work to their colleagues and the academic staff); 6. *a constructivist activity has been merged with academic teaching*, leaving to all "stakeholders" the possibility to contribute as much as they could to the common knowledge; 7. *e-learning activities have been integrated inside a more comprehensive framework*, and not isolated as sometimes happens when adopting the "Manichean" point of view: "face-to-face *vs.* online" (Rowley, Lujan & Dolence 1998; see also Cantoni & Paolini 2001); in particular, 8. also *a lively relation with the professor and the assistants took room as a milestone of the learning experience* (Dufeu 1994).

It could be argued that in a similar organization of the role-play – where the collaboration between groups of students is a necessary condition for the success of the project – the failure of one student group (e.g. no output delivered on time, no communication with other groups, no respect to the management guidelines) could cause the crash of the entire project. Actually, this was not the case: the project organization took into account this possibility. Even if any of the 8 groups of students responsible for the content development had failed, that would have not stopped the project, which would have still delivered a running online course (but with a module missing).

The problem would have been harder if the pedagogical-design and implementation groups had failed the job (other students with similar technological skills were difficult to find). In case of failure of the management group, that could have been replaced by the role-play master.

The robustness of the project organization was due to the fact that the content developers groups could work in parallel because the content modules had minimum or none overlapping.

One year after the end of the course, students who were involved in the project were asked to give their feedback through a simple questionnaire. Among the positive aspects of the project experience, students mentioned that they learned concepts underlying online business models; learned how to use a collaboration tool like WebBoard; combined in practice technology with education; learned how to define precise guidelines for content developers; performed a creative activity; lived a new class experience[7]. Moreover, students appreciated that the members of the management group were colleagues (peers) and not the professor/assistants. Respondents pointed out also weak points of the collaboration experience, such as the fact that some content development groups were not interested in the work of the other groups; on the other hand, intra-group collaboration was evaluated as very effective. Some students said that the time frame of the project was too long with respect to the final result delivered; others claimed that there was not enough time to complete an in-depth reflection and research for the content of the modules.

The questionnaire had seven main questions. Nine students filled in the questionnaire. Following charts (Figure 4 and Figure 5) show the marks expressed by each of the nine students for the two most relevant questions, the first about the perceived effectiveness of the collaboration within the group, and the second about the perceived learning outcome. The scale used was a five points scale measuring the level of agreement (1: *not at all*; 5: *at all*).

Question 1: *Was the collaboration within your group positive and useful?*

Question 2: *Do you think you got a useful insight in the theme of Web Business Models?*

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[7] For the majority of the students involved, it was the first time that they experienced such an innovative project in a class. Only some of the students had experienced something similar (at a smaller scale) at the WebAtelier of the Faculty of Communication Sciences (a web design lab led by Lorenzo Cantoni, www.webatelier.net). Each term, at the WebAtelier a half-dozen web applications are designed and produced by groups of three students. Clients are public and private companies in Switzerland and Italy. While the WebAtelier offers a lively and realistic working experience, the project presented in this paper has two important additional features: it allowed the students to learn about the content of the application (web business models) and to collaborate in a larger project (31 students instead of 3).

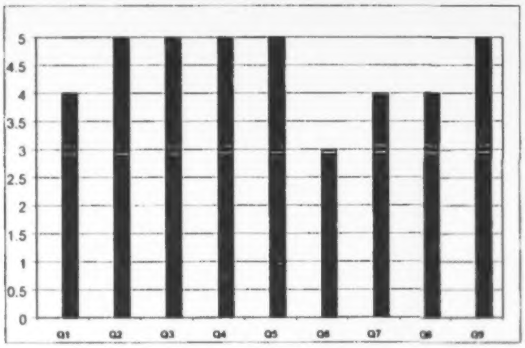

Figure 4: Marks for question 1

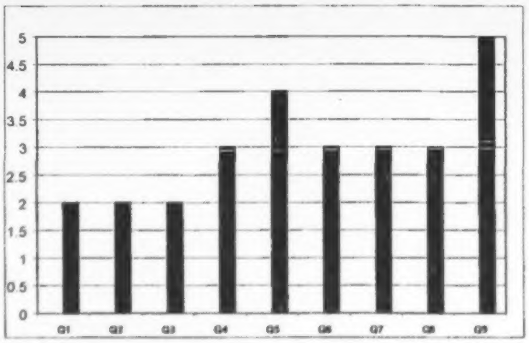

Figure 5: Marks for question 2

In the term starting in November 2002, we would like to perform a similar project. One of the lessons learned from this experience is to select properly the students and assign them to group according to their competence and management ability (instead of randomly). The learning outcome of the class could also be improved in the future by verifying that the pedagogical-design and development groups have enough time to learn the topic of the course, without being overwhelmed by the time-consuming implementation activities.

The project was exciting both for the students – who were committed to the responsibility of coordinating the work and learning the materials for delivering a complete running application – and for the teachers – who could see week after week the success of an innovative educational experience. The counterpart – on the teacher side – was the amount of effort required for the preparation of all the details of the activity (project schedule and possible breakdowns) and the monitoring of the project (managers – who represent the potential weak ring of the chain – had to be followed step by step).

References

Cantoni, Lorenzo & Paolini, Paolo (2001) Hypermedia Analysis: Some Insights from Semiotics and Ancient Rhetoric, «Studies in Communication Sciences», 1: 33-53.

Clarke, J. H. (1990). *Patterns of Thinking: Integrating Learning Skills in Content Teaching.* Allyn and Bacon, Needham Heights (Ma).

Dodge, Bernie (2001) *The WebQuest page,* available at: http://edweb.sdsu.edu/webquest/webquest.html (last visit: November 2001).

Dufeu, Bernard (1994) *Teaching Myself,* Oxford University Press, Oxford.

Koenig, Robert (2001) *Riding Off into an Alpine Sunset-Or Sunrise*, «Science», 293: 1585.

Rappa, Mike (2000) *Managing the Digital Enterprise, an online guide to the literature about e-commerce,* available online: http://digitalenterprise.org (last visit: October 2001).

Rowley, Daniel J., Lujan, Herman D., Dolence, Michael G. (1998) *Strategic Choices for the Academy,* Jossey-Bass, San Francisco (Ca).

A Classification of Document Reuse in Web-based Learning Environments

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Abstract. The last few years, Information and communication technology (ICT) has been introduced in education at a very rapid pace. Large amounts of resources (time and money) are invested in the development of educational resources, to be used in the new learning environments.

Reuse of existing material is often cited as an approach to reduce the investments involved. Several research projects focus on the management of educational content, often by associating metadata to the resources. Research about the reusability of documents is much more rare, because it is much more difficult.

In this paper we report on our research on reusability of educational documents. This is part of a PhD research in the context of ARIADNE. We have investigated different educational environments, focussing on the type of documents that are typically used. We have developed a classification of document use, based on four questions: how, when, who and what.

1. Introduction

One of the main goals in research on learning objects is to enable reuse technically. The focus is often on the development of a management system for educational documents and their metadata. Users can search learning object repositories for relevant content and reuse it in their courses. An example of such a system is the ARIADNE Knowledge Pool System [ARIADNE 2000, Duval et al. 2001].

Enabling reuse technically, however, is only one side of the medal; designing for reuse (i.e. producing reusable documents) is the other. Depending on the context, a document can be more or less reusable for a certain course. Much less attention is paid to this aspect in research.

Reusability aspects can be divided into two different groups.

1. In [Barrit 2000] the CISCO reusable learning object strategy is presented. This strategy focuses on how a typical document should be compiled from smaller units to form a new reusable object.
2. The other issue considers the type of document, its adaptability, teaching style, and so on.

In this paper we report on our preliminary findings on the reusability of educational documents. We consider different didactical contexts and look for properties a document should have to be reusable in that context. In the first section we define the different contexts we consider for study. Then, we look at how documents are reused, by asking four questions about the reuse. How are documents reused, who selects the documents, when are they selected and what is reused?

Reusability is also stronly influenced by the metadata for the documents. Clear and precise metadata helps the instructors to retrieve appropriate documents. In [Cardinaels et al. 2002] we focus on automatic metadata generation for learning objects. In this paper we focus on the documents themselves.

2. Pedagogical Environments and Approaches

In [Janssens et al. 2000] three different learning environments are described that are applicable for different learning goals. A learning environment defines how the content is handed to the learners and how those learners can reach the goals of the course, based on their knowledge and possibilities. In each environment, the teacher can choose between different approaches, depending on his preferences and the goals of the course. In this section, we briefly discuss the different environments and approaches.

1. The first environment is an **information** environment. In this environment, the focus in on providing external or new information to the learner. The learner should process this information, by memorising it, giving it a meaning or applying it in other situations

   The pedagogical approaches for this environment depend on how the information is provided to the learner, which medium is used to 'store' the information. The authors distinguish between five work forms for this environment:

      i. lectures,

   ii. written material,
   iii. video and documentaries,
   iv. hypertext and hypermedia,
   v. world wide web.

In our discussion the distinction between written material, video and computer-based material isn't important. This kind of environment mostly relies on so-called 'expositive' learning objects [LOM 2001].

2. The second environment is an **interaction** environment. Here the learners interact with each other, with the teacher or computer programs. The result not only depends on the individual learner and his activities, but mainly on the cooperation with the environment. It isn't important whether the interaction is issued using some medium or not. Janssens distinguishes between the following pedagogical approaches:
   i. discussion,
   ii. computer-supported education,
   iii. collaborative work,
   iv. computer-supported collaborative work,
   v. internet-supported collaborative work.

   Document reuse in the last three forms is minimal, mainly giving an exercise to the learners. From our point of view, we can group these forms together with the first work form, discussion.

3. The third environment is the **action** environment. Its goal is to train cognitive skills of the learners. As in the interaction environment, the emphasis is on active participation, the initiative, however, must mainly come from the learner himself. This means that the learner works mainly individually and he guides the learning process himself. Typical work forms for this environment are:
   i. assignments,
   ii. simulations,
   iii. computers as a tool.

   This kind of environment mainly relies on so-called 'active' learning objects [LOM].

3. Characteristics of Document Reuse

In this section, we look at the different environments and investigate how documents are reused. This will help us to define characteristics for the reusability of documents in a specific context. We consider four questions about the reuse of documents:

1. *Who* selects the documents that will be used?
2. *When* is the selection performed?
3. *Which types* of documents are reused?
4. *How* are the documents reused?

In question (1) we distinguish between *automatic* reuse and *manual* reuse. An automatic reuse system is a computer-based environment in which the computer selects the documents automatically from a pool or repository. This selection can be based on the learner's capabilities (as in a learner model) or on prescriptions provided by the instructor (as in a pedagogical model). With manual reuse, the instructor selects the documents manually from the pool.

The main difference for reuse requirements on learning objects relates to the descriptions, i.e. the metadata. An instructor performing manual selection can both examine the document contents and interpret the metadata; a computer application can only look at formally provided metadata. Of course intelligent document analysers could study the content itself but it is very difficult to interpret the difficulty of the document, the time it takes to study it, and so on.

Note that manual reuse often takes place without explicit use of a reuse system. We call this silent reuse. The World Wide Web is a practical resource for demonstrations, simulations and so on. These are made available for internet users and can easily be reused in courses. This type of reuse is opposed to explicit reuse through reuse systems. Of course, storing documents for explicit reuse facilitates searching, retrieving and using documents. Explicit reuse enables specific queries with pedagogical metadata parameters [Duval et al. 2001, Duval et al. 2000].

In question (2), we focus on when the documents are selected for reuse, or, more specifically, when the decision to (re-)use a certain document is taken. Again, we recognize two extreme situations. The first is an a-priori selection of documents. This means that all documents are selected before the start of the course, or at least before the system knows about the learners. In the other extreme the documents are selected at runtime, just in time to be displayed to the learner. In the latter situation, the system, being a computer application or the teacher, can consider knowledge about the learners to select the appropriate documents.

The third question asks about the type of documents that are reused. Are the documents always rather large, like a slide set, or a complete textbook? Or are the documents very small, handling one specific topic. An example of such small documents can be found in a questionnaire system in which single questions are selected to compile a test.

The last question, but maybe the most important one for the reusability aspect, is about how documents are reused. From the point of view of the re-user, the easiest and most powerful reuse type is *as-is*. In this approach, the document is retrieved and integrated in the course without any modifications. More likely, however, is reuse with some degree of modification. Such modifications can range from technical adjustments, for example changing the background colour, to semantical changes like changing the vocabulary (e.g. mathematical symbols).
Another form of reuse that is applied often is *based-on* or *indirect* reuse. With this term, we indicate the creation of new documents that are based on other documents. From the reuse perspective this reuse probably is mostly overlooked, but it certainly is reuse. To create a learning object. several such objects are consulted (cfr. the bibliography in texts) to compose a new document fulfilling the needs for that specific course.
Why a certain document is reused, with or without modifications, or only as a source of inspiration, also depends on didactical aspects and the learners. Considering the knowledge of a group of learners, a document can be appropriate to use. For another group the same document, in the same didactical context might not be suited for reuse directly. Maybe the document should be extended with more examples, or can be summarized to a denser document.

4. Document Reuse in Different Environments

In this section, we combine the knowledge about the different learning environments and pedagogical approaches with the different types of reuse. For each pedagogical approach, we indicate the most likely types of reuse for the four questions. Table 1 depicts the result of this exercise.

	Who?	When?	What?	How?
Information environments				
Lectures	instructor	a priori	(fairly) large	based-on
'Written' material	instructor	a priori	Small or large	based-on or as is
Interaction environments				
Discussion	Instructor/learner	at runtime	small	based on
Computer-supported education	system	at runtime	small	as is
Action environments				
Assignments	instructor	at runtime	small	based on
Computer as a tool	system	at runtime	small	as is

Table 1: Document use in different educational environments and work forms

We now discuss some of these pedagogical approaches, through specific examples. The different pedagogical approaches we describe are:

- Ex cathedra lectures
- Intelligent Tutoring Systems
- Questionnaire systems

Of course, these three are only examples to clarify the questions asked above.

1. With ex cathedra lectures we refer to the more traditional teaching environment, in which the teacher explains theory. The learners mainly listen to the teacher and follow in their textbook or presentation slides, making notes where necessary. This pedagogical approach in fact is a combination of lectures and written documents.

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For the lectures, the instructor typically selects a textbook before the beginning of the course and uses this as a basis. Examples, definitions, etc. are taken from the book and used without serious modifications. Other reference material is being used as a basis for new material. The reuse is thus both "as is" and "based on".

The handouts and other material that students receive are mostly directly related to the lectures. So, these documents are also created from base material and other modified documents.

All the material is selected before the start of a course, or at least without knowing much about the learners.

2. Research on reuse in intelligent tutoring system (ITS) mainly focuses on reuse of active modules or program modules to make the system intelligent and adaptive to the learners [Sarti et al. 1995]. Our interest goes to the reuse of the documents. One of the main problems in adaptive systems is the amount of material that is needed to serve all the different learners. Each learner at each moment in time should receive a document that is suited for his knowledge about the topic at hand, his learning style, etc. The document pool in these systems must contain a large set of learning objects to be effective.

   The adaptation to the learners in an ITS is performed by the system itself. As a consequence, the system must choose the documents presented. The system selects the document at runtime, based on information it gathered previously. Of course a system cannot change much to a document, except for maybe layout and ordering in specific applications; this implies a literal or as is reuse.
3. The third system we briefly describe is a questionnaire system. In such systems, a template for questionnaires (exams, multiple choice questions...) is defined by the instructor and the system instantiates it with questions. These questions are selected from a repository and used without modification (except maybe for layout changes).

5. Conclusions and Further Work

In this paper, we presented the preliminary findings of our research on reusable learning objects. Our point of interest is not so much how documents can be reused, but mainly how it can be ensured that a certain document is reusable in a specific course. A developer only benefits from the reuse if it doesn't cost (in time, money, etc.) more to adapt and reuse a document than to create it from scratch. Unfortunately, reusabilitydepends on a multitude of parameters, such as the pedagogical approach, the system being used, the information known about the learners, and so on.

We started with an analysis of different didactical environments and pedagogical approaches. For each environment, we asked who selects the documents, when the documents are selected, how they are reused and what type of documents is reused. Most courses in this environment are guided self-study courses, with a mixture of lectures and on-line resources.

Clearly, this research is only at the beginning and many questions remain unanswered at this moment. Topics we will consider in further research are guidelines for building courseware, extensions of the LOM metadata for reusability aspects, style checkers for on-line courses concerning their consistency (audience consistency, presentation consistency...).

Looking at the interest for learning object 'pools', we can conclude, however, that there clearly is a need and demand for reusable courseware. Enabling search and retrieval through metadata is only a small step towards reuse.

6. References

[El Saddik et al. 2001] A. El Saddik, S. Fischer, and R. Steinmetz, *Reusability and Adaptability of Interactive Resources In Web-Based Educational Systems*, ACM Journal of Educational Resources in Computing, Vol. 1. No. 1, 19 pages, 2001.

[ARIADNE] http://www.ariadne-eu.org.

[Barritt 2000] C. Barritt, and D. Lewis, Reusable Learning Objects, Definition, Creation Process, and Guidelines for Building, CISCO Systems Inc., 2000, http://www.cisco.com/warp/public/10/wwtraining/elearning/learn/whitepaper_docs/rlo_strategy_v3-1.pdf.

[Cardinaels et al. 2002] K. Cardinaels, E. Duval, H. Olivié, *Issues in Automatic Learning Object Indexation*, ED-MEDIA, World Conference on Education Multimedia, Hypermedia & Telecommunications, Denver, Colorado, June 24-29, 2002, accepted.

[Duval et al. 2000] E. Duval, E. Vervaet, B. Verhoeven, K. Cardinaels, H. Olivié, E. Forte, F. Haenni, K. Warkentyne, M. Wentland Forte, and F. Simillion, Managing digital educational resources with the ARIADNE metadata system, Metadata and Organizing Educational Resources on the Internet

(J. Greenberg, ed.), Haworth Information Press, New York, 2000, pp. 145-171; see also J. Internet Catalog. 3, 2/3 (2000).

[Duval et al. 2001] E. Duval, E. Forte, K. Cardinaels, B. Verhoeven, R. Van Durm, K. Hendrikx, M Wentland Forte, N. Ebel, M. Macowicz, K. Warkentyne, and F. Haenni, The ARIADNE Knowledge Pool System, Communications of the ACM, May 2001, Vol. 44, Nr. 5. pp.xxx-yyy.

[Janssens et al. 2000] S. Janssens, L. Verschaffel, E. De Corte, J. Elen, J. Lowyck, E. Struyf, J. Van Damme, and R. Vandenberghe, Didactiek in beweging, Wolter Plantyn, ISBN 90 301 7232 0.

[LOM 2001] IEEE Learning Technology Standards Committee (LTSC), Learning Object Metadata Working Group, http://ltsc.ieee.org/wg12/index.html.

[Sarti et al. 1995] L. Sarti, and K. Van Marcke, Reuse in Intelligent Courseware Authoring, AI-ED-95 Workshop on Authoring Shells for Intelligent Tutoring Systems, 6 pages, 1995.

Issues in Automatic Learning Object Indexation

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Abstract: Acquiring a critical mass of pedagogical elements is a condition sine qua non for reuse. One of the main obstacles to attain a large amount of documents is the difficulty in creating associated metadata. Accurate metadata contain a considerable number of attributes. Assigning correct values toeach of these attributes is a tedious task and few users arewilling to invest considerable time to do this. Automatic indexation of learning objects could solve this problem. Furthermore, it could help to create more consistent metadata. In this paper, we discuss several issues for the development of an automated indexation system for IEEE LTSC Learning Object Metadata.

1. Introduction

The success of educational metadata strongly depends on the willingness of teachers, authors or other users to provide their pedagogical documents with accurate metadata. Indexing learning objects, however, is a tedious task and an extra burden. Automatic indexation tools could overcome this problem and increase consistency and quality of metadata. .

In this paper we discuss three different approaches to automatic metadata generation: profile-based indexation (section 2.1), document properties analysis (section 2.2), and similarity search (section 2.3).

In the last section, we briefly discuss a framework for automatic indexationthat combines these three techniques. We are developing the framework in the context of the ARIADNE Knowledge Pool System [Duval et al., 2001].

2. Different Approaches to Automatic Indexation

In this section we discuss three above mentioned approaches for generating metadata about learning objects.

2.1 Profile-based Indexation

With profile-based indexation, information about the author/indexer is used to deduce document properties. The general idea is that different documents of one specific author are often quite similar. An obvious example is the institution that the author works for: this information can be inserted automatically, as it does not vary for most documents.

We are investigating how this profile-based approach can be extended to information about the courses the documents are used in. Quite often, a batch of documents is indexed at once within a same course context. Several properties can be assigned to all these documents. At the beginning of the indexation, the appropriate courseprofile canbe loaded. As an example, while indexing documents about sorting algorithms for a programming course, we can preserve many of the semantic and pedagogical attributes. The concept of the documents can be 'sorting algorithm' and the didactical context can be 'university first cycle'.

2.2 Document Properties Analysis

Most technical metadata attributes can be derived automatically from the *intrinsic* document properties. Obvious examples are file size and name, MIME types, and so on. In most operating systems, all documents have associated metadata, such as the file name, permissions for different classes of users, etc. Specific document types have document specific attributes, which provide more detailed information about the document. We can also declare user-defined attributes for the documents (e.g. typical learning time,...). All these attributes can easily be retrieved and recycled when the document is indexed with Learning Object Metadata.

Many operation systems also support inheritance of document properties through document templates. MS Word and MS PowerPoint documents, for instance, use a document template (.dot or .pot file) for their style definitions. These templates carry metadata (called "properties") also and all the documents based on them inherit those properties. In this manner, we can define a 'course specific' template with the appropriate metadata for attributes like discipline, main concept, didactical context, and so on. All the course documents based on this template inherit these metadata values automatically (see Figure 1). As an example we could have databasecourse.pot and programming.pot file for the slides of two courses, one about databases and another about introduction to programming.

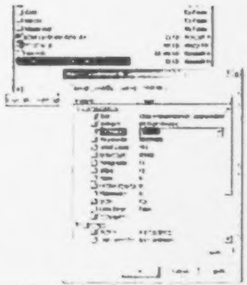
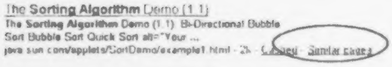


Figure 1: Document Properties for a MS PowerPoint Presentation



The Sorting Algorithm Demo (1.1)
The Sorting Algorithm Demo (1.1) Bi-Directional Bubble
Sort Bubble Sort Quick Sort alt="Your ...
java.sun.com/applets/SortDemo/example1.html - 2k - Cached - Similar pages

Figure 2 : Google search for similar pages

2.3 Similarity Search

A potentially very strong mechanism for automatic indexation is the reuse of existing descriptions when generating metadata for new documents. In the ARIADNE Knowledge Pool System, the indexer can do this manually [Duval et al., 2001], by editing an existing description to create a new one.

Automating this process can be based on similarity search. Similarity search is often implemented in web search engines (see for example GoogleScout from http://www.google.com). These search engines compare web sites and classify them according to an ontology (see http://www.dmoz.org about the open directory project). Each line in the result can be used to query for pages related or similar to the page in that line (Figure 2).

Extending this mechanism allows us to find similar learning objects in the repository and automatically reuse their descriptions to create a new one. The indexation tool creates a summary of the document and searches for matching summaries in the databases. The metadata for the best matching document is reused as the basis for the new metadata.

3. An Indexation Framework

The framework we are developing fits in the ARIADNE Knowledge Pool System (KPS) as an automatic Learning Object Metadata indexation tool. It tries to combine the above-mentioned indexing techniques. A first prototype analyses HTML and MS Word documents.For other document types, only evident attributes – mostly technical values – are extracted. The current version of this tool implements the document properties analysis and profile-based indexation; similarity search is not supported yet.

The result of automatic indexation is a LOM XML instance, which can be inserted into the KPS as a new element. The framework allows easy extensions with new document-specific index classes, which handle one type of documents, for example portable document format (PDF) documents.

4. Conclusions

In this paper, we proposed a combination of three techniques for automatic pedagogical metadata generation. We are convinced that (semi-)automatic indexation can help knowledge pool systems to gather the critical amount of data to be widely useful and used.

The prototype indexation tool and framework we discussed fits in the ARIADNE Knowledge Pool System. The current version of this tool indexes HTML pages and MS Word documents. It can be extended by new indexer classes.

The third methodology of metadata generation, similarity search, must be studied further. In our opinion, this can be very helpful to generate accurate metadata (semi-)automatically.

5. References

[ARIADNE]	http://www.ariadne-eu.org.
[Duval et al., 2001]	Erik Duval, Eddy Forte, Kris Cardinaels, Bart Verhoeven, Rafael Van Durm, Koen Hendrikx, Maria Wentland-Forte, Norbert Ebel, Maciej Macowicz, Ken Warkentyne & Florence Haenni (2001), *The ARIADNE Knowledge Pool System: a Distributed Digital Library for Education*, Communications of the ACM, Vol.44, No.5, pp.73-78, May 2001.
[Jenkins et al. 1999]	C. Jenkins, M. Jackson, P. Burden, and J. Wallis (1999), *Automatic RDF Metadata Generation for Resource Discovery*, Proceedings of the 8th International WWW Conference, Toronto, May 1999.
[LOM]	IEEE P1484.12, Draft Standard for Learning Object Metadata, March 2002, http://ltsc.ieee.org/wg12/

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Towards the Flexible University: Conditions for Change

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Abstract: Considering the take-up of e-learning platforms at Higher Education Institutions(HEI) as an innovation process, it is arguable that HEI have to be themselves re-designed and that innovations promoted at a course level should therefore be articulated within a broader institutional level. This creating conditions for successful re-think the HEI intervention, allowing more flexible operational modes. Focusing in the development of knowledge and understanding about the adoption and use of e-learning systems in HEI, a case study was structured based in an iniciative being launched at a traditional university department. Elements of the environmental, organisational and information system context are identified as key influences of the innovation process.

Introduction

Although it is generally accepted that web-based technologies offer valuable opportunities for innovation in education, their generalized integration in higher education activities is considered to be still relatively incipient (Collis & Pals 2000). There is a great interest in the use of these technologies in education but the uptake has been slow and with very few visible changes (Bates 2001). In order to consider the adoption of distributed learning environments (DLE), based in e-learning platforms in high education institutions (HEI) as an innovation process, it is necessary to contemplate in the first place the need of HEI re-structuring from an organizational point of view, so as to fully exploit the new opportunities offered by these learning technologies (Liber 1999). The innovations promoted at course level should be articulated in a wider institutional viewpoint, leading to a reappraisal of the traditional HEI intervention (Taylor 1998), enhancing the development of more flexible models of operation. The implementation of these technologies implies, as a rule, significant changes in both the innovation and organization (Rogers 1995). Focusing on the contextual and processual elements associated with the action of key players, the technology-based organizational change may be represented through the model adapted from Orlikowski's proposal which points out the interactions between the institutional context and the process of adoption and use of the technology (Orlikowski 1993). Creating conditions for the adoption and use of DLE in HEI can be seen as influenced by the environmental context of HEI operation, from the organizational context and from the DLE specific information system (IS) context. Whereas those conditions themselves will also influence the wider institutional context.

A case study was structured based on an innovation process being launch at the Information Systems Department (DSI) of Minho University - Portugal. Data collection covering the initiation phase of the adoption process included relevant documents, reports, meetings notes, and written communications picked up in the departmental mailing list and other email exchanges. Fourteen DSI leaders and teachers were interviewed following a semi-structured format during 2000/2001. Interviews cover organizational, social, cultural, technological, pedagogical and methodological issues (Fullan 1991). The collected data is being processed using content analysis, which is the main qualitative analysis form applied in this research (Bardin 2000).

Results

From content analysis, the key-concepts associated to institutional change categories (such as environmental, organizational and IS context) which influence the conditions for adopting and use DLE in HEI, were being identified and are presented below (Figure 1).

Shared understanding about the Role of DLE

Technology-based innovation in a HEI organization can be understood as the result of human interaction, as a process where meaning is gradually worked out through discussion, dealing with different arguments and points of view. DLE can be exploited by teachers and by the institution even though with very different goals, implementation speeds and achievements. Building a shared vision and a common understanding of the role technology plays in HEI is certainly a major issue to face. The adoption of a research attitude, along with the design and preparation of demonstration trials proved to be a way to achieve the change desired. Such trials can also contribute to a deeper awareness and understanding of the possible role of e-learning systems. They have allowed DSI to mark "the development of a coherent and mature vision of the use of these products in higher education" and have also facilitated institutional decisions.

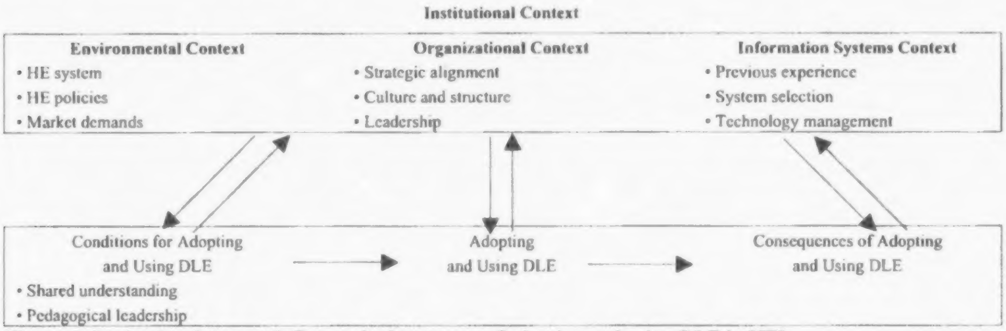
Institutional Context
Environmental Context
• HE system
• HE policies
• Market demands
Organizational Context
• Strategic alignment
• Culture and structure
• Leadership
Information Systems Context
• Previous experience
• System selection
• Technology management
Conditions for Adopting and Using DLE
• Shared understanding
• Pedagogical leadership
Adopting and Using DLE
Consequences of Adopting and Using DLE

Figure 1. Institucional context influence in the process of adopting and using DLE in HEI

Pedagogical Leadership

The discussion concerning the role technologies play in education and HEI development is still very active. This type of innovation will, along with the adoption and use of a new technology in the organization, require a real change in professional practices. With this change happening in the main activity of an organization, even if itself helped to identify and give merit to the decision to innovate, it still is an ambitious goal and a deep change. This is a situation of facing a process of pedagogical re-engineering: course enrichment or redesign (Collis 1997). The competence in defining a policy for the adoption and use of technologies in an uncertain context is a key issue, whether it refers to the evolution of this technology in the market or to more global adoption policies (at a school level, university, national....). In this context, emphasing the pedagogic change which might be involved, and the notion that the department must possess a distributed learning system turn out to be decisive factors.

References

Bardin, L. (2000). *Análise de Conteúdo.* Lisboa: Edições 70.

Bates, T. (2001). The Continuing Evolution of ICT Capacity: The Implications for Education. *The Changing Face of Virtual Education*, Farrell, G. (ed.) COL, 29-46.

Collis, B. (1997). Pedagogical Reengineering: A Pedagogical Approach to Course Enrichment and Redesign With the WWW. *Education Technology Review*, 8, 11-15.

Collis, B. & Pals, N. (2000). A Model for Predicting an Individual's Use of a Telematics Application for a Learning-Related Purpose. *International Jl. of Educational Telecommunications*, 6 (1), 63-103.

Fullan, M. & Stiegelbauer, S. (1991). *The new meaning of educational change.* London: Continuum.

Liber, O. (1999). Structuring institutions to exploit learning technologies: a cybernetic model. *ALT-J*, 6 (1), 13-18.

Orlikowski, W. (1993). CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development. *Management Information Systems Quarterly*, 17 (3), 309-340.

Rogers, E. (1995). *Diffusion of Innovation.* New York: The free press.

Taylor, Peter G. (1998). Institutional change in uncertain times: lone ranging is not enough. *Studies in Higher Education*, 23 (3), 269-79.

Multimedia and Visual learning; build interactive elements for course/syllabus

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Abstract:
At the Faculty Technology Center of Adelphi University, we support and advise faculty in technology-related questions or projects. We offer ongoing workshops on a large variety of topics in educational and instructional technology. The workshop focuses on communicating difficult to explain concepts through a variety of media.

Introduction

Our workshop uses both inductive and deductive pedagogies to build an interactive course/syllabus template for visual learners (Nishikant & Sonwalker,2001). Induction suggests that learners first be introduced to a concept or a target principle using specific examples that pertain to a broader topic. The examples enable learners to develop their own connections between the concept and the examples that confirm the principle. Recommended content and media objects for induction including text, graphics, audio and video. The other learning style is deductive, which is based on stimulating the discernment of trends through the presentation of data, simulation, graphs, charts or other data.

Faculty today are widely required to include online components in their teaching. Developing learning material is time consuming and challenging. A generic template, for interactive course content elements, can be adjusted for the course goals. The template can be used for both the online setting and face to face settings. We will discuss a general educational template that we designed with Flash. Results and data will be provided on how faculty at Adelphi used such an application.
The workshop for designing visual learning material is our first attempt in taking full advantage of the online medium. We first start with building small multimedia elements to be implemented in a media rich adaptive environment.

Brief overview of the workshop

The workshop described here covers four days (six hours a day). We had three instructors and two student Educational Technologists providing information and assistance. We used a five-part framework of vision, design, production, outcomes and analysis. Participants introduced themselves to each other and conveyed their expectations and their goals.
The first day we covered the theory of visualizing data and basic theories of displaying visually difficult concepts (E. R. Tufte 'Envisioning information' Herdeg, 'Herdegs graphics/diagrams').
We used induction to expose the participants to Flash and showed examples and explained what might be possible to exploit with Flash.
We employed hands-on activity with the program to demonstrate the basic elements; symbol, timeline, layers. At the end of the day participants suggests learning elements (concepts) they might want to explain using multimedia elements. Discussion with all participants was initiated.

The second day a brief paper design is made. The theory of design, flowcharts and concept mapping is covered. In the afternoon we started with the first principles of Flash and worked out a small assignment (via a template of 3 layers 1 images and 2 objects).
We discussed how effective templates can be. How precisely templates work to explain the abstraction for all type of learners?

The third day, we discussed their storyboards (at least four screens showing the animation, text and images). We talked about some theory for recording sound and shooting video. In addition copyright issues are pointed out.

We wrote instructions to explain the equipment and software. To record sound, we use the computer Sound recorder. Each participant records at least 1 minute of voice and music via the internal CD player. For shooting video, small personal cameras are handed out.

The assignment for video is to give a brief introduction to each participant's own course they design their visual material for. The assignment is to find a setting and an activity, which demonstrate who or what the person is. Talking heads was discouraged. This gathering of video footage was a collaborative effort; each participant recorded the video of another participant.

At the end of the day in the discussion we talked about the difficulties of recording voice and mixing sound with music, and gathering some good video footage. Producing audio and visual material stimulated ideas about how to present this material in an online class.

Day four started out with participants reflecting on each of the sound and video products. After this general session the participants worked on their animation and brought in sound where needed to support the visual elements. The video clips where treated as 'stand alone' and saved as QuickTime movies.

The animation was saved as a shockwave file for easy delivery via the Internet. All these elements where brought on to a WWW - page and into Blackboard.

These hands on-activities helped communicate the wealth of opportunities for multimedia to enhance the learning experience. The design and development of the combined media components – text, graphic, audio video animation- will eventually depend on the learning model appropriate for the delivery of given course content. This should be covered in a follow up workshop.

Participants feedback

The participants expressed surprise how far they had come in only four days. There was also concern that too much material was covered for that condensed time period.

The workshop has made some faculty aware of breaking up teaching material into smaller units.

The faculty has gained insight into how 'easy' it is to use or develop audio and video and animation. They wanted to continue to build more animation as part of the courses.

Participants find using or having a video camera in the classroom a good idea. They saw how helpful footage might be for reflection on teaching and for backing-up lectures and for lab experiences.

Implementation into Blackboard or WWW-pages was relatively easy but not always without problems.

Our reflection

Templates did not really save time or provide better understanding for programming Flash. A format can be designed in which elements can be placed. But this is more limited than a template.

We suggest incentives for faculty to design their own teaching material.

References:
Edward Tufte, (1990). Envisioning information. Connecticut: Graphic Press.

Herdeg, Walter, (1976). Film & TV graphics 2 : an international survey of film and television graphics. Zurich: The Graphis Press.

Nishikant Sonwalkar (2001). The sharp edge of the cube. *Syllabus* Volume 15, NO 5 *December. 2001.*

S.M. Alessi and S.R. Trollip (2001) Multimedia for learning., Methods and development. Boston: Allyn and Bacon.

URL: *www.freewebtemplates.com*

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On-line AACE Forums: Joining, Participating, and Leading

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Attempts to create and sustain on-line professional communities for teacher education have received considerable attention from the press. Frequently, however, on-line groups do not deliver what on-line users want. We can, with reasonable assurance, identify and nurture those factors that increase the likelihood of sustainable on-line learning community success. These factors fall into four general categories. First, the selection of an *ease of learning* and *ease of use* application permits an adequate default setting to begin operation yet permits users and managers to customize their on-line environment. Second, creation and support of users, moderators, and administrators by providing training and supporting excellent experiences that evolve into an on-line learning culture. Third, both users and managers must believe that content of an on-line group is an added value. Fourth, the effort required to participate in an on-line professional group are worth the added effort.

Most educators will admit that the current state of online groups are not as good as they will become (Vail, 2001) and perhaps view on-line groups as another e-mail like media to be managed (Barmann, personal communication, February, 1993). This perspective is due to educators attempting to fit technology into the traditional world without recognizing how on-line interactions can change and add value to lives. In the professional literature one rarely reads that deeper and different learning can happen in an on-line learning community, but it can.

Educators more commonly read about and subscribe to the popular idea that face to face interactions in a traditional room are the ideal. In traditional interactions the presenter speaks to the audience. At a conference there is limited interaction and contact over a relatively short time. The use of AACE and SITE professional boards permit and encourage more extensive and longer lasting connections.

Personal interactions involved in face to face learning can be powerful. We must also recognize that an on-line community of collaborating peers where every person sees, discusses, and reacts to thoughts and ideas of individuals within a group can be extremely accommodating related to content, as well as time and distance. Participation in on-line professional groups and a skillful use of technology creates more than just a difference in the way we work. It will provide an ubiquitous on-line learning vehicle, a place to express and develop ideas, and provides us with access to a support group of our peers. Such a community is exceedingly powerful. An on-line learning community can add muscle and flexibility to the learning experience. An on-line learning community has the potential to add value to the learning enterprise.

In a recent welcoming address to MIMIC, the Dean of Cleveland State University, Dr. James McLaughlin said it exactly right when he said:

> "Technology has become such an integral part of my life that I wonder how I did without it. I knew that it would allow me to do my work differently. What I did not realize was how it would change my thought processes, professional identity, and communication frequency and style....
>
> I think differently too. Having information at my fingertips allows me to rely on my memory for other things. I scan for the immediately relevant and otherwise store information away for quick retrieval. I am more prone to think ahead than behind. I seem more adventuresome than before."

Delivered MAY 20,2002
Dr. James McLaughlin, Dean
College of Education
Cleveland State University

Most educators still use technology tangentially as an add-on and are not motivated to use professional on-line groups in their professional lives. They too often continue to perceive the use of technology negatively and an effort without adequate incentives or tangible rewards (Schlager, Fusco, and Schank, 1998). The majority of teacher education faculty still fails to infuse educational technology procedures into their educational curriculum at substantial levels.

The point is that, other than using the web for cheap access to free materials, teacher educators seemingly do not recognize that on-line participation in a professional group is beneficial In many instances, web-based groups and listservs are led by those who have failed to experience sufficient on-line activities to enable them to plan or lead on-line groups. Sometimes there is a failure to continue to maintain the on-line activities once they were launched. Think about this, how often is webpage content out of date? We believe that when faculty have had few or no positive experiences creating and leading an on-line learning community, they seem to retreat toward teaching the way they were taught, that is, without technology (Schlager, Fusco, Schank,1999).

Whether one is an on-line learning community user or leader, success requires the use of an application that is robust and flexible. At AACE and SITE we use software that:

- is easy for all users to learn
- is easy for moderators to learn and manage
- is dependable and requires little maintenance and is secure
- can attach files created with most popular applications
- offers a variety of personalized settings

Examples of personal configuration options include, notification of the creation of new discussion topics being formed in one's favorite areas, subscription to topic threads, hiding topics and conversation areas where one has little interest, and much more.

Many universities use campus-wide software such as WebCT® or WebBoard® as their solution for web-based content. Both of these applications are excellent. This presentation will reference these applications so that users who are familiar with them can understand functionality of AACE's professional boards.

Initially participants may view on-line groups as being unsatisfying and as an isolated activity. This need not be so. The promise of anywhere, anytime connectivity is becoming a reality. When educators are uninitiated into an on-line culture or they have inadequate training and support the tendency is to retreat from the on-line leadership position. Content flows into AACE and SITE forums participants begin to support each other. Everyone is able to see how others think. This brings up an important point to remember, participation in an on-line professional group is not like sending e-mail. Thoughts should be well crafted and often demand thoughtful reading and pithy (responses requiring deliberation, not just yes or no) replies.

The AACE and SITE professional boards represent an agora, what we would call a forum for open discussions. Agora is an ancient Greek term for an open space where citizens come together for public meetings. An agora was first attributed to Homer and connoted both a) the assembly of the people or congregation and 2) the actual physical setting. An agora, much the same as what we would think of as a "commons" was regarded as an ordinary element of their life. Every citizen had a voice. These are similar to the learning communities that AACE and SITE are developing on-line.

On-line learning communities will evolve. One must be careful, however, because there are assassins waiting to kill the on-line learning community. Apathy and non-participation is a dangerous thing. When teachers and administrators fail to gradually acquire on-line management knowledge and skills they limit their ability to understand and develop on-line learning communities. When one uses technology one improves speed and range of collaboration and communication. The use of on-line communication applications also exposes charlatans. Cultural readiness may trump some efforts to form on-line learning communities. In the past we have waited 20 years for a new generation of educational leaders. Today we can not wait. We must work to build the educational culture that will support and value on-line knowledge sharing.

When Thomas Carroll (2000) asked the question, "If we didn't have the schools we have today, would we create the schools we have today" he was really asking us to make something different. An electronic on-line learning community is not business as usual. On-line learning communities permit us to share half thoughts and enlist others in their development. It permits others in on the secret and the private information, and makes the whole process more democratic, in part because I can access so many people so easily (McLaughlin, 2002).

References

Carroll, T. G. (2000). If we didn't have the schools we have today, would we create the schools we have today? *Contemporary Issues in Technology and Teacher Education*, 1 (1).

McLaughlin, J. (2002) *MIMIC WELCOME*, The welcoming speech at MIMIC delivered at Cleveland State University on May 20, 2002.

Schlager, M., Fusco, J. and Schank, P. (1999) Evolution of an On-line Community of Practice. In Renninger, K. A., and Shumar, W. (Eds) Building virtual communities: Learning and change in cyberspace. Cambridge NY: University Press.

Schlager, M., Fusco, J. and Schank, P. (1998) Cornerstones for an On-line Community of Education Professionals. *Technology and Society.* 17 (4).

Vail K. (2001) Online Learning Grows Up: No longer an experiment, virtual schooling is here to stay. September. *Electronic-School.com.* Access: http://www.electronic-school.com

Van Buren, M. E. (1998) Virtual Coffee Klatch. *Technical Training.* September/October, American Society for Research and Development. Alexandria, VA.

Activating Web-Based Learning

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Abstract: Students today expect learning to be linked to the real world and by using active learning strategies we can help students develop those links. Active web-based learning involves the user being engaged in a knowledge-building, skill-building, or attitude-changing task, and being required to meaningfully and overtly interact with instructional content. This brief paper explores the idea of active learning on the web and examines some good examples of web resources that incorporate basic principles of active learning.

Active Learning

> The test of a good teacher … is, "Do you regard 'learning' as a noun or a verb?" If as a noun, as a thing to be possessed and passed along, then you present your truths, neatly packaged to your students. But if you see "learning" as a verb[,] the process is different. The good teacher has learning, but tries to instill in students the desire to learn, and demonstrates the ways one goes about "learning" (Schorske, cited in McCleery 1986, p. 106).

Schorske invokes the argument that "good" teachers use active, not passive, processes to encourage learning. This brief paper explores the idea of active learning on the web and examines some good examples of web resources that incorporate basic principles of active learning.

Many, if not most, faculty members have an intuitive understanding of the term "active learning," but have difficulty defining it. This leads to general agreement over the *need* for active learning, but ambiguity and confusion over *how* to make this part of our instruction. For most of us, active learning means learner involvement with both the instructional content and learning processes. Logically, this implies that any type of interaction between the learner and the instructional content indicates active learning. Yet traditionalists choose "passive" activities such as listening to deliver instructional content, asserting that test grades "prove" that learning has taken place. Students can learn from teachers who use passive strategies – they have been doing so for years. Listening to lectures is probably the way most of us spent the majority of our time as students in various classrooms. How can we respond to this argument?

Learning strategies form a continuum from passive through active. While each endpoint is useful and has value in different situations, we also agree with Bonwell and Eison (1991) that in active learning

- Information transfer is less important than skill building,
- Higher-order thinking skills (problem solving, cognitive strategies) are emphasized,
- Students pursue activities that involve doing something more than listening, and
- Students' exploration of their own attitudes and values are emphasized.

Examples Of Web-Based Active Learning Sites

It should be an easy task to find numerous examples of active learning sites on the web. However, it is difficult to find truly interactive, learning sites. Our operational definition for active web-based learning is that the user has to be engaged in

- a knowledge-building, skill-building, or attitude-changing task, and
- during the usual course of the task the learner must be required to meaningfully and overtly interact with instructional content.

We also consider the core techniques Silberman suggests: team-building, on-the-spot assessment and immediate learning involvement. (1996, p. xi)

A look at the web revealed many excellent learning aids, but few active learning sites. Most of the sites that we classified as useful for instruction came in the form of web-based books. These sites were usually colorful, content-rich, interesting, well organized, and focused, but lacked any feature that would require to learner to interact with the content short of clicking "next" or choosing from a pull-down menu. Another common site layout was a question bank or test on a particular subject area. The third type of site that we found was one that promised to be useful and. Unfortunately, many of the truly interactive sites were fee based. Some had part of their content available (and we used some of these sites as examples) so we could see the added value of the active instruction. What follows is a compendium of sites that exemplify active learning principles.

Sprocketworks (http://www.sprocketworks.com/) showcases games and other instructional resources designed with Shockwave. Categories include space, music, U.S. history, flight, horses, chemistry, birds, ships and oceans. While some of the games are strictly knowledge level (ocean trivia, for example) others do build problem-solving skills in a creative an interactive way.

A. Pintura: Art Detective (http://www.eduweb.com/pintura/) is an online game about art history and art composition designed for fourth grade and up. In the game, you play a 1940's noir detective with a degree in art history. In it, a distraught woman asks you to identify the artist who made a painting she found in her grandfather's attic. To do so, you must examine paintings by famous artists from Gauguin to Van Gogh. Each example highlights an art concept such as composition, style or subject.

Learn Spanish (http://www.studyspanish.com/) is a site designed to complement an audio CD series. This free online tutorial currently covers over 50 separate topics, including written and oral exercises and an automatic, free grading service. Also available is a vocabulary builder with interactive games, Cultural Notes for Spanish-speaking countries, a text and web translator, and other interesting and useful features.

Visual Calculus (http://archives.math.utk.edu/visual.calculus/) is a collection of tutorial modules that can be used to review or teach calculus. Examples abound in this NAWEB 99 winner in the single course category. NAWEB annually honors outstanding achievement in the field of web-based instruction. One of the problems associated with this site is the requirement to have a specific (and quirky) plug-in loaded. It may not be for everybody.

Biology Labs On-Line (http://vcourseware.sonoma.edu/) is a series of twelve (12) different inquiry-based, interactive labs designed for college and AP high school students. This is a diverse collection of labs that cover many different subjects in the biology field. All of these labs are subscription based. A free 3day trial subscription is available.

Who Killed William Robinson? Race, Justice and Settling the Land (http://web.uvic.ca/history-robinson/indexmsn.html) is an invitation to students to solve an 1868 murder by examining the archival records relating to the death of William Robinson, a Black American murdered in the British Colony of British Columbia. In seeking the real murderer site-users will come to terms with racism, (in)justice and patterns of land settlement in the colonial world.

Conclusion

The web is a great resource. It is simple to present information to students. But, learning involves more than just the presentation of information to students – it involves the student interacting with the information in such a way that the information becomes a part of his knowledge structure. As teachers, we are charged with the responsibility with designing and developing these knowledge systems – systems that encourage active participation of the student. The preceding examples provide models of good, web-based active learning sites.

References

Bonwell, C. C. & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom.* ASHE-ERIC Higher Education Report No. 1. Washington, DC: The George Washington University School of Education and Human Development.

McCleery, W. (1986). *Conversations on the Character of Princeton.* Princeton, NJ: Princeton University Press.

Silberman, M. (1996). *Active learning: 101 strategies to teach any subject.* Boston: Allyn & Bacon.

Introduction to Educational Computer Technology: Evaluating a first phase of a Distance Learning Program in Brazil

The Government of Rio de Janeiro, through the Secretariat of Science and Technology -SECT - created the Center of Distance Learning of Rio de Janeiro – CEDERJ, coordinated by the SECT. The CEDERJ is a consortium of the six public universities of Rio de Janeiro (UERJ, UNIRIO, UENF, UFRJ, UFF e UFRRJ.The aims of CEDERJ are: (a) to contribute to the spread of public higher education among municipalities in the interior of the state of Rio de Janeiro; (b) to foment the access to higher education of those that cannot study in the traditional schedules; (c) to act on continuing education programs, with special attention to teachers of the public education schools using distance learning mode; and (d) to increase the offer of vacancies in undergraduate and masters courses in the State. There is a technical and pedagogical staff that is in charge of elaborating different support material for the web, printing, and video. This staff is also responsible for the evaluation process.

A homepage (www.educacaopublica.rj.gov.br) elaborated and maintained by our team is a place for teachers to get information about courses and workshops, to play author role writing articles, relating their experience and interact with other teachers to discuss teaching and learning processes.

Regarding one of the CEDERJ aims, to offer teacher professional development courses and workshops, we will present an analysis of one educational computer technology course. The purpose is to evaluate aspects such as interactivity, student autonomy, and student cooperative work in a program based on a constructivist approach. Participants were 23 teachers from different subjects, teaching in public middle and high schools in Niterói, Rio de Janeiro. The teachers/professors who implemented this course were members of the CEDERJ staff. They planned the course and all resource material to be used.

The Course

The course was developed by a multidisciplinary team: educators, designers, programmers, illustrators and editors. The lessons dealt with hands-on activities to develop basic computer skills. For many of the participant teachers, the face-to-face phase, focus of this paper, was a unique opportunity for handling a computer. The topics discussed included the Windows environment, using the Internet, registering an e-mail account, using a text editor, and participating in educational chats and forum. To better achieve our goals, instead of just telling the teacher/students what to do, all the tasks were always initiated with a challenging question and not with an explanation. It was a 20 hour-course, divided in five meetings.

The Didactic Material

The didactic material included: material to be used by teachers or future tutors, printed material for participants and a CD-Rom with programs and a navigation simulator to be used in the computers if any problem emerged with the machines during the meetings.

Teachers in (inter) action

The participants worked in pairs, attending Vygotsky's theory about knowledge production. They registered their findings, suggestions and critiques in a daily log, written at the end of a meeting using the WordPad.

The advantage of using a collaborative/cooperative learning approach is to promote a reflection not only upon an individual work but also on the group production. Students come to view their peers not as competitors but as resources. Mutual tutoring, a sense of shared progress and shared goals, and a feeling of teamwork are the natural outcomes of cooperative problem-solving, and these processes have been shown to produce substantial advances in learning.The teacher served as a guide, rather than the source of knowledge. The teacher was there to organize and to assist the participants while they take the initiative of their self-directed explorations, instead of directing their learning autocratically. Flexibility was the most important feature of teacher's role in such environment. Sharing their findings allows teachers and participants to reflect upon their actions and to recognize all contributions as valid ones. It was important to reassure their self-confidence and moreover to develop a new attitude.

Evaluating this course

Our goal was to evaluate this course, to do so it was important to find a model that helped us to identify indicators to be used in future evaluations. We found out that the conflict between quantitative and qualitative analysis relies more on the nature of the goals than in a natural cause.

A particular method, illuminative evaluation, is now being widely used in the U.K. for evaluating human-computer interaction and computer-assisted learning. Illuminative evaluation approach, first outlined by Parlett and Hamilton, addressed the question of using scientific quantitative approaches to educational evaluation without regarding specificities of each research field. Our investigation matches the suggestions of Parlett and Hamilton (1972) to embrace a more qualitative approach.

> "... to study the innovatory programme: how it operates; how it is influenced by the various school situations in which it is applied; what those most directly concerned regard as its advantages and disadvantages; and how students' intellectual tasks and academic experiences are most affected. It aims to discover and document what it is like to be participating in the scheme, whether as teacher or pupil; and, in addition, to discern and discuss the innovation's most significant features, recurring concomitants and critical processes. In short it seeks to illuminate a complex array of questions: ..."

Observation was one of the main methods of collecting data and was especially useful during the early 'immersion' period. The teachers/investigators and researches built up a continuous record of events that were considered important for this study taking care to not underestimate events that could also bring lights to this study. Discussions between participants are recorded, and great attention was on language conventions, slang, jargon, and metaphors that characterize conversations, as well as in written materials as logs or e-mail messages. It revealed tacit assumptions, interpersonal relationships and status differentials. Also, we were very careful while analyzing data in order to triangulate or cross check data analysis.

Evaluation and analysis were done in a daily basis as mentioned before. After the 20 hour course we had collected data from participants log and e-mail messages, and we needed to categorize the indicators in order to organize them according to their nature. We will present and discuss each of the indicators: (1) cooperative work; (2) autonomy; (3) viability of the course; and (4) Interaction.

In summary, teachers acted as participant observers and appraisers immersed in the context with two specific purposes: to better understand different aspects of course impact; and then to extract considered tracks for future change or continuance of the program course. The procedure steps were: (a) All the impact indicators were registered (b) Impact evidences were selected, then (c) Final analysis was undertaken and generated a discussion study group that is still in the process of planning future courses.

Analysis and Partial Outcomes - Regarding the course content and pedagogy

The group chosen for this study was quite heterogeneous and some of the participants had attended other courses. Eighteen of them had computers at home, three of those used computer a few times to type a text; only six considered themselves as not so regular users; and the others had never used a personal computer before beginning this course. They were quite unanimous when expressed their impressions of the first meeting, in their words "it is a first time I have the experience of learning the basics".

Participants who had difficulties handling the mouse in the first days were encouraged to play solitaire or free cell before class started. And by the end of the week they were so skilled in using a mouse, they almost forgot their initial difficulties. Finally they were comfortable with that new technology and above all thinking about using it pedagogically in their daily routine.

Looking forward

It is fundamental in planning educational computer technology courses to think about partnership instead of the traditional mode. When participants are not treated as empty vases but as authors of their learning and knowledge production they feel confident in establishing goals for significant changes in their praxis.

This evaluation revealed that regarding our country peculiarities it is necessary to have a face-to-face phase before a Distance Education course. To refer to one crucial point, most of the in-service teachers were not exposed to any computer technology in their undergraduate education and as we mentioned before even those who have, now a day, a personal computer do not know how to use it. Therefore it was and still is important to demystify the use of those machines in a course that helps participants to develop autonomy, self-confidence and consequently desire to continue learning.

References

Parlett, M.R.(1990). Illuminative evaluation. In Walberg,H.L. et al.The Internatiohnal Encciclopedia of Educational Evaluation. Oxford: Pergamon Press.

Vygotsky,L.S. (1998). A formação social da mente. São Paulo: Martins Fontes.

Instigating Cultural Change Via Targeted Initiatives in a Research-led University

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Abstract: Although the potential exists to transform higher education through the impact of technology founded on pedagogy, many attempts have met with mixed success because of the fundamental premise that academics have to be intimately involved with the selection and control of their course. The "control issue" argument that is being presented here is that the key to successful integration of digital technologies into the curriculum is by empowering the academics themselves rather than provide some turnkey development service. This paper describes the challenges faced in Trinity College Dublin, a research-led institution and highlights the experience over three years of target initiatives in a research-led university.

Introduction

Many universities worldwide have a reputation based on research excellence, publications and research achievements. In addition to research, teaching and learning are seen to be vitally important. Now there is a powerful new force entering the picture, namely digital technology. Technology is impacting higher education, stirring up debate, and is beginning to restructure the learning-scape. Today higher education finds itself in the midst of an increasingly globally market-driven new economy, along with rapid social transformations while dealing with the impact of technologies. Given changing student demographics, rising costs, overcrowding, faculty shortages, increased accountability, and other external factors, universities are re-examining their long-standing values and practices in order to find ways in which to meet these challenges successfully (Van Dusen, 1997). The debate over digital technologies and meeting these challenges, is causing a paradigm shift by moving higher education away from an educator-centric environment toward a more learner-centric educational environment presenting even further challenges to educators in acquiring the necessary skills and competencies related to technology and pedagogy. In the not too distant future, institutions that are integrating technology successfully to improve teaching and learning, as well as research will be seen as more dynamic and effective than their less-engaged competitors (Newman & Scurry, 2001).

Strategies for E-learning Integration

Cultural change is required for colleges and universities to be successful in harnessing the power of digital technologies in ways that capitalize on what we know about how students learn, that

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they learn more when they are actively engaged in self-driven rather than passive learning activities (Newman & Scurry 2001 & Lim, 2001). One can consider cultural change at three levels, academic, organisational structure, and external influences. When developing policies and solutions these levels need to have representation across college.

We believe that one of the first places to start is at the academic level. Some of the key factors for instigating change at this level include: identifying early adopters, increasing awareness; providing professional development and incentives (e.g. monetary, time off, recognition); emphasizing pedagogy over technology; ensuring technical support and sustaining this cultural change. Secondly, cultural change is dependent upon the organizational structure. Goals of the university must include harnessing the power of technology to improve teaching and learning. The organization must support this by restructuring to some extent if necessary. Integrating with existing college services is critical. A combined top-down and bottom-up approach is essential. Thirdly external influences must be considered such as the shift from local markets toward a global economy; an increase in the demand for quality assessment; and the growing and changing role the government in higher education.

Case Study

At Trinity College Dublin (TCD), the University Council and Board established the Centre for Learning Technology as a joint initiative involving College Academics, Staff Development Office and Information Systems Services which is responsible for supporting academic staff instigating & developing innovations in teaching and learning with Information and Communication Technology. The Centre's objectives are to support e-learning across College by: supporting numerous (six monthly) e-learning projects in all departments; providing consultancy services for e-learning initiatives in TCD courses; and hosting seminars, workshops and courses in e-learning pedagogy & technical skills. One major lesson learned from the Centre's successful initiatives is that a holistic, pedagogically led approach to enhancing learning with digital technologies is required and that it is essential to integrate it within the university's academic community and organisational infrastructure.

Some successful strategies for providing support identified here at Trinity College Dublin over the past three years include: integrating services; emphasizing pedagogy over technology; identifying early adopters; providing high quality professional development and incentives (e.g. monetary or time off); increasing awareness in incorporating research for publication; facilitating knowledge building and sharing; ensuring recognition and support by college body; and providing technical/pedagogical support.

References

Howland, J. & Mayer, C. (2000). Tools of Innovation: Supporting Change Through Online Web Solutions. *WebNet World Conference Proceedings.* pp. 517-22.

Lim G. (2001). *A Framework for Integrating Technologies in Teaching & Learning*. The 12th International Conference of Society for Information Technology & Teacher Education, SITE, March 2001, Florida, USA.

Newman, F. & Scurry, J. (2001). Higher Education in the Digital Rapids. *The Futures Project: Policy for Higher Education in a Changing World*, Brown University. Retrieved 19 March 2002 http://www.futuresproject.org/publications/digitalrapidsreport1.pdf

Rogers, P. L. (2001). Traditions to Transformations: The Forced Evolution of Higher Education, *Educational Technology Review* Vol. 9, No. 1. Retrieved March 26 2002 from: http://www.aace.org/pubs/etr/rogers.cfm

Somekh, B. (1998). Supporting Information and Communication Technology Innovations in Higher Education. *Journal of Information Technology for Teacher Education*, Vol. 7, No. 1.

Van Dusen, G. C. (1997). The Virtual Campus: Technology and Reform in Higher Education. *ERIC Digest*. Retrieved 18 March 2002 from http://www.ed.gov/databases/ERIC_Digests/ed412815.html

Wade, V. P. (1998). Learning And Technology Steering Committee Report, University of Dublin, Trinity College. Retrieved 26 March 2002 from http://www.tcd.ie/CLT/elearning/

Wade, V., Carroll, V., Huntley-Moore, S., O'Rourke, B., Schwienhorst, K., Tangney, B. (2002). E-Learning Sub Committee Report for Working Party on Teaching and Learning, Trinity College Dublin. Retrieved 20 March 2002 from http://www.tcd.ie/CLT/elearning/

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I. Introduction

NASA Langley Research Center and Christopher Newport University (CNU) provide, free to the public, distance learning programs that focus on math, science, and/or technology over a spectrum of education levels from K-adult. The effort started in 1997, and we currently have a suite of five distance-learning programs. We have around 450,000 registered educators and 12.5 million registered students in 60 countries. Partners and affiliates include the American Institute of Aeronautics and Astronautics (AIAA), the Aerospace Education Coordinating Committee (AECC), the Alliance for Community Media, the National Educational Telecommunications Association, Public Broadcasting System (PBS) affiliates, the NASA Learning Technologies Channel, the National Council of Teachers of Mathematics (NCTM), the Council of the Great City Schools, Hampton City Public Schools, Sea World Adventure Parks, Busch Gardens, ePALS.com, and Riverdeep.

II. Major Goals of Distance Learning Programs

Our mission is based on the "Horizon of Learning," a vision for inspiring learning across a continuum of educational experiences. The programs form a continuum of educational experiences for elementary youth through adult learners. The strategic plan for the programs will evolve to reflect evolving national educational needs, changes within NASA, and emerging system initiatives. Plans for each program component include goals, objectives, learning outcomes, and rely on sound business models.

It is well documented that if technology is used properly it can be a powerful partner in education [1]. Our programs employ both advances in information technology and in effective pedagogy to produce a broad range of materials to complement and enhance other educational efforts. Collectively, the goals of the five programs are to increase educational excellence; enhance and enrich the teaching of mathematics, science, and technology; increase scientific and technological literacy; and communicate the results of NASA discovery, exploration, innovation and research.

All pre-college distance learning programs support the national mathematics, science, and technology standards; support K-12 systemic change; involve educators in their development, implementation, and evaluation; and are based on alliances and partnerships.

In addition the programs seek to invoke a sense of geographic, ethnic and cultural diversity by featuring schools from all over the U.S.; schools from urban, suburban, and rural areas; public, private, and religious schools; and schools with large populations of African-American, Asian and Hispanic students.

III. History of Distance Learning Programs

The Office of Education at NASA Langley began its first distance first learning program, NASA CONNECT, in 1997. The second and third programs, NASA Science Files (formerly NASA Why? Files) and NASA's Destination Tomorrow premiered in 2000. The fourth and fifth programs, NASA's Kids Science News Network (KSNN) and NASA LIVE, premiered in 2001. CNU joined the effort in 1999. The programs have won numerous awards for distance learning, videography, and web design.

IV. Description and Methodology for Distance Learning Programs

We define distance learning as "getting people--and often video images of people--into the same electronic space so they can help one another learn," and we provide "a system and process that connects learners with distributed sources"[2]. All the programs are appropriate for one or more of the following national audiences: public, private and parochial schools; home schoolers; girls and boys clubs, colleges and universities, parents, teachers, caregivers, and adult learners.

In this section we discuss the methodologies used to create the various distance learning programs. The broadcast components air nationally on PBS stations and on many Cable Access Channels, but are also available on tape, DVD, and the web.

A. NASA KSNN

Goal: Support national efforts to prepare all children to succeed in mathematics, science, and technology.
Description: NASA's KSNN is a series of 1-minute news breaks and associated web support and activities that uses children to explain to people of all ages specific mathematics, science, technology, and computer science concepts that often address misconceptions. Confronting misconceptions at an early age with the combination of lively, kid-oriented newsbreaks and activities will fit well into the grade 3-5 classrooms. The newsbreaks will get wide visibility as interstitials on Public Television and commercial networks. See the web site at **ksnn.larc.nasa.gov** for more information.
Methodology: We have a pilot program in place at CNU to develop scripts, activities, and web page content for NASA KSNN. Teams of 3-4 students develop scripts, activities, background material and web page content for one of NASA's KSNN newsbreaks as part of their course work and the teams find a content expert for their project at CNU, NASA, Jefferson Lab, or another appropriate institution. Effective communication with 3-5 graders through the video medium is presented in class; students present their newsbreak for video taping and report on the other components. Finally, a committee of CNU and NASA judges selects the best projects each semester for production. Involving pre-service teachers is valuable for their education and introduces them to NASA distance learning programs that they can use in their classrooms.
Student Outcomes: 1) Stimulate interest in and increase understanding of mathematics, science, and technology; 2) correct commonly held mathematics, science, and technology misconceptions; 3) gain awareness of NASA: programs, projects, and facilities; 4) increase scientific and information technology literacy; 5) increase interest of minority and female students in mathematics, science, technology, and NASA; and 6) improve literacy of students who do not use English as their primary language.

B. NASA Science Files (formerly NASA Why? Files)

Goal: The NASA Science Files television broadcast, web site, and educators' guide use Problem-Based Learning (PBL) to help students in grades 3-5 explore topics through scientific inquiry.
Description: This program consists of a series of four, standards-based instructional programs for grades 3-5 that introduce students to science as inquiry, the scientific method, problem-based learning and NASA. Each 60-minute program is divided into four 15-minute "teachable segments" and is supported by a web site and resource-rich teacher guide. See the web site at **scifiles.larc.nasa.gov** for more information.
Methodology: In the television broadcast, the tree house detectives are confronted with real-world problems and are provided with the knowledge and tools to attack the problem. The tree house detectives walk through the problem solving process during the four 15-minute instructional segments, reaching a solution in the final segment. The television broadcast features content experts from NASA and the community with careers requiring problem-solving skills, museum resources, experiments, and classroom activities to help the tree house detectives solve the problem. The web component of the NASA Science Files is the nerve center of the learning experience and contains separate sections for students, educators, and parents. The kids' tree house contains content information, experiments and activities, experts to contact, and a variety of other resources to aid student teams in finding possible solutions to the featured online problem. The design of the site encourages the teams to take on roles and approach solving the online problem as a scientist would. An array of Problem-Based Learning tools (action plan, basic design log, PBL questions, "get up and go", problem board, problem log, reflection journal, scientific investigation log, scientific method flowchart, scientific process log, and web site evaluation) is readily available for them to employ as they research the problem. The web site provides resources and guidance for the team's culminating report and presentation. The educators' area of the site is structured so that essential information is one click away and other information a maximum of three clicks away. It contains an overview of the NASA Science Files television broadcast, web site, and educators' guide and is an excellent starting point for professional development in the area of PBL. PBL instructional tools and strategies, worksheets, classroom activities, and assessment tools can also be found on the site. The educators' guide is designed to augment the television broadcast and can be downloaded from the web site or received in the mail. The guide features segment overviews, program objectives, vocabulary, classroom activities, worksheets, literature and Internet resources, and implementation strategies. A team of elementary school teachers, NASA researchers, and NASA Distance Learning Center staff develops the programs and guides.
Student Outcomes: 1) Increase understanding of Problem-Based Learning and science as inquiry; 2) develop the literacy and technology skills needed to use the Internet for investigation and research; 3) increase scientific and technological literacy; 4) gain awareness of careers requiring problem-solving skills, mathematics and science proficiency, and technology application; 5) view mathematics, science, and technology as a process requiring creativity, critical thinking, and problem-solving skills; 6) gain awareness of NASA: programs, projects, and facilities; and 7) overcome stereotyped beliefs by learning about women and minorities actively involved in challenging engineering and scientific tasks.

C. NASA CONNECT

Goal: Support the integration of mathematics, science, and technology in grades 6-8.
Description: NASA CONNECT establishes the "connection" between the mathematics, science, and technology concepts taught in the classroom and NASA research. Each program consists of a 30 minute broadcast (also available on video tape), a classroom activity, and a web activity, which are supported by a web site and resource-rich teacher guide. See the web site at **connect.larc.nasa.gov** and published articles [3,4] for more information.
Methodology: The three components complement one another and produce a cohesive, flexible unit for classroom use. The broadcast intersperses classes of students from diverse backgrounds and geographical locations doing the classroom and web activities with NASA experts from diverse backgrounds who describe their research and use of mathematics. Two dynamic hosts weave the story together and take the students on an adventure in learning. Throughout the video, the cartoon character Norbert invites the viewers to pause and consider questions on what they are learning. Short animated mathematics activities are featured during the video as reinforcement. The script for the video is produced in conjunction with educators and the scientists featured in the video to be an effective learning experience for middle school students. The activities are developed and tested by educators who provide an overview, connections to national standards, resources, a glossary, a complete description of the activity, and extensions and questions. In practice a teacher would ideally first use the video with the class, next do the classroom activity, and finally act as a facilitator for the web activity. However, teachers often don't have the time for all three components so they are designed as independent units.
Student Outcomes: 1) Make connections between the mathematics, science, and technology taught in their classroom and the real world applications by observing NASA engineers and scientists; 2) increase understanding of mathematics, science, and technology concepts through hands-on and interactive web activities; 3) develop the literacy and technology skills needed to use the Internet for investigation and research; 4) view mathematics, science, and technology as a process requiring creativity, critical thinking, and problem-solving skills; 5) gain awareness of careers requiring problem-solving skills, mathematics and science proficiency, and technology application; 6) gain awareness of NASA: programs, projects, and facilities; and 7) overcome stereotyped beliefs by learning about women and minorities actively involved in challenging engineering and scientific tasks.

D. NASA LIVE

Goal: Increase the understanding of mathematics, science, technology, and NASA among: K-12 students and educators, 13-18 students and faculty, and adult (life long) learners in formal and informal settings.
Description: NASA LIVE consists of a series of synchronous (two-way), interactive videoconferencing sessions designed to communicate NASA Langley research, educational programs and career opportunities to educators and students in grades K-12, grades 13-18, and adult learners. A 30 topic series is currently available on the NASA LIVE web site at **live.larc.nasa.gov**.
Methodology: The programs address the educational need to connect students to real problems and real world applications of mathematics, science, engineering and technology (MSET). Therefore, program topics are chosen based on an educational need to complement university courses relating to MSET as well as aeronautics. After completing the online registration and confirming the presentation date and time, participants (i.e., a NASA researcher with faculty and students) are engaged in an interactive videoconference live from NASA Langley. Each videoconference consists of a 60-minute session divided into a 30-minute presentation, a 20-minute Q&A segment, and a 10-minute overview of educational and professional opportunities.
Outcomes: 1) Stimulate and increase scientific and technological inquiry and literacy; 2) enhance, enrich, and facilitate the learning process; 3) model the effective use and integration of instructional technology; 4) raise awareness of NASA pre-college, college/university, and distance learning programs; 5) gain awareness of NASA: programs, projects, and facilities; 6) increase NASA and university collaboration; 7) increase outreach to the informal education community; 8) increase interest of under-represented groups in mathematics, science, technology, and NASA; 9) improve literacy of students who do not use English as their primary language.

E. NASA's Destination Tomorrow

Goal: Create and heighten the interest of high school students and adult learners in mathematics, science, technology, and NASA.
Description: Destination Tomorrow is a series of five 30-minute nationally aired video programs designed to increase the scientific literacy of educators, parents and lifelong learners. The material is drawn from current research and spin-offs developed at NASA Centers – primarily the NASA Langley Research Center. See the web site at **destination.larc.nasa.gov** for more information.

Methodology: Research, theory and principles of adult learning guide the developers. Topics are chosen to broaden the public's perception of NASA beyond space and flight by discussing less known spin-offs of NASA researchers. The 30-minute show is divided into five 5-minute segments: Behind the Scenes, How It Works, On the Runway, Future/Tech Watch, and Retrospective and two 30-second "Did You Know?" vignettes. Two hosts set the tone of the show and introduce the segments. Individual correspondents cover the segments in depth and interview one or two researchers.

Outcomes: 1) Stimulate and increase scientific and technological inquiry and literacy; 2) enhance, enrich, and facilitate the learning process; 3) gain awareness of NASA: programs, projects, and facilities; 4) interest NASA and university collaboration; 5) increase outreach to the informal education community; 6) increase interest of under-represented groups in mathematics, science, technology, and NASA; 7) improve literacy of students who do not use English as their primary language.

V. Validation and Evaluation of Distance Learning Programs

A. Testing and Evaluation of Activities and Web Site

All NASA CONNECT activities are tested by teachers during a special summer program and during the school year in nearby school systems. During the academic year, focus groups of middle school teachers select three NASA CONNECT programs. The teacher and students are observed by NASA distance learning educators as the teachers use the three program components with their students. The observations, informal discussions, and final evaluation report from the teachers serve as tools to continually improve the program. Activities from other NASA centers are tested by the providers. As part of the NASA Science Files web site development, formative evaluation and usability tests are conducted before and during each season with the help of public and home-based educators in grades 3-5. The results are evaluated and used to improve the usability and structure of the web site. Testing in the development cycle is essential to ensure a quality product.

B. Analysis of Survey Data

NASA CONNECT has been evaluated by surveys sent to registrants for three years and NASA Science Files for one year. Although the original questions have been included each year, new questions have been added to improve the survey. For the NASA CONNECT 1999-2000 season [5], 1000 registrants were selected randomly and 27% of the responses were usable (out of a 34% response rate). A total of 99 questions in 9 categories were asked regarding instructional technology and programming in the classroom. Generally, the respondents agreed that instructional technology has a positive impact on learning, is supported by the administration, and that facilities are available for its use. In particular, they strongly supported web-based activities and would like to see more NASA web activities. The assessment of the NASA CONNECT programs was very positive, with overall ratings ranging from 4.17 to 4.63 on a 5-point Likert scale (compared to 4.09 to 4.61 for the 1998-1999 season [6] and 3.97 to 4.56 for the 2000-2001 season). The videos, lesson guides, classroom activities, web activities, and web site were all very highly rated. The use of the videos ranged from 19% to 44%, lesson guides from 22% to 50%, classroom activities from 18% to 42%, and web activities from 9% to 13%. The low use of NASA web activities is in contradiction with the high ratings for positive impact on learning, availability of technology, and desire for more web activities. The low usage may simply reflect that the web activities are the last in the chain of the NASA CONNECT learning offerings (video, classroom activity, web activity). Further, the three lowest ratings for the NASA web activities were: content easily integrated into curriculum (4.09), able to complete in reasonable time (3.86), and appropriate for my students (4.04). Survey data for NASA Science Files for 2000-2001 have overall ratings from 4.39 to 4.64. Both programs have been given consistently high ratings for their program offerings.

Continental Research Associates (Norfolk, VA) conducted an evaluation of NASA's Destination Tomorrow. The methodology included telephone interviews with 400 (out of 537) managers of cable access television stations across the United States that aired the programs in the 2000-2001 season. Overall, the findings were extremely positive. Significant among the findings were (1) 73.5% of the station managers said that the quality of the programs in the series is "better than average" when compared to other educational programming their station airs; (2) 90.5% indicated the five programs in the 2000-2001 series have been successful in educating people about what NASA Langley does; (3) 64.8% of the stations airing NASA's Destination Tomorrow reported that the programs have been "very well received" by their audience; and (4) about 80% of those television station managers interviewed stated that the information provided by NASA Langley in the five programs is "very credible."

VI. Future Directions

NASA's KSNN is in its first season and the one-minute newsbreaks appear to be on target for programming demand in the grade 3-5 category. Spanish versions of NASA's KSNN programs and web site are complete for the first year and 12 more are planned. Once we have had experience developing the content, we will open up the newsbreaks and web content to a statewide competition. NASA Science Files had a very successful first two seasons and the web page will continue to evolve into a more useful learning center. NASA CONNECT is the most mature of the programs and will continue its present course using the survey results to improve the programs. We are currently streaming some of the video broadcasts from our web site. In the future a complete year's programs (video broadcasts, lesson plans, and web activities) will be collected on one DVD for dissemination. NASA LIVE is in its infancy but promises to be a very useful program for on-demand video conferencing and has already progressed towards including the K-12 audience in the future. The current mode of video conferencing is directly through ISDN connections. In the future we plan to move to web conferencing and increase the number of available topics. Faculty and students will assess the quality of the content, web-based materials, method of delivery, and the presenter by using an online evaluation. NASA's Destination Tomorrow also had a very successful first season and will continue along the same lines to produce quality programs that we plan to market to commercial TV. The 5-minute segments are available in Spanish and on DVD. For all the programs, we will continue to promote dissemination and use of the many learning opportunities for all ages. It is clear that it is important to train teachers in the use of our technology-based activities in general and to promote the use of our web activities. We plan to address the need for training in using technology because of the concern expressed in the educational community [7,8]. We will develop web-based training, including technology training for teachers so that they can to use our program's components effectively in the classroom.

References

1. How People Learn: Brain, Mind, Experience, and School, National Research Council, (National Academy Press, Washington, DC, 1999)
2. Putting the Learning into Distance Learning, B. Filipczak, TRAINING 32, no. 10, pp. 111-118 (October 1995), EJ 511 253.
3. NASA CONNECT: Three Years after the First Broadcast, T. E. Pinelli, K. L. Frank, and M. Waheed, TELECON East Proceedings (Washington, DC, March 3, 2000).
4. New Distance Learning Approaches to Remote Sensing Education, E. J. Prior, T. M. Pinelli, R. M. Starr, S. E. Massenberg, paper presented at the IEEE International Geoscience and Remote Sensing Symposium (July 24-29, 2000, Honolulu, Hawaii).
5. Evaluating the Effectiveness of the 1999-2000 NASA CONNECT Program, T. M. Pinelli and Frank, NASA/TM-2002-211447 (February 2002) Washington, DC: NASA.
6. Evaluating the Effectiveness of the 1998-1999 NASA CONNECT Program, T. M. Pinelli, K. L. Frank, and P. L. House, NASA/TM-2000-210542 (September 2000) Washington, DC: NASA.
7. Technology and Learning, R. Allen, Curriculum Update, Association for Supervision and Curriculum Development (www.ascd.org), Fall 2001.
8. Teachers and Technology, J. Franklin, Curriculum Update, Association for Supervision and Curriculum Development (www.ascd.org), Fall 2001.

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The Evolving Electronic Classroom

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Abstract: Electronic Classrooms have become increasingly common over the past decade. The combination of data projectors, computers, video playback, and a range of ancillary devices have been found useful in a variety of instructional formats, resulting in pressures for more, and with an important institutional cost impact. Simultaneously, faculty recognize that the configuration of 'smart' rooms has a powerful influence on the conduct of instruction. A desire to facilitate collaborative/constructivist learning in such spaces has led Dickinson College and this researcher to devise new models for physical learning spaces, while simultaneously trimming the costs of creating them. This paper presents our developing 'Smart3' (3rd generation) classroom designs, including seminar, mid-sized, and larger spaces. Their rationale, underlying research, and the technological and physical features of these spaces are presented.

A synopsis: The published version of this paper provides a synopsis of the visual and verbal material to be presented at EdMedia 2002.

Background: From their origins twenty or more years ago, 'smart' classrooms have become increasingly routine, are demanded by many faculty, and used quite routinely for a range of tasks. It is necessary to create them expediently and economically, yet have them fulfill all routine demands made by those using them. This researcher and Dickinson College have created processes for the analysis of needs and the creation of class spaces that are much streamlined from our earliest days. This report and the accompanying visual and supporting material (to be found on line at http://www.dickinson.edu/~cavenagh) detail our progress to date.

Dickinson's existing 'smart' classrooms provide a computer, a data projector, and a mixture of other components. Some rooms add more computers for group work, others add enough computers for every student. These exist in several configurations. We also retain a few cart-based and laptop systems for flexibility. Altogether we currently support 66 facilities for a faculty of about 200, and this number is growing. Unfortunately, the distribution of such facilities is very uneven. New buildings are equipped at a 95-100% level, while older structures are at 30-35%. There are pressures to increase support in these older buildings, which actually house a very large number of classrooms. These buildings are predominantly used for humanities and social sciences.

A number of the humanities and social science faculty are very much interested in discussion based teaching with much collaborative/constructivist work, while lecturing is much less common than in the past. They often arrange seating in circular or group configurations and want rooms to be flexible. Conversely, the demands of projection tend to force all learners to face a single screen. Our 'smart' rooms need to flex to meet these demands. Finally, groups quite often give presentations, so we need a means of allowing several students to address a class at once, while using technology.

Needs analysis: Dickinson has conducted a formal analysis of needs using several instruments. The first, a facilities utilization study, was carried out by our Registrar and an architectural consultant. Student and faculty surveys yielded detailed insights into the perceived needs of these groups. Room-request data was analyzed to reveal the spatial and time patterns faculty wished to meet, and in turn led to a renovation of the college's weekly calendar to better utilize slack time periods.

The Smart3 configuration: Many of our older smart classrooms were custom-tailored to meet the demands of specific departments. Gradually, we recognized that their inherent variability made the rooms difficult for others to use. Our policies mandate that all classrooms be available for all courses, so some means to simplify and standardize was clearly necessary. This resulted in a core equipment package to be used in all new construction, and to be provided when replacing older equipment. As this represented our third generation of classrooms, we labeled this core package **Smart3**. The package includes only a computer (Mac or PC), a data projector, a modest sound system, and a combination VCR/CD/DVD player. Much of the equipment is housed in a custom lectern (see photos on web site), which is itself designed to be used either by a faculty member or up to four presenters.

At this writing these components cost in the vicinity of $5500, plus installation, plus any required modifications to the classroom. (Most classrooms are already network equipped, have screens, and adjustable lighting.) We then add other computers, accessories, and furniture as necessary.

The use of a combination VCR/CD/DVD player is an important 'simplifier,' as it requires only a single input to the data projector. The entire operation is controlled by two remotes, one for the projector and one for the player, and the audio package has a simple integrated remote control.

The **Smart3** configuration represents a breakthrough in user convenience, and we have been able to create custom instructions for each classroom by simply cutting and pasting and adding photos of the rooms.

Computer-per-user classrooms are expensive but fairly straightforward. We try to minimize the number of these facilities, and then try to maximize their use. We have explored a number of layouts (see photos on web site), and our most recent room maximized desktop space by using LCD monitors. (Surprisingly, this cost less than using CRTs because of savings in furniture costs.) The costs of multiple computer installations cascade in sometimes surprising ways, such as increased cooling costs, needs for better sound control, and difficult demands on lighting systems. The control of 'sight lines' in such facilities takes particular care and small variations from good design practice can reduce the effectiveness of a room quite significantly. The **Smart3** core components provide an instructor's station.

A fascinating challenge: Groupwork classrooms present our single most interesting challenge and potentially our greatest pedagogical innovation. Making classrooms flexible for different seating configurations restricts both furniture and technology choices. At first glance the use of laptops seems to solve all problems, but our analysis demonstrates that two learners often work badly at a single laptop and three or more face such problems of visibility as to render effective group interaction virtually impossible. Further, moving laptops around within a class is time consuming and places the computers at risk.

This writer has engaged in analysis of group performances when using technology, and this work has resulted in the creation of a range of group workstations with curved fronts that provide eye-to-eye contact among group members, while a large monitor insures good visibility. Distributed around our campus, such stations have repeatedly proved their worth. (This work has been reported previously at EdMedia 2000, Educause 2001, and Educause/Baltimore 2002; see web site for references.) Using this experience as a base, we have redesigned these workstations to be wall-mounted in existing classrooms.
Requiring only 10 inches of classroom depth and having folding desktops, 4-6 such units can be distributed around the periphery of a classroom without consuming too much space. Combined with movable tables and chairs in a classroom, an instructor can change room configurations without prior planning, and so can adapt teaching modes to 'the teachable moment.'

Dickinson's Smart3 model for classroom evolution seeks simplification, reduction of costs, and increased flexibility. Simplification results in additional hidden savings such as reduced training time for users, reduced design time, and reduced construction time. Increased flexibility of rooms means that faculty have greater range for their teaching styles, and like the facilities better. It also means that more faculty can use rooms than was the case when we custom-designed every facility. Finally, our use of analytic instruments means we have a much improved understanding of real needs, and can concentrate our development efforts on rooms where they are most needed.

The particulars shown here meet the needs of one campus, but we feel that the underlying principles we have followed have application at any institution.

(References, images, and supporting information to be found at http://www.dickinson.edu/~cavenagh.)

A Personalized Navigation Tool for Online Listening and Free Browsing: The Glass Engine

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Introduction

The growing popularity of the World Wide Web (WWW) and the competition in electronic commerce has created a need for online product catalogs. The conventional display approach arranges data in multiple pages and sections; users then traverse a hierarchical tree structure to discover the range of products or services that the site offers. Often, users have to navigate within a complex world of classifications and descriptions, making arbitrary decisions without the slightest idea what, if anything, lie at the end of the path. With each choice, users are shut off to perfectly viable options. Furthermore, the experience of traversing multiple paths and viewing many pages may draw users away from the context of the entire product space causing disorientation and distraction. In fact, after security concerns, navigation problems are the second most cited reason for not shopping online and contribute a significant aspect to the users' negative web experience [1]. We argue that it is important to create interfaces that support interactive product browsing on the Web, and promote enjoyable and productive user experiences as e-commerce sites continue to flourish. In this paper, we describe the *Glass Engine*, an innovative single-paged interactive visualization developed at the IBM T J Watson Research Center in conjunction with the composer, Philip Glass. This multi-attribute electronic music catalog invites users to view, browse, and manipulate a large repository of items with common attributes according to their interests and affinities and at their own pace.

Related work

For the past two decades, research has explored the application of interactive graphics and visualization techniques which facilitate the ready comprehension of large information sets. Some of the new visualization techniques include: Tree Maps (Johnson & Shneidermann, 1991) [2], the Perspective Wall (Robertson, Mackinlay, & Card, 1991) [3], Cone Trees (Robertson, Mackinlay, & Card, 1991) [4], Fisheye Views (Furnas, 1981, 1986) [5, 6], and Hyperbolic Browser (Lamping & Rao, 1995 [7]; Munzner et al, 1997) [8]. A number of websites also specifically use a variety of visualization techniques to present large amounts of information online, e.g., "Map of the Market" at Smartmoney.com [9] and the Sony Music web site [10]. Using a rectangular grid of boxes, "Map of the Market" offers a quick view of over 600 stocks. Nevertheless, by using two dimensions to represent a single variable, it does not provide an optimal depiction of multidimensional data. The Sony Music site provides the user with a Thinkmap displaying the links among the themes of songs, which are represented by circles. However, users are not allowed to download or sample the music.

Design rationale

Our project builds on Inselberg's work on the parallel coordinate visualization technique [11] and Ahlberg, Williamson, and Shneiderman's research on the Alphaslider selection tool [12]. In parallel coordinates plots, a vector intersects multiple parallel axes to define a point in n-dimensional space, and multiple vectors representing an array of data points can reveal interesting patterns in the data. One of the goals for our multi-attribute online catalog is to address the problem of multiple look-ups. We decided to adopt a single-page arrangement that displays the entire musical work of Philip Glass with all attributes sorted independently. Equipped with a flexible overview of all his works, users can navigate the entire product space without following a pre-set sequence of choices. By selecting the desired attributes and their values, users can restrict the display to the relevant data set.

While we cannot anticipate the needs or intent of every user, we strive to present a dynamic multi-attribute online catalog with an open structure that encourages discovery-based browsing. Thus, users are engaged to freely browse, explore, and manipulate the product space on their own term and at their own pace.

Key features

The display is dvided into two halves (Figure 1): the top half is composed of 3 sliders, each representing a single characteristic of the *whole musical work,* while the bottom half incorporates 5 additional sliders representing the corresponding track numbers of the works and the attributes pertaining to the *tracks of the works*

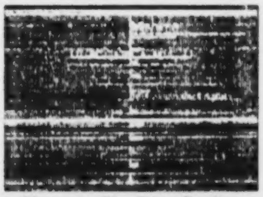

Figure 1: The Glass Engine

The sliders on the top half of the display are:
- Title – arranged alphabetically
- Date – date of copyright
- Length – in hours, minutes, and seconds

The sliders on the bottom half of the display are:
- Joy – emotional effect from low to high
  - Sorrow – emotional effect from low to high
- Intensity – emotional force from low to high
  - Density – complexity of orchestration from low to high
  - Velocity – perceived tempo of the track/work

The central interactive elements of the *Glass Engine* are sliders, each of which can be considered a single dimension of the data (as in parallel coordinates); and Philip Glass's entire works are plotted along each dimension. For instance, the work "*Einstein on the Beach*" is plotted near other works starting with D-E-F on the Title slider and near works composed in 1976 on the Date slider. To navigate, a user moves a slider so that a desired work lines up with the crosshair, and music from the work begins playing. Simultaneously, the other sliders move automatically so that the selected work in each dimension also lines up with the crosshair, thus indicating the position of the selected work on thees other dimensions.

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Furthermore, users can fine-tune their navigation (such as accessing the previous work or the next work) by clicking on the back/next buttons above the slider. Users find this particular function practical and necessary when the plotted works are dense. The *Glass Engine* allows users to perform two kinds of filtering: linear and categorical. Linear filtering is accomplished by pulling tabs from the endpoints of the sliders. For instance, one might move the endpoint "2001" on the Date slider to "1990," effectively hiding all works written after 1990. Categorical filtering (Operas, Symphonies, etc.) is accomplished through selecting *View: all work type* from the toolbar; users can then select their desired category from a pull-down menu.

In addition, the *Glass Engine* allows users to navigate all of Glass's works by his music characteristics, (e.g., joy or tempo). In the bottom part of the display, users can navigate along the tracks that are, for example, happy or slow or densely orchestrated. In addition, using the endpoint filters, it is possible to navigate solely through the tracks that satisfy multiple criteria, e.g., happy, slow, and densely orchestrated (i.e., navigate or browse the entire product space with multiple criteria specified.) Bookmarking is another well-received feature of the *Glass Engine*. By selecting *Favorites* from the toolbar, users can bookmark works or tracks of interest to return to them conveniently. The *Glass Engine* also facilitates comparisons among works and tracks. Since the works are displayed as patterns of sliders, users can compare the values of musical attributes by observing screen changes in slider patterns. In short, browsing and interactive navigation with sliders simplify free exploration; if a selected piece is not what the user expected, the operation is reversible by just sliding the bars in the opposite direction. Finally, the *Glass Engine* allows novice users to begin browsing with little training, while providing expert users with powerful features such as the ability to perform multip lo-criteria searches.

Implementation

The Glass Engine interface is a Java applet. Since Java applets are often large, slow to download, browser-dependent, or require additional plug-ins, we restricted the applet to what is supported in jdk1.1.8 which is a version commonly supported by most browsers. The applet can be downloaded quickly and requires no additional plug-ins to run. All catalog data is downloaded with the applet. The music is hosted at a different site and is streamed on demand when a work is selected. Javascript in the Glass Engine HTML page serves as glue between the applet and whatever media player is installed on the client machine.

Ongoing usability study

A usability study comparing users' performance and experience with the *Glass Engine* and a hierarchical interface was conducted at IBM Research in August 2001. Amazon.com was chosen as the control interface because of its hierarchical structure and diversity of products offered. Sixty-one subjects participated in the study. Three dependent variables were measured: knowledge acquisition, music identification, and user satisfaction. Results of the usability study showed that the Glass Engine (GE) group achieved significantly higher overall accuracy than the hierarchical interface (HI) group in both the knowledge acquisition and music identification tasks ($t(59)=5.076$, $p<.001$). With respect to user experience, the GE group found it easy to find the music using the Glass Engine and gave significantly higher satisfactory ratings than the HI group on their experiences with the interface ($t(59)=5.294$, $p=.000$). Finally, 74% of the participants in the GE group would like to learn more about Philip Glass as opposed to 60% of the subjects in the HI group who would like to do so.

Conclusion and Future Directionp

In this paper, we describe the *Glass Engine*, a novel single-paged, multi-attribute electronic catalog, which presents users a personalized navigation tool to view, browse, and manipulate a large repository of items or products with common attributes. By including as many possible aspects of the composer's music, the users' navigation through his works may be guided by their personal interests, associations, and affinities. Empirical studies in progress point to a possible correlation between the free-form navigation made possible with tools like the Glass Engine, and learning and retention. Another set of empirical studies comparing users' performance and experience with the *Glass Engine* and other innovative visualization systems is underway at IBM Research. The final analysis of the study will hopefully shed light on the research question: Can advanced user interfaces be successfully employed to give users a new and comprehensive view of large product spaces on the Web?

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References

[1] Manning, H., McCarthy, J.C., & Souza, R. K. (1998). Why Most Web Sites Fail. Interactive Technology Series Volume 3, November 7, Cambridge, MA: Forrester Research, Inc.

[2] Johnson, B. & Shnedierman, B. (1991). Tree-maps: A Space-filling Approach to the Visualization of Hierarchical Information, in Visualization 1991, IEEE, pp. 284-291.

[3] Mackinlay, J.D., Robertson, G. G., & Card, S. K. (1991). The Perspective Wall: Detail and Context Smoothly Integrated. in Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems (Nov, 1991) ACM Press, pp. 173-179.

[4] Robertson, G. G., Mackinlay, J.D., & Card, S. K. (1991). Cone Trees: Animated 3D Visualizations of hierarchical Information. in Proceedings of the ACM CHI'91 Conference on Human Factors in Computing Systems, Information Visualization ACM Press, pp. 189-194.

[5] Furnas, G.W. (1981). The Fisheye View: A New Look at Structured Files. Murray Hill, NJ: AT&T Bell Laboratories.

[6] Furnas, G.W. (1986). Generalized Fisheye Views. in Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems (April, 1986) ACM Press, pp. 16-23.

[7] Lamping, J., & Rao, R. (1996). The Hyperbolic Browser: A Focus + Context Technique for Visualizing Large Hierarchies. Journal of Visual Language and Computing, 7(1), pp.35-55.

[8] Munaner, T. (1997). H3: Laying out Larger Directed Graphs in 3D Hyperbolic Space. in Proceedings of Info Vis'97, IEEE Symposium on Information Visualization, IEEE, pp. 2-10.

[9] Map of the Market, (2000) http://www.smartmoney.com/marketmap

[10] Sony Music Licensing. http://www.sonymusic.com/ licensing.

[11] Inselberg, A. (1981). n-dimensional graphics, part I-lines and hyperplanes. Technical Report G320-2711, Los Angeles, CA: IBM Los Angeles Scientific Center.

[12] Ahlberg, C. & Shneiderman, B. (1994). The Alphaslider: A Compact and Rapid Selector, in Proceedings of the CHI '94 Conference (Boston, April 1994), ACM Press, pp. 365-371

Assessing and Analyzing the Effects of WBLP on Learning Processes and Achievements: Using the Electronic Portfolio for Authentic Assessment on University Students' Learning

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Abstract: A Web-Based Learning Portfolio (WBLP) was evaluated through practical teaching process to understand if the WBLP system helps students to grasp the learning process and enhances learning outcomes. The evaluation results reveal that this WBLP system has been more useful for them to obtain the feedback from other students than from their teachers. It reflects the fact that the feedback from other students has been helpful for them and has thus become the necessary component to help them in learning. Next step, we will conduct the further empirical study in terms of learning effects for the system.

Research Background

Portfolio has been used to gather the learning activities of students in various aspects as well as the works of students with one purpose in mind. It allows the teachers, students, or their parents to understand and evaluate the learning process, improvement situation, and academic achievement of students. It may also be used as evidence for the pupils to reflect on their learning and the changes in their comprehension during the study process. Portfolio may provide the following benefits (Hewitt, 1995):

1. It may demonstrate students' growth and improvement situation.
2. It may encourage students to set up learning goals.
3. It may provide the hard evidence concerning students' efforts.
4. It may show students' performance or works.
5. It may serve the purpose for job application or school application.
6. It may help the faculty to review students' learning progress.
7. It may serve to inspire the teacher and understand students' performance.
8. It stimulates students' introspective thinking and enhances self-assessment (Smith & Tillema, 1998; Wade & Yarbrough, 1996; Carroll, Potthoff & Huber, 1996; Vavrus, 1990).
9. It encourages students' learning interest, builds up students' self-confidence, and assists students to know more about themselves, and develops writing skill as well.
10. It encourages students' participation in cooperation, and increases their self-esteem (Mullin, 1998).

Portfolio method emphasizes that a learner participates actively and thus establishes the learning results of his/her own concern. Therefore, its development process whether it be instructed by teachers or established by students' own accord, shall both attain the goal of encouraging the learners to be responsible for his/her own learning and to grasp all the goals of learning activities. Furthermore, portfolio assessment was originally designed as an authentic assessment approach meant for the improvement of the traditional pencil-paper tests. Thus, the assessment is real and active. In contrast with the traditional way of assessment, portfolio assessment pays attention not only to the results but also the processes involved. Since learning, teaching, and evaluation comprise of the integrated activities that shall go hand in hand, hence portfolio approach is actually a better way to grasp the complexity of learning processes. It also allows the learners or teachers' introspection to take place. It may also help to reflect on the overall learning and teaching process, so as to give feedback and offer suggestions, thus to benefit the learning in the genuine way. In general, portfolio possesses the following characteristics or features (Wade & Yarbrough, 1996):

1. Developmental: portfolio represents a certain period of students' growth and learning. Portfolio is the long-term accumulated learning results, not meant for short-term goals. Hence, it is actually an on-going process in its development.
2. Dual-valued: portfolio offers both the teachers and students the value of two-way interaction. It allows a learner the opportunity to reflect and record his/her own learning process. It also offers teachers a good approach or method to evaluate students' growth and achievements.
3. Selective: portfolio offers students the opportunity to choose, so that students may self-determine what kind of contents that they want to put in the portfolio and how to organize the whole portfolio. It also allows students to set up the standard or basis for evaluation/ assessment.
4. Authentic: portfolio incorporates the genuine works or performances of students. Traditional tests normally cannot reflect a student growth or potential in all aspects, but portfolio may demonstrate solid learning results and thus offers an authentic way of learning.
5. Reflective: portfolio may reveal the evidence of self-reflection. Thus learners may review his/her own work, then to set up further goals through such a reflection. It may also help to review the previous efforts, and compare them with the actions afterward, for better understanding of his/her improvements or growth.
6. Individual: portfolio is a personal learning and growing record based on individual ways of choices and organization. Consequently, it

reflects personal contents and style in students' personal portfolio.

7. Interactive: a learner may share with his/her teachers and peers through personal portfolio, and thus seeking guidance and suggestions. In this way the development and establishment of portfolio may be regarded as the process of cooperative interactions.

Other than that, portfolio also possesses the characteristics of self-regulated learning and self-directed learning (Fischer & King, 1995; Smith & Tillema, 1998), this is due to the fact that a portfolio allows the learner to self-determine his/her learning goals, strategies, and contents and then records them. Thus the role of scholars is merely to assist and provide feedbacks. That is why it would encourage a learner to become an independent, self-directed person through the development of personal portfolio.

The Web-Based Learning Portfolio (WBLP) that has been structured through web interface and also has gone through the different stages of analysis, design, development, and test is now being established. The effects of the WBLP in students' learning are the issue worthy of our analysis and investigation. With the above pre-requisite in mind, this research hopes to achieve the following goals:

1. To assess the perceived effects of the WBLP, and analyze its impact on students' learning process.
2. To propose the suggestions for future research direction based on the results of evaluation.

Web-Based Learning Portfolio

This WBLP is mainly used to provide students with a web-based user environment. It would help students to complete their individual portfolios through simple, easy-to-use interface for necessary guidance. It also allows the teachers and students to browse their classmates' portfolios, and to give their feedback or assessment opinions. The contents of this WBLP include the following seven major items: the basic information of students, the learning goals of students, the works of students in a course, the records of students' self-reflection or self-assessment, records of teachers' feedback and assessment, records of peer feedback and assessment, personal web page of students. In addition to the afore-mentioned, in order to support students to create and browse the portfolios, as well as to facilitate and meet the needs for teachers to inspect and evaluate students' portfolios, the functional areas of WBLP system consists of the following eight major items: *Portfolio Browse, Portfolio Creation, Portfolio Guide, Portfolio Discussion Board, Portfolio Bulletin Board, Portfolio Suggestion Board, Student Data Maintenance, System Management* (Chang, 2000; Chang, 2001). These functional areas mainly provide the following functions to the portfolio (as shown on Figure 1):

1. The function for students to conduct the various productions of portfolio contents.
2. The function for teachers and students to browse the portfolios of other students or peers.
3. The feedback and assessments of teachers as well as the feedback and mutual assessment mechanism among students themselves.
4. The on-line guidance and illustration for students to create portfolio contents.
5. The searching and management function of students' personal information.
6. The asynchronous discussion channel of portfolio creation process.
7. The opinion feedback channel for students in using the system.
8. The updated system announcement or course information concerned.
9. The function for teachers to manage student information and announcement information.

Design of the Research

We use an established Web-Based Learning Portfolio (WBLP) on an undergraduate course in university. Through practical teaching process, we may evaluate if the WBLP helps students to grasp the learning process, if it enhances learning outcomes. The evaluation consists of user evaluation, user in-depth interviews, and expert evaluation. The evaluation also helps to understand the difficulties and problems of this system in its application and its possible impact on students' learning.

The user evaluation method had been conducted one and half month after the WBLP system implementation. It was carried out through the evaluation questionnaire designed by the researcher. The questionnaire was distributed in several copies to a class of 35 students who were taking the course of "Computer and Instruction" in a Pre-service Teacher Education Program. This research has designed its own questionnaire for evaluation (as shown on Table 3). The questionnaire primarily asked the questions of the WBLP impact on the learning process. The contents of this questionnaire are based on relevant literatures and discussions of scholars and experts. They have gone through the process of examination for validity and reliability. The questions have been presented based on Likert's five-point scaling method. That means the choice for answer is: strongly agree, agree, average, disagree, and strongly disagree.

In order to understand the WBLP impacts on students' learning in depth, so we supplement the study through the researcher self-designed "Questions Listing of User In-Depth Interviews" after the completion of user evaluation questionnaire analysis. Interviews in-depth would then follow up to get to know the opinions and suggestions of the users concerning the unresolved answers and controversial issues that could never be revealed through the previous questionnaire. Targeting for the unresolved questions and the controversial issues of the previous questionnaire of user evaluation, in-depth interviews were then conducted on 5 students selected randomly after the completion of questionnaire analysis work in order to deeply understand the users' opinions and suggestions.

Three experts were being invited to conduct the expert evaluation (including the course instructor, a portfolio assessment expert, and a web technology expert) to use this WBLP on-line. The evaluation work was then conducted through interview method after one week. In terms of expert evaluation, interviews were conducted based on the researcher's self-designed " Questions Listing of Expert Interviews". In this way that we got to understand the expert opinions in regarding the WBLP impact on learning and teaching.

Validity and Reliability of Questionnaire

Validity refers to whether a tool for measurement/survey that may achieve its intended functions or purpose. The questionnaire of user evaluation in this research has gone through the processes of pre-test and pilot-study to verify the validity of the questionnaire.

For attaining the goal of questionnaire validity, it was necessary to consult two expert/scholars of portfolio assessment and web technology, and one teacher who instructed the course after the completion of the questionnaires for their opinions on revising the framework of said contents, words and expressions relating to the issues, etc. The suggestions for revising the questionnaire include: increasing the contents of the questionnaire, more articulate in the expressions of questions, word polishing, etc. Then could the contents of the questionnaire be able to attain the goal originally intended for the effectiveness in its measurement/survey. Through the implementation of such a method, this research meets the needs of measurement/survey tool efficiency. The above process involved is the so-called expert validity.

We may achieve more complete validity verification through the further process of pilot-study. We picked up 5 students randomly for the purpose of this research at that time to conduct pilot-study based on the rough draft of the questionnaire. We hoped to go through such a pilot-test and render the results to the researcher to get to know if the questionnaire could effectively measure/survey the purpose intended for this research, and to revise any inappropriateness whatever necessary. The opinions or feedback for revision include the clarification of some questions and word polishing, etc., so as to present the questions in the way better understood by students who were answering the questions in the questionnaire.

Reliability refers to being consistent and steady in terms of measurement/survey method. In this way we could understand the extent or degree of reliability for measurement/survey instruments. In order to attain the reliability goal of this questionnaire, we conducted the reliability test of Cronbach's alpha coefficient by using the contents of the above retrieval questionnaires. The extent or degree of consistency within the questionnaires could thus be determined. Then we could determine if the research measurement tool possessed certain degree of reliability. The Cronbach's alpha coefficient of formal questionnaire after revision is equal to 0.8346 ($n = 35$). This shows that the reliability level of this research has attained a rather reliable level.

Results and Discussions

User Evaluation

User evaluation consists of survey and interviews. Tables 1 list the statistics results of each evaluation item within the questionnaire. Among the 25 evaluation items of Table 1, other than the later debut of the *Discussion Board* (came out only about one week prior to the evaluation) that has led to the insufficient understanding and use of its function, and thus resulted in the mean of this two items both lower than 4 (3.83 & 3.87 respectively) for Item 16 -- the articles of *Portfolio Discussion Board* enhance my growth in learning and Item 17 -- the feedback on the *Portfolio Suggestion Board* have been helpful for me to overcome the difficulty in producing personal portfolio. As for the other 23 items of survey, the degree of agreeability mean is higher than 4, and most users are either agree with the statement or very much agree with it. The means of 6 items (Item, 12, 18, 19, 20, 24, 25) are even higher than 4.5, and 90% of the users regard them very helpful for their learning.

From the survey results, it appears to be that most of the users are rather agreeable that this system has been helpful for their learning process or learning outcomes, and thus have come out with positive appraisal for this system. As for the questions in regarding to whether the browsing of other students' portfolio, learning goals, works, basic information, personal web page, etc. may help them in some way (from Item 6 to Item 14), most students regard that it has been most helpful for them to browse other students' works. The mean for this question is as high as 4.53. As high as 93% of the students regard that the quality of their own work can be improved by such an emulation through the browsing of others' works (Item 12). 94% of the users regard that it helps to understand the merits and shortcomings of other students' learning by browsing other students' portfolio (Item 7). 97% of the users regard that it enhances their own academic growth and improvement by browsing other students' portfolios (Item 8). All these survey results have revealed the fact that the use of portfolio has really helped the users in learning.

Table 1: Percentages and means of student agreement in WBLP impacts on learning process

Impacts on Learning Process	Percentages of Agreement (%)					
	5	4	3	2	1	Means
1 Set up learning goals may help me with the direction in self-learning	27	53	20	0	0	4.07
2 The uploading and gathering of course works helps to reveal my genuine learning outcomes	37	60	3	0	0	4.33
3 The writing process for self-reflection and assessment records help me to grasp and reflect on genuine learning process	37	53	10	0	0	4.27
4 Teacher feedback helps me to reflect on my merits and shortcomings in learning	53	40	4	3	0	4.43
5 The feedback from peers help me to reflect on my merits and shortcomings in learning	47	43	7	3	0	4.40
6 Browsing classmates' portfolios helps me to reflect on the merits and shortcomings in my learning	47	43	7	3	0	4.33

7 Browsing classmates' portfolios helps me to understand the merits and shortcomings of my classmates in learning	47	47	3	3	0	4.37
8 Browsing my classmates' portfolios helps me to grow and improve in academic achievements	38	59	0	3	0	4.31
9 Browsing my classmates' portfolios helps to motivate me for the learning of this course.	43	50	7	0	0	4.37
10 Browsing my classmates' portfolios helps me to increase the communication and exchanges with my classmates	37	43	17	3	0	4.13
11 Browsing classmates' learning goals helps me to understand classmates' work effort, and thus enhances that of my own	57	33	7	3	0	4.43
12 Browsing my classmates' works helps to upgrade the quality of my works	63	30	4	3	0	4.53
13 Browsing my classmates' basic information helps me to understand my classmates better	50	33	14	3	0	4.30
14 Browsing my classmates' personal web page helps me to better understand my classmates and thus enhances relationships with them	40	40	13	7	0	4.13
15 The information in *Portfolio Bulletin Board* helps me to better understand this course	57	33	7	3	0	4.43
16 The articles of *Portfolio Discussion Board* help my academic growth	17	57	20	6	0	3.83
17 The message feedback in *Portfolio Suggestion Board* helps me to solve the problems that I have encountered in portfolio creation	30	43	10	17	0	3.87
18 It helps me to know about the learning outcomes of my classmates by using this system	67	33	0	0	0	4.67
19 It helps me to know about my teacher feedback and suggestions by using this system	63	27	10	0	0	4.53
20 It helps me to know about my classmate feedback and suggestions by using this system	60	37	3	0	0	4.57
21 It enhances my interactions and exchanges with my classmates by using this system	40	47	7	6	0	4.20
22 It helps me to better understand my growth and improvements in the course by using this system	44	43	13	0	0	4.31
23 It helps me to better understand the growth and improvements of other classmates in this course by using this system	43	40	14	3	0	4.23
24 It helps me to learn this course by using this system	70	27	3	0	0	4.67
25 I hope to use this system in other courses as well	60	33	7	0	0	4.53
Total Means	**46.96**	**41.88**	**8.4**	**2.76**	**0**	**4.33**

The most positive feedback comes out in terms of the overall benefit in using this system (from Item 18 to Item 24), most of the students agree that by using this system, it helps them to better understand other students' learning achievements (mean = 4.67, Item 18), allowing them to obtain the feedback and suggestions of other students (mean = 4.57, Item 20), and benefit their learning of the course from the portfolio (mean = 4.67, Item 24). 100% of the users regard it useful to utilize the portfolio to get to know the learning achievements of other students (Item 18). 97% of the users regard it helpful to obtain the feedback and suggestions of other students through this system (Item 20). As high as 97% of the users expressed that it helps them to learn the course by using this system (Item 24).

Furthermore, one very interesting phenomenon is when being presented with the question (Item 19 and Item 20) that whether using this system helps them to obtain the feedback from teachers (mean = 4.53) or from the other students (mean = 4.57), the results show that this system has been more useful for them to obtain the feedback from other students than from their teachers. We deduce that one of the reasons may be that students generally hold higher expectation for feedback from teachers. Another reason may be that the contents of teachers' feedback are not as much as that of other students'. Since the teachers have to answer and feedback to all students while the students only need to feedback to a few selected peers. The above survey results reflect the fact that the feedback from other students has been helpful for them and has thus become the necessary component to help them in learning.

On the average, as high as 88.84% of the users feel that the system has been helpful in their learning process and outcome. Only 2.76% a small percentage of the users think otherwise. This shows that the implementation of portfolio truly helps most of the students in academic growth and improvement with great efficiency. Thus it has created positive impact on learning process and outcome. Figure 2 shows the distribution of means for student agreement percentages in WBLP impacts on learning process.

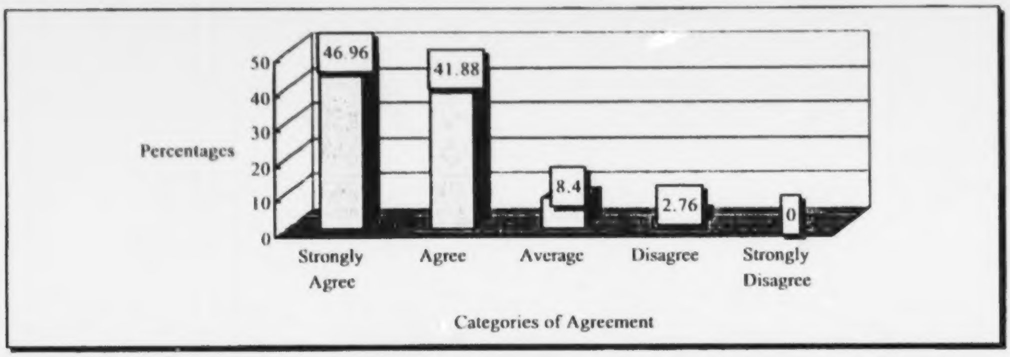

Figure 2: The distribution of means for student agreement percentages in WBLP impacts on learning process

To sum up the results of the above user evaluation, the appraisal for impact on learning process is high (mean = 4.33). To learn from the lesson above, teachers should give much more encouragement to their students, and pay more attention to the difficulties that the students may come across in the implementation process of future portfolio assessment.

User In-Depth Interviews

We conducted in-depth interviews with 5 users (who were chosen randomly from the students who had been taking the course) after the statistics that have come out based on the suggestion items and questionnaire results to deduce or conclude a few important user opinions or suggestions.

In terms of the impact on learning process, most students regard that the overall design of the WBLP system is good. They are able to get to know other students' learning processes, learning experiences, and thus enhance their learning of the course through their browsing. This WBLP system provides the gathering and browsing to access to other students' works, and thus allows one to get to know better about his/her merits and shortcomings. Then one can improve accordingly in learning. Some students regard that to set up learning goals may allow themselves to be ready for individual learning direction. However, there seems to be no direct evidence reflected through our assessment standard to support the assumption that such a learning goal set up may help them in terms of assessing their final learning results. Hence, its real purpose and function seems to be ambiguous. In addition, introspection and self-assessment help to review the process in students' learning or producing their works. It would allow the students to discover the areas that they may improve. As a result, it enhances learning for maintaining such a reviewing process.

Expert Evaluation

Upon the completion of this system establishment, we had invited 3 experts (including a portfolio assessment expert, an Internet technology expert, and the course instructor) to use this system. The researcher was then interviewing them one week later. In this way we have obtained the valuable opinions and suggestions of these experts.

These experts also answer the following questions, such as: "whether this system has been helpful for students' learning and teachers' teaching?" "Is it possible to provide an effective and appropriate portfolio production and browsing environment in order to allow both the teachers and the students to better understand the genuine learning processes and results of students?" Some experts regard that this WBLP system provides the opportunity for gathering students' works for emulation among the peers. Consequently, the practice will surely enhance students' learning result. The introspection and self-assessment records of students would allow the teacher to better understand students' prerequisite ability as well as the practical issues or problems that students have encountered, and also students' achievements in learning. This will help to attain the goal of being more objective in student assessments, and it will also help the teacher to adjust his or her teaching method in the future. Some experts point out that the works that students have presented via this WBLP system are mainly the final completed works of students, but the processes of such productions in terms of gathering and demonstration shall also be incorporated as well. Hence, the production processes or the on-going works shall be demonstrated as well. Finally, the system has to improve its management functions in terms of supporting the teachers to perform on-line assessments for students' works, and to track the status of students' using the services of this system through on-line records and statistics.

Summaries and Conclusions

The characteristics of the WBLP is meant to allow the teacher and students' genuine understanding of the individual learner learning process and outcome, and thus to enhance the feedback and interactions among teachers and students. Furthermore, it helps students to get to know the merits and shortcoming in his/her own learning, also the difficulties and problems involved, thus to pro-

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mote the integration of teaching, learning, and assessment.

As high as 88.84% of the users regard the electronic portfolio system has benefited their learning. As high as 93% of the students regard that the quality of their own work can be improved by the emulation through the browsing of others' works (Item 12). 94% of the users regard that it helps to understand the merits and shortcomings of other students' learning by browsing other students' portfolio. 97% of the users regard that it enhances their own academic growth and improvement by browsing other students' portfolios. The evaluation results also show that this WBLP system has been more useful for them to obtain the feedback from other students than from their teachers. It reflects the fact that the feedback from other students has been helpful for them and has thus become the necessary component to help them in learning.

Whether the use of web-based portfolio system will definitely enhance students' self-regulated learning, self-directed learning, enhancing the ability for self-reflection, encouraging learning motivation, etc. are all the interesting issues worthy of our further research and verification. Therefore, we will conduct the relevant future experiment study in terms of the practical applications in teaching and learning efficiency for web-based portfolio system.

References

Carroll, J. A., Potthoff, D., & Huber, T. (1996). Learning from three years of portfolio use in teacher education. *Journal of Teacher Education, 47*(4), 253-262.

Chang, C. (2000). Web-based learning portfolio (WBLP): An electronic authentic assessment tool on web. In *Proceedings of 8th International Conference on Computers in Education 2000 (pp.1456-1463)*. Taipei, Taiwan.

Chang, C. (2001). Construction and evaluation of web-based learning portfolio: An electronic authentic assessment tool on web. *Innovations in Education and Teaching International, 38*(2), 144-155. (to be appear)

Fischer, C. F. & King, R. M. (1995). *Authentic assessment: A guide to implementation*. California: Corwin Press, Inc.

Hewitt, G. (1995). *A portfolio primer: Teaching, collecting, and assessing student writing*. Portsmouth, NH: Heinemann.

Mullin J. A. (1998). Portfolio: Purposeful collections of student work. *New Directions for Teaching and Learning*, 74, 79-87.

Smith, K. & Tillema, H. (1998). Evaluating portfolio use as a learning tool for professionals. *Scandinavian Journal of Educational Research, 42*(2), 193-205.

Vavrus, L. (1990). Put portfolios to the test. *Instructor*, 100, 48-53.

Wade, R. C. & Yarbrough, D. B. (1996). Portfolio: A tool for reflective thinking in teacher education?. *Teaching & Teacher Education, 12*(1), 63-79.

Record desktop activity as streaming videos for asynchronous, video-based collaborative learning

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Abstract: As Web-based courses using videos become popular in recent years, the issue of managing audio-visual aids becomes noteworthy. In general, the contents of audio-visual aids may include a lecture, an interview, a featurette, or an experiment etc. Then, the audio-visual aids of Web-based courses are transformed into the streaming format that can make the quality of Internet-based videos acceptable to learners using a limited bandwidth. Although streaming technique enables the learners' accessibility of audio-visual aids over Internet, the usage of audio-visual aids is still totally adhere to instructors' perspectives. In fact, distance learners can contribute ideas not only in text format, but also in audio-visual format. However, previous researches did not consider the feasibility of audio-visual aids contributed from distance learners. The objective of this paper is to argue that the usage of audio-visual aids from distance learners' perspectives should be considered in designing Web-based course. To demonstrate this concept, this paper first introduces a screen camcorder tool, which enables learners to record screen activity as videos in standard format or streaming format. Then, a collaborative learning strategy, called Jigsaw II, is applied to encourage expertise group contribute streaming videos for training other learners. Finally, a preliminary survey of technology acceptance is implemented on 37 learners. Results confirm the feasibility of audio-visual aids contributed from distance learners.

Introduction

As Web-based courses using videos become popular in recent years, the issue of managing audio-visual aids becomes noteworthy. It is not a new idea of using videos for distance learning (Kozma, 1986; Zigerell, 1991; Levne, 1992). For instance, a distance learning course may conventionally transmit videos by videotapes, cable TV, broadcast TV, or VCD. Although researches indicate that the face-to-face (synchronous or asynchronous) situation is not an essential factor of learning performance, some reports show that distance learners prefer video to other media. Hence, a distance learning instructor may often provide teaching video to distance learners by Internet in recent years.

The contents of audio-visual aids may include a lecture, an interview, a featurette, the operation of a machine, or an experiment etc. In fact, the contents of audio-visual aids are discipline-dependent. For instance, the major portion of the video contents for a Physics course may be used to demonstrate an experiment. Anyway, the instructor is the only provider of audio-visual aids in most Web-based courses. Furthermore, very few instructors were involved in planning or designing the teaching videos. Instead, audio-visual aids are considered as replacements of learning activities that can not be implemented in a classroom situation. As Benney said "Most certainly video is a successful medium for taking students into the field to observe facts, processes and emotional events which would otherwise be impossible to see and experience" (Benney, 2001).

To provide teaching video over Internet, the video signals should be transformed into the streaming format that can make the quality of Internet-based videos acceptable to learners in a limited bandwidth. The streaming format means that the requested video signals are stepwise transmitted from server to clients. The most famous commercial products for providing streaming-video functionalities are the windows media server of Microsoft™ and the realmedia server of RealNetworks™. Consequently, a Web-based course should prepare contents of videos, transform videos into streaming format, and setup a media server to provide teaching videos through Internet.

Existing learning strategies of video-based instruction can be categorized by three types: (1) passive watching, (2) learn/practice while watching, and (3) learn/practice after watching (DeMartino, 2001). The passive watching strategy means that students do not be engaged in a discussion activity or a learn-by-doing activity. The passive watching strategy generally results in poor long-term outcomes. The learn/practice while watching strategy means that a student or a learning group can pauses, stops, forwards, or rewinds a video clip to self-pace learning by joining a discussion or learn-by-doing activity with learning partners. The learn/practice after watching strategy means that the discussion activity or learn-by-doing activity following a teaching video provides a reflective opportunity to deepen long-term outcomes.

No matter which type of learning strategies for video-based instruction is used, the usage of audio-visual aids is totally adhere to instructors' perspectives. Distance learners are not expected to be able to provide videos to depict an idea or communicate with others. Hence, a distance learning instructor tends to provide BBS, email list, or WBB (Web Bulletin Board) to support asynchronous, collaborative learning after watching an instruction-video (Repenning, Ioannidou, & Phillips, 1999). In fact, distance learners can contribute ideas not only in text format, but also in audio-visual format. However, previous researches did not consider the feasibility of audio-visual aids contributed from distance learners.

The required computer hardwares for videoconferencing, such as video camera, video capture card, and netowrk bandwidth etc., will be a considerable expense for a distance learner. Consequently, most Web-based courses do not implement completely video-based communication environment because of considering distance learners' financial burden. Moreover, video-based instruction is generally regarded as a synchronous communication tool or a passive medium such as recorded lectures. However, a noteworthy idea is that distance learners can contribute audio-visual aids in their own way instead of an instructor's way. In other words, distance learners can record computer screen activity as video and oral explanation as audio in a video-based communication environment without additional computer hardware. Consequently, distance learners can join the process of asynchronous, video-based instruction to ease the general problem, that is instructors tend to spend too much time lecturing, of video-based instruction.

To demonstrate this idea, the followng section first introduces a screen camcorder tool, which enables learners to record screen activity as videos in standard format or streaming format. Then, a collaborative learning strategy (Jigsaw II), which was proposed by Elliot Aronson(Slavin, 1995; Aronson & Patnoe, 1997), is applied to encourage expertise group contribute streaming videos for training other learners. Finally, a preliminary survey of technology acceptance was investigated and results are shown and discussed.

Computer Desktop Camcorder

Many commercial products can record computer desktop activity and voice from a microphone as videos in standard AVI formats, for instance Lotus™ ScreemCam[1], TechSmith™ Camtasia[2], and Hyperionics™ HyperCam[3] so on. Computer "desktop activity" means that learners' every action, such as open a file, execute a program, show slides for a lecture, use browser, and even all mouse-pointer movements so on, wil be recorded as a video. Furthermore, learners' explanations during the aforementioned interval of actions can be recorded as the audio track of a teaching video through the microphone of a computer. Because computer desktop or screen is like the viewfinder of a video recorder, aforementioned softwares are called *desktop camcorder* or *screen camera*.

Originally, desktop camcorder tools are used to train users for new software by an kind of active style. Hence, most desktop camcorder tools includes the following features:

(1) Users (here it means learners) can determine the video capture area.
(2) Users can use zoom effects to zoom in or zoom out during capture.
(3) Users can annotate a caption on the captured video.
(4) Users can use a microphone to input audio during capture.

To get an overview of computer desktop camcorder, TechSmith™ Camtasia is used for demonstration. Figure 1 illustrates use TechSmith™ Camtasia to capture slides, mouse movement, audio from microphone input as teaching videos. Instructors can press the capture hotkey or click on the record button (the red one) on the toolbar to start recording. During recording, Camtasia recorder can be minimized to aviod obstructing learners' lines of sight. Instructors can stop the capture by a hotkey and save the captured video to a file.

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[1] Lotus ScreenCam. URL: http://www.lotus.com/home.nsf/rightframe/1screencam

[2] TechSmith Camtasia. URL: http://www.techsmith.com

[3] Hyperionics HyperCam. URL: http://www.hyperionics.com/hc/index.html

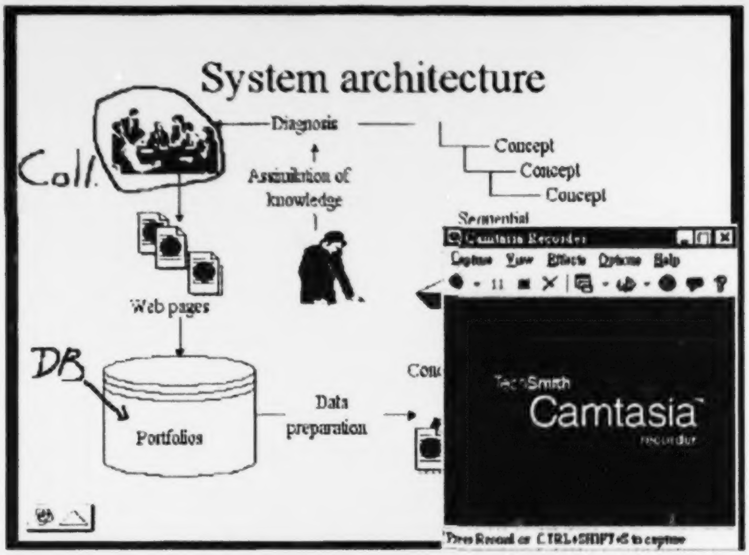

Figure 1. Use computer desktop camcorder to produce lecture videos.

In general, the captured videos are produced in standard AVI formats. However, the captured videos can be easily transformed into proper streaming formats that depends on the technology for streaming media services, i.e. the windows media server of Microsoft™ or the realmedia server of RealNetworks™. Both companies provide freeware to transform videos of standard AVI formats into proper formats. Fortunately, TechSmith™ Camtasia tools can support both transformations. Consequently, users can easily produce streaming videos no matter which technology for streaming media services is used.

Collaborative learning strategy

The elements for a collaborative learning strategy include heterogeneous grouping, interdependence, individual accountability, and group processing (Warschauer, 1997). Those elements are used to make sure learners will try to help each other. Some researches developed learning environment for implementing collaborative learning strategy (Brandon & Hollingsheda, 1999; Persico & Manca, 2000). However, there is not any collaborative learning environment based on streaming, asynchronous, and video-based technique instead of Web-based or videoconferencing techniques. Furthermore, collaborative learning strategies are also required to promote learning motivation and learning performance when we apply the novel technique to distance learners.

Before developing prototype system, another question arises from 'which one of collaborative learning strategies in literature is more suitable for computer desktop camcorder technique than others'. It is difficult to prove that a collaborative learning strategy is more suitable than others are because no literature reports using computer desktop camcorder technique in collaborative learning activities. Furthermore, the selected collaborative learning strategy should be able to encourage distance learners contributing instructional videos to training learning partners from distance learners' perspectives. In consideration of those issues, the Jigsaw II collaborative learning strategy is choosed because the expertise groups mechanism of Jigsaw II can support distance learners to master a learning topic. Then, we can encourage members of an expertise group to sharing their knowledge in streaming video style.

It is assumed that an instructor would like to construct a collaborative learning strategy, for this example Jigsaw II, on Web. In general, there are three steps in the Jigsaw II collaborative learning strategy. First, distance learners are heterogeneously assigned to groups according their cultures, mother tongues, and grade point averages so on. Hence, the groups of first step are called *heterogeneous groups or jigsaw groups*. Then, every distance learner of a heterogeneous group is respectively assigned to a study group for mastering a specific learning topic. Distance learners collaboratively study an expertise or learning topic to support each other

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becoming an "expert" of a topic in a study group. Consequently, the study groups of step two are called *expertise groups*. Finally, every member of an expertise group will return to his/her own heterogeneous group. After distance learners return to geterogeneous groups, every member of a heterogeneous group is acountable for teaching a learning topic, which he/she learned in an expertise group, to the other members. In other words, each student should present a well-organized report to teaching a learning topic when he/she comes back to his/her heterogeneous group.

The required processes, heterogeneous groups, and expertise group for Jigsaw II collaborative learning are illustrated in Figure 2. From the perspective of a distance learner, computer desktop camcorder can support him/her to tutor learning partners in a heterogeneous group by video-based instruction. To apply video-based instruction, a distance learning instructor should setup a media server as a streaming video provider. Then, distance learners of an expertise group should not only study a learning topic, but also plan a teaching video. Finally, distance learners of an expertise group can produce a teahing video by computer desktop camcorder and upload the teaching video to a media server. Consequently, video-based instruciton in a heterogeneous group becomes feasible. The refining part of Jigsaw II collaborative learning is depicted in the right part of Figure 2.

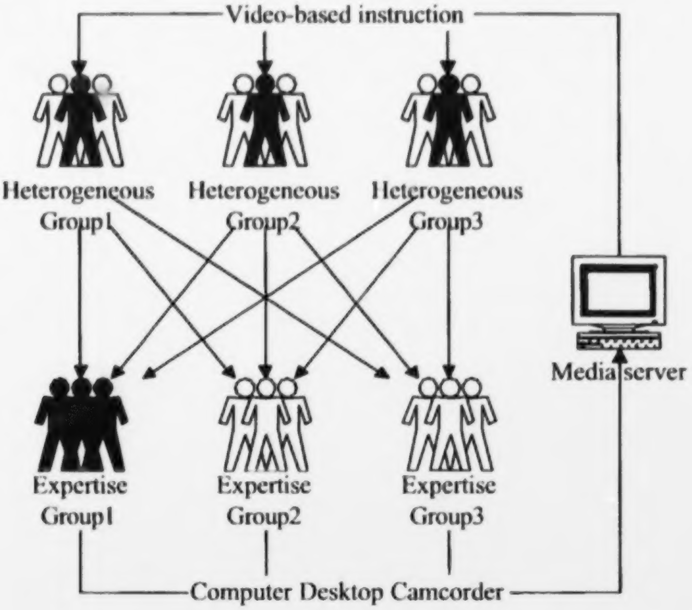

Figure 2. Integrating video-based instruction by a desktop camcoder supports Jigsaw II collaborative learning

Analysis of Preliminary Evaluation

The evaluation presented in this section attempts to analyze distance learners' technology acceptances of using desktop camcorder for collaborative learning. This experiment was carried out in Da Yeh University and a sample of 37 students (18 females and 19 males) was chosen from a class of information management department. The objective was to figure out how useful and ease of use the distance learners think desktop camcorder is.

A questionnaire, used in Davis 's technology acceptance model (TAM), was chosen as an evaluation tool (Davis, 1989). Davis 's TAM can support managers to understand the process of adopting new technology. One can realize the importance of TAM from this description: "(TAM)...are widely accepted among the MIS research community as tools for evaluating information system applications and predicting usage" (Doll, Hendrickson, &

Deng, 1998). In other words, the results of TAM can provide evidence to be weigh for or against the application of adopting desktop camcorder in collaborative learning. Originally, there are twleve questions classified as two categories (perceived usefulness and perceived ease of use) in Davis's questionnaire for TAM. In this evaluation, one overall ranking question was added to the original questionnaire. The contents of the questionnaire used in this evaluation are listed as following:

USEFULNESS	Q1.	Using <computer desktop camcorder> in my job would enable me to accomplish tasks more quickly.
	Q2.	Using <computer desktop camcorder> would improve my job performance.
	Q3.	Using <computer desktop camcorder> in my job would increase my productivity.
	Q4.	Using <computer desktop camcorder> would enhance my effectiveness on my job.
	Q5.	Using <computer desktop camcorder> would make it easier to do my job.
	Q6.	I would find <computer desktop camcorder> usefule in my job.
EASE OF USE	Q7.	Learning to operate <computer desktop camcorder> would be easy for me.
	Q8.	I would find it easy to get <computer desktop camcorder> to do what I want it to do.
	Q9.	My interaction with <computer desktop camcorder> would be clear and understandable.
	Q10.	I would find <computer desktop camcorder> to be flexible to interact with.
	Q11.	It would be easy for me to become skillful at using <computer desktop camcorder>.
	Q12.	I would find <computer desktop camcorder> easy to use.
	Q13.	Overall, I find using <computer desktop camcorder> useful in my job and believe that <computer desktop camcorder> is easy to use.

Table 1: Contents of the questionnaire for evaluation.

Every question in Table 1 was scored on a 7-point scales, with strongly disagree (1) and strongly agree (7) as the two endpoints. Table 2 depicts descriptive statistics to analyze results of this preliminary evaluation. From the mean of the 13-th question (Q13), most learners *agree* that computer desktop camcorder is useful and easy to use. Noteworthily, the data show that, on the average, learners' *perceived usefulness* respondents (Q1~Q6) had relatively lower than learners' *perceived ease of use* respondents (Q7~Q12). Through an informal interview, students indicate that video-based instruction is not very critical because they are not in a distance learning situation. One student said "it (teaching video) will be very useful in heterogeneous group status if we (learning partners of a heterogeneous group) can not meet one or two times per week".

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Mean	5.27	5.19	5.03	5.22	5.08	5.65	5.86	5.43	5.49	5.11	5.62	5.73	5.68
SD	1.52	1.21	1.38	1.46	1.62	1.36	0.98	1.26	1.10	1.43	1.16	1.12	1.42

Table 2: Descriptive statistics of preliminary evaluation results.

Conclusion

Although streaming technique enables the learners' accessibility of educational multimedia over Internet in recent years, the usage of educational multimedia is still totally adhere to instructors' perspectives. In other words, all teaching videos and audio-visual aids of most instructional website are contributed by instructors or instructional teams. This paper introduces a tool, computer desktop camcorder, to support distance learners contributing teaching videos for collaborative learning. We integrated computer desktop camcorder into a famous collaborative learning strategy, Jigsaw II, as additional supports for heterogeneous group learning. After training distance learners for using desktop camcorder, a preliminary evaluation of technology acceptance is implemented on 37 learners. Results show that most learners agree that computer desktop camcorder is useful for collaborative learning and easy to use. Most important of all, this paper indicates the feasibility of audio-visual aids contributed from distance learners.

Acknowledgements

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References

Aronson, E., & Patnoe, S. (1997). *The jigsaw classroom: Building cooperation in the classroom (2nd ed.).* New York: Addison Wesley Longman.

Benney, A. (2001). Creating An Active Learning Environment Using Digital Video: What I Did And How I Did It. *Proceedings of ED-MEDIA 2001* (World Conference on Educational Multimedia, Hypermedia & Telecommunications), pp. 133-138, Tampere, Finland, June 25-30.

Brandon, D., & Hollingsheda, A. (1999). Collaborative learning and computer-supported groups. *Communication Education*, 48(4), 109-126.

Davis, F.D. (1989). Perceived usefulness, perceived ease-of-use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-338.

DeMartino, D.J. (2001). Use of Video Mediated Instruction in Teaching American Heart Association Emergency Cardiac Care Training Courses. *Proceedings of ED-MEDIA 2001* (World Conference on Educational Multimedia, Hypermedia & Telecommunications), pp. 388-392, Tampere, Finland, June 25-30.

Doll, W.J., Hendrickson, A., & Deng, X. (1998). Using Davis 's perceived usefulness and ease-of-use instruments for decision making: a confirmatory and multigroup invariance analysis. *Decision Sciences*, 29(4).

Kozma, R.B. (1986). Implications of Instructional Psychology for the Design of Educational Television, *Education Communication and Technology Journal*, 34(1), 11-19.

Levne, T.K. (1992). *Going the Distance: A Handbook for Developing Distance Degree Programs*. Washington, DC: Annenberg/CPB.

Persico, D., & Manca, S. (2000). Use of FirstClass as a Collaborative Learning Environment. *Innovations in Education and Training International*, 37(1), 34-41.

Repenning, A., Ioannidou, A., & Phillips, J. (1999). Collaborative use and design of interactive simulations. *Proceedings of ACM Conference on Computer Supported Cooperative Learning (CSCL 99)*. Stanford.

Slavin, R.E. (1995). *Cooperative learning: Theory, research, and practice.* (2nd ed.) Needham Heights, MA: Allyn and Bacon.

Warschauer, M. (1997). Computer-mediated collaborative learning - theory and practice. *Modern Language Journal*, 81(4), 470-481.

Zigerell, J. (1991). *The Uses of Television in American Higher Education*. New York: Praeger.

An Interactive Storytelling System for the Pearl of the Desert Exhibit

Computer technology brings flexibility and more interactive into museum exhibition. The characteristic of computer multimedia can present audio, video, graphic, animation as well as text with well-designed program structure. Recently, most of the museums created a multimedia-based learning environment using new computer technology. The goal is to set up new directions of exhibition for visitors to explore, to enjoy, to be inspired as well as to improve their knowledge. This paper proposes an interactive storytelling system which reveals the art collections of the Tunhuang and its historical information based on film theory and computer technology. The collection of visitors' motion as they interacted with computers is also investigated.

Tunhuang art is one of the most famous artistic works in Central Asia in which Buddha statues are carved and painted. It consists of Tunhuang Grottoes from 4th to the 14th centuries. From the historical view, in the past thousands of years, many stories about these caves in Tunhuang were described in books or magazines. An interesting story as "story about the 17th cave in Tunhuang" would be described briefly as following:

Time : 1900

Place : Tunhuang

Cast : Wang Juan-Lu who is a taoist

Wang Juan-Lu was assigned to take care of the caves in Tunhuang by Chin Dynasty government. His duty was to maintain the painting wall and clean the sandy ground. One day, as he cleaned the 16th caves, the wall crashed suddenly. He found another caves where many important manuscripts of literature, linguistics, philosophy, population, religion, science, medicine, economy, society and so on were collected.

He reported to the Chin Dynasty government. However the officers ignored that with negative attitude. Finally, Wang Juan-Lu traded most of the manuscripts with foreigners under the table.

In order to present the historical information and art collections, National Museum of Natural Science in Taiwan conducts an exhibition called " The pearl of the Desert: The caves of Tunhuang Exhibition" in 1999. This exhibition combines the historical background of Tunhuang with beauty of arts. With the goal of understanding, computer played an important role as an art works presenter, an interpreter as well as a story-teller. The outcome is to entertain the visitors, to enrich the visitors' knowledge, to inspire their emotion and also to meet their variety needs.

The computer project was well-designed with Interactive storytelling construction. Based on film theory, time, place and cast with animation text were shown on the first scene. Next, the cast Wang Juan-Lu appears and is introduced by himself with speech and animation. The audience are asked to sweep the dust by clicking the mouse on the monitor. The cursor is also designed to look like a broom. Some incredible feedback such as spiders, rats, and interesting dialogs appears on the screen as the mouse is clicked. Certainly, the wall would crash as the audience click certain area on the screen. After the wall crashed, Wang Juan-Lu is moved near the wall with curiosity and a new cave with lots of manuscripts can be found. After that, he would ask audience some questions about the information of this new cave in dialog-inquiry mode. Some manuscripts and art works then can be retrieved in detail with its moving and zooming images on the computer screen.

Actually, computer not only provides a good solution to preserve the objects in the exhibition, but also provides the image as clear and real to satisfy individual interests and needs.

A Study of Internet situations with Smileys

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Abstract: "Smileys" are part of the Netspeak (Crystal, 2001), which is considered a hybrid of spoken and written languages. Because literacy practices are embedded in contexts (Barton, 1994), online literacy practices should differ depending on the Internet contexts or Internet situations. The current paper intends to validate the conceptualization of "Internet situations". It also aims to refute Crystal's lumping of asynchronous discussion board and synchronous chat as one type of Net situation. Comparisons were made of the frequencies of smileys in three online communication media: instant massager, email, and discussion boards. Findings indicate that "time" and "personal" dimensions to be useful parameters of Internet situations.

Introduction

The prevalence of "faceless" computer-mediated communication (CMC) (Voiskounsky, 1998) has resulted in the development of "smileys" or "emoticons". Smileys are signs meant to mimic the human facial expressions that reflect an individual's emotional state. It has been postulated that the online use of smileys is on the order of compensation for the lack of emotional richness in electronic communication (Crystal, 2001; Voiskounsky, 1998). Crystal (2001) further stressed the essential role of smileys in the emergent "Netspeak."

A discussion of Netspeak – the language of Internet communications – could not do without the context of "spoken" and "written" languages because Netspeak is the meeting point of the two (Crystal, 2001). In an analysis of Netspeak based on seven criteria that differentiate written and spoken languages, Crystal found that Netspeak is closer to written than to spoken language.

Since the development of language and literacy are inseparable from contexts (Barton, 1994), the diversity of possible Net discourse contexts infers the inherent heterogeneity in literacy practices via Internet media. Crystal (2001) proposed four categories of social situations in which Netspeak occurs, calling them "Internet situations." By comparing discourse patterns among different Internet situations to those of spoken and written languages, Crystal concluded that the degree of similarity between Netspeak and written or spoken language is dependent on the context. For instance, it was found that language used in chatroom discourse is closer to spoken language than is that used in Web-page presentation.

As part of Netspeak, the evolution of smileys has also been influenced by social and cultural contexts. Observations on the development of smileys (as well as Netspeak, itself) indicate an emerging divergence – as opposed to convergence – in Net-linguistic evolution. A comparison of the English and Japanese smileys indicates that the differences are deeper than in the "face" value (i.e., the form); variation in socio-cultural values is also evident. For instance, since it is impolite for a Japanese lady to show her teeth while smiling or laughing, a female smile is presented as "^.^" rather than "^_^". Given that the users and the environment are the developmental outcome of the social and cultural contexts, the development of Japanese smileys provides a good example for the social construction of language and literacy practices. While the aforementioned example points out the impact of the cultural context on online literacy practices, the following section examines the role of online situations on the occurrence of literacy events and the defining dimensions of these situations.

Since literacy practices are situation-dependent (Barton, 1994), practices involving the use of smileys should also vary in accordance to the situation. Crystal (2001) lumped the synchronous chat and asynchronous discussion into one Internet situation. Because the lag between messages is one major difference between spoken and written languages, the time factor should play an essential part in the ecology of online communications. Thus, given its asynchronous nature, online discussion would share a higher degree of similarity with e-mail than with online chat. Moreover, discussion board postings are viewed by the public and aim to communicate facts and ideas. When compared to discussion postings, e-mails are more likely to be used for social and unplanned discourse. Thus, given the degree of "personal" involvement, there should be a higher degree of similarity between e-mail and chatroom than between discussion board and chatroom. Furthermore,

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spoken languages are enriched by emotional signals, like facial expressions, of which written languages are deprived. Given that the introduction of smileys aims to compensate for the lack of emotional richness, it is postulated that there will be a higher degree of smiley usage in those Internet situations most similar to spoken discourse. Thus, when comparing the usage of smileys in chat, e-mail, and discussion situations, the highest degree of smiley usage would be expected to occur in the chatroom and the lowest on the discussion board.

Method

100 recent postings in discussion boards for three distance learning courses; 100 e-mails for both business and personal purposes; and 100 instant messages were collected. While 18 e-mails and 57 instant messages contain at least one smiley face, smiley faces appear on 15 of the discussion board postings. T-tests were performed to examine whether there are significant differences in the occurrences of smileys across Internet situations. While no significant differences were found between the e-mail and discussion board situations, smileys appeared significant more frequently in instant messages when comparing to the e-mail ($t=6.40$, $df=198$) and the discussion board ($t=6.85$, $df=198$) situations. Similar findings have been reported in a previous study (Af Segerstad & Ljungstrand, 2002).

Findings

The large smiley difference between chat and discussion implies an inherent difference between the two forms of discourse, which contradicts Crystal's (2001) categorization. The current findings imply that, while there is a large difference between the chat situation (i.e., instant message) and the other two, that between the e-mail and discussion situations is not as salient. Such findings imply a "time" dimension for Internet situations because, while the use of instant messaging is mostly associated with synchronous CMC, e-mailing and postings in discussion boards are media for asynchronous CMC. Moreover, in the current study, the instant messaging was for personal purposes, while the use of discussion forums was for public purposes (e.g., delivering facts and ideas). Serving both personal and business purposes puts e-mailing in the middle situation between discussion and chat. Such observation further insinuates a "personal" dimension for Internet situations.

The current paper rests on the assumptions that the emergent "Netspeak" exists and that smileys are a sub-component of Netspeak (Crystal, 2001). One major purpose of the study was to validate the conceptualization of "Internet situations" by conducting a case study about the usage of smileys. While findings seem to support the notion of such conceptualization, discussions also point out that the "time" and "personal" dimensions might be two useful parameters to describe Internet situations. It is suggested that future research should focus on refining the conceptualization of Internet situations and their defining parameters. Such efforts would be useful in establishing a conceptual framework, which could aid in untangling the topic of "Internet literacy." It should be noted that the current study was based on data collected from only 1 subject, which cast doubts on the generalizability of the results. A larger sample will be required to establish the generalizability of the given findings.

Reference

Af Segerstad, Y. H. & Ljungstrand, P. (2002). Instant messaging with WebWho. *International Journal of Human-Computer Studies*, 56 (1), 147-171.

Barton, D. (1994). *Literacy: An introduction to the Ecology of Written Language*. Malden: Blackwell.

Crystal, D. (2001). *Language and the Internet*. Cambridge, UK: Cambridge University Press.

Pollack, A. (1996). Happy in the East (^_^) Or Smiling :-) in the West.
http://www.nytimes.com/library/cyber/week/0812smile.html

Voiskounsky, A. E. (1998). Internet: Culture diversity and unification.
http://www.it.murdoch.edu.au/~sudweeks/catac98/pdf/07_voiskounsky.pdf.

Problem-Based Learning in an On-Line Biotechnology Course

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Abstract: Biotechnology in Agriculture, Food, and Human Health is a World Wide Web course developed by Project BIO, a program to develop and share Internet biology education resources, at Iowa State University. This course has been utilizing problem-based learning as a mode of instruction in a unit dealing with pre-symptomatic DNA testing for a genetic disease. Problem-based learning is the use of a "real world" problem or situation as a context for learning. Quantitative and qualitative assessments of student gains in critical thinking, improvements in ability to solve real-world problems, acquisition of knowledge, development of the ability to work productively as a team member, and development of skills supporting life-long learning were analyzed. The current study indicates that problem-based learning is a valid and efficient means of expanding student learning in on-line courses.

Problem-based learning (PBL) is an increasingly integral part of education reform around the world. The essence of PBL can be summarized as the use of a "real world" problem or situation as a context for learning (Duch, 1995). The purpose of PBL is to increase education's relevance to the perceived needs of the professional community, and to increase the problem-solving abilities of graduates, by having design problems presented in class that resemble reality (Cowdroy, 1994). Learning objectives in PBL situations include the development of critical thinking skills, development of a high professional competency, development of problem solving abilities, acquisition of knowledge, development of the ability to work productively as a team member and make decisions in unfamiliar situations, and acquisition of skills that support self-directed life-long learning, self-evaluation, and adaptation to change (Albanese and Mitchell, 1993; Ryan and Quinn, 1994). The student learns in the context of a real-world problem, which may lead to a desire to successfully solve the problem because the student has internalized the problem (Schmidt, 1993). PBL has traditionally been conducted in cooperative learning groups in a face-to-face setting. Less is known about its use in the virtual environment (Camp, 1996).

A problem-based learning approach is being tested in an on-line course entitled "Biotechnology in Agriculture, Food and Human Health" offered by Iowa State University. This is a three-credit survey course that covers biotechnology and its applications as well as associated ethical, legal and social issues. The biotechnology course consists of on-line audio-visual lectures that are modeled after lectures in a face-to-face classroom, experiential learning assignments and reading assignments. About 50% of the grade in the course is based on experiential learning activities and the other 50% is from on-line exams based on content in the on-line lectures and reading material.

Design of the Problem-based Learning Unit and Assessment

In the unit, students assume the role of a 29 year-old man whose mother died of a genetic disease called Huntington's disease. The ultimate objective of the activity is to make a decision about whether the man should undergo pre-symptomatic DNA testing for the genetic disease.

Two versions of the PBL unit were tested. Version 1 had three assignments (Defining the Issues, Gathering Information, and Solving the Problem), which served as guiding problems for the unit. All of the assignments were done as cooperative learning activities involving groups of 2 or 3 students.

A problem with the first version of the PBL unit was the narrow focus on just one genetic disease. Because of this the unit was revised by replacing the Gathering Information assignment with two other assignments, Genetic Diseases and Genetic Testing, which gave the students a broader view of the subject. The other two assignments, Defining the Issues and Solving the Problem, were used unchanged in Version 2 of the PBL unit.

Evaluation of the Problem-based Learning Unit

Students using PBL Version 1 took a non-credit pre-module exam containing questions from the same test bank (thus, the same difficulty) as the for-credit post-module exam. Results indicated that students experienced a significant gain in factual knowledge about genetic testing during the unit.

We also compared student performance on the post-module exam with the performance of students who took the course prior to developing the PBL unit. The Genetic Diseases module was initially taught using an instructor-centered approach. The exam scores for students taking either version of the PBL unit were not significantly different from those of students taking the module in the instructor-centered mode (pre-PBL). This suggests that teaching the module in a problem-based mode does not compromise the acquisition of factual knowledge.

Average grades for the Genetic Diseases, Genetic Testing and Solving the Problem assignments were 90%, 91% and 92%, respectively. This indicates that significant higher order processing of the fact-based information was occurring.

Student evaluations of the PBL unit were positive when asked to evaluate the accomplishment of learning objectives. Student attitudes toward the two PBL versions were similar in both quantitative and qualitative measures. The cooperative learning aspect of the PBL offered students experience in time management, schedule coordination, and division of labor. However, some students expressed concerns about scheduling difficulties for synchronous electronic meetings with their cooperative groups, and the technical difficulties inherent in an on-line setting (such as Internet lag, computer crashes, or bandwidth or browser problems). In addition, group activities decrease some of the temporal and geographic flexibility advantages that asynchronous on-line courses offer.

Conclusions

Learning objectives in PBL situations include the development of critical thinking skills, professional competency, problem-solving abilities, the acquisition of knowledge, the ability to work productively as a team member, and the acquisition of skills supporting life-long learning (Albanese and Mitchell, 1993; Ryan and Quinn, 1994). The assignments and exams for the PBL were designed to evaluate the achievement of the first four of these objectives, while student evaluations allowed us to evaluate the achievement of the final two. The reports by the student groups indicate a high level of internalization, synthesis, and discursive construction of knowledge, integrating their learning of material from this course with their individual background and experiences, fused to a common consensus within the student groups. Evaluation of exam scores indicates that significant factual knowledge is acquired through the PBL format. While PBL did not increase factual learning over the non-PBL format, it did not appear to negatively compromise factual learning, either. Student evaluations of this unit indicated that the final two objectives were met in a realistic fashion. Although students did note a few difficulties with the PBL format in the on-line setting, we feel with student performance on this unit that the advantages of the cooperative PBL format balance the disadvantages experienced by certain students and student groups. Our experience indicates that PBL is a valid means of expanding student learning in on-line classes.

References

Albanese, M. A., and Mitchell, S. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine* **68**: 52-81.

Camp, G. (1996). Problem-based learning: A paradigm shift or a passing fad? *Medical Education Online* **1**: 2.

Cowdroy, R. M. (1994). Concepts, constructs and insights: The essence of problem-based learning. *Reflections on Problem Based Learning* (S. E. Chen, R. Cowdroy, A. Kingsland, and M. Ostwald, eds.). Sydney: Australian Problem Based Learning Network. 45-56.

Duch, B. J. (1995). What is problem-based learning? *About Teaching* 47: 4.

Ryan, G. L., and Quinn, C. N. (1994). Cognitive apprenticeship and problem based learning. *Reflections on Problem Based Learning* (S. E. Chen, R. Cowdroy, A. Kingsland, and M. Ostwald, eds.). Sydney: Australian Problem Based Learning Network. 15-33.

Schmidt, H. G. (1993). Foundations of problem-based learning: Some explanatory notes. *Medical Education* **27**: 422-432.

The Design of a Web-Based Calculus Learning Environment

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Background

For most students in the department of Information Management, "calculus" has always been one of the most difficult courses to study. The largest part of reason for their problems results in their previous educational experiences. For the past educational system in Taiwan, students have to pass the entry exam in order to enter colleges. Therefore, students know how to take tests without understand the underlying concepts of the test items. Although calculus teachers often use visual aids to demonstrate concepts, students usually do not have the ability or enough information to understand. As a result, more and more students fail calculus course, and have to take it repeatedly. It has always been the major concern for the calculus teachers to find a way to solve the problem.

Web-based learning environments have been the main trend for education in the last few years. The unique function of web-based learning environment provides teachers a space to upload their teaching materials, a location to interact with individual student, and to trace students' learning progress without time constraint. web-based learning environment also offers students the opportunity to interact with others, to review learning materials whenever they needed, and to share their thoughts with fellow students and teacher. Due to the promising multimedia and web technology, calculus teachers will be able to demonstrate abstract concepts in a understandable manner, to provide step by step guiding on how to solve calculus problems, and to monitor students' problem solving pattern in problem solving activities.

The purpose of this study is to design a web-based calculus learning environment to supplement the traditional classroom teaching, and to exam the effectiveness of this web-enhanced learning environment on calculus learning. It is hoped that through detailed investigation, this study will contribute additional information to the design of web-based learning environment, and provide guideline for teachers and instructional designers to construct better environment for procedure knowledge learning.

Theoretical Framework

In the learning process, failures to access and use potentially relevant information result in failure to transfer (Bransford, et al., 1990). A few studies suggested that when information is introduced in a problem-solving context, it is more likely to be used in new context (Adams, et al., 1988; Lockhart, Lamon, & Gick, 1988; Perkins & Salomon, 1989). Many research have found that working on projects or problems is an engaging activity with potential for facilitating learning (Blumenfeld et al., 1991; Katz, 1994; Moursund, 1999).

Constructivist theories support the development of open-ended learning environments, and tend to favor problem-solving activities that are linked to student interests, that have some attributes of real-world problems, and that are meaningful and satisfying for students to solve. From the constructivist perspective, interest is the fuel of the constructive process. Without interest, the learners will never make the constructive effort to make sense out of experience (DeVries, 1993). Learning should be an active, constructive process whereby learners generate meaning for information by accessing and applying existing knowledge (Jonassen, 1988). The majority of learning theories guiding web-based instruction are based on the constructivist principles.

The design of web-based instruction should integrate the constructivist principles, instructional implications and the Web features, such as hyperlink, multimedia, and synchronous and asynchronous communication (Khan, 1997). Hyperlink structure enables learners to build their own representation of knowledge, and control content sequencing. Multimedia material provides a variety of presentation of learning materials. Different modes of communication support collaboration learning that enables learners to construct knowledge (Miller, & Miller, 2000). How to design a web-based learning environment that presents learning materials meaningfully, that provides authentic problem-solving activities, that implements the unique web technology in the learning activities, that offers teachers and students a space to convey information and construct knowledge is a big challenge for educators and instructional designers.

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Web-Enhanced Learning Environment

The content of the web-enhanced learning environment focused on the differential calculus. There are seven sections in the web environment:

1. Learning Material Bank:

   This section uses hypertext and multimedia to present information and to demonstrate concepts. Due to the nature of the calculus concepts, many animation clips were designed to provide additional information channels on problem solving process. Real-world situations were connected to more difficult and abstract concepts that were demonstrated by interactive multimedia segments.

2. Test Bank:

   This test-item database provides three different levels of test items. Based on their ability, students can select the appropriate level of tests to evaluate their understanding on learning materials. After the test, the program will provide a test report that will indicate the test items missed by the students. This report also has hyperlink linking the missed test item to the relevant learning section. This test bank can also be used as on-line tests during the class.

3. Guided-problem-solving section:

   This section, based on the scaffolding principles, provides step-by-step guiding in solving problems. The problems presented in this section are also related to students' daily life experience. Students can solve problems directly or choose guiding whenever they encounter problems.

4. Problem-based learning section:

   This section requires cooperative learning in groups. The problems are real world situations that involve students in problem-solving, decision making, give students the opportunity to work autonomously over extended periods of time with group members; and to present the solutions. Students can use e-mail or chat room or discussion center to communicate and interact with each other. All the discussion and problem solving process will be stored as log file for further investigation.

5. Mathematical place:

   The history of mathematics, mathematicians and web links are presented in this section, giving students additional knowledge on mathematics.

6. Record tracking:

   Students' learning paths, test record, and discussion will be stored in the tracking database. Teachers will be able to track down individual student, or groups to monitor their learning progress.

7. Idea sharing:

   Students use this section to share their ideas, thoughts, or new problem-solving skills with other students and teacher, and to express their feeling about the course or learning materials. It also gives teachers the opportunity to understand students' thinking and comprehension of the course.

The effectiveness of this learning environment will be evaluated in the next school year.

References

Adams, L., Kasserman, J., Yearwood, A., Perfetto, G., Bransford, J., & Franks, J. (1988). Memory access: The effects of fact-oriented versus problem-oriented acquisition. *Menory & Cognition, 16*(2), 167-175.

Blumenfeld, P.C., Soloway, E., Marx, R.W., Krajcik, J.S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist, 26,* 369-398.

Bransford, J. D. Sherwood, R. S., Hasselbring, T. S., Kinzer, C. K. & Williams, S. M (1990).Anchored instruction: Why we need it and how technology can help. In D. Nix & R.Spiro (Eds.). Cognition, education, and multimedia: Exploring ideas in high technology,(pp. 115-141). Hillsdale, NJ: Lawrence Erlbaum Associates.

DeVries, R. (1993, April). Using constructivist theory and research to design a framework for curriculum and assessment. Paper presented at the Annual Meeting of the American Educational Research Association, Atlanta, GA.

Kahn, B. H. (1997). *Web-based instruction.* Englewood Cliffs, NJ: Educational Technology Publications.

Katz, L.G. (1994). *The project approach.* http://ericps.crc.uiuc.edu/eece/pubs/digests/1994/lk-pro94.html

Jonassen, D. H. (1991). Evaluating constructivistic learning. *Educational Technology, 31*(9), 28-33.

Lockhart, R., Lamon, M., & Gick, M. (1988). Conceptual transfer in simple insight problems. *Menory & Cognition, 16*(1), 36-44.

Miller, S. M & Miller, K. (2000). Theoretical and practical considerations in the design of web-based instruction. In B .Abbey (Ed). *Instructional and cognitive impacts of web-based education* (pp156-177). Hershey: Idea Group Publishing.

Moursund, D.(1999) *Project-based learning using information technology*?OR: International Society for Technology in Education Books and Courseware Department.

Perkins, D., & Salomon, G. (1989). Are cognitive skills context-bound? *Educational Researcher, 18*(1), 16-25.

Enhancing Distance Education with Aglets*

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Introduction. In this paper, we propose using aglets, a specific type of Java-based mobile agents, to enhance distance education. The Internet has become a ubiquitous environment for students, researchers, and educators to share resources, exchange information, distribute reports, and collect data since the creation of the World Wide Web (WWW). Among the many factors that have contributed to the unquestionable success of the Internet, the wide availability and ease use of computer software programs have played an important role, in addition to the increasing bandwidth of the communication networks. Most of the software programs currently in use on the Internet, however, are either stationary or reactive, meaning that during the execution of a task the code stays in a given host until the task is completed. Although the code of the agent can be transported from one host to another, it is transferred without carrying any state. On the other hand, mobile agents are software programs that can be instructed to halt its execution on a given host, travel with the current state to other participating hosts across a network and continue execution there. They can also be retracted back to its original host if necessary. Mobile agents offer certain capabilities that are not readily available with stationary agents.

What Are Aglets. An aglet is a software agent implemented with Java using the IBM Aglets Workbench, developed at the IBM Tokyo Research Laboratory [LaOs98, URL01]. The term *aglet* is really a combination of two words: *agent* and *applet*. An agent is in general referred to as an autonomous software program that acts as a representative of some user, and an applet is a Java class (a piece of Java code) that can be transported, at the user's request, from a web server to a web client and then executes on the client machine as a thread within a browser. Although aglets can be stationary, the main objective of the Aglets Workbench is to allow users to develop mobile agents and the majority of aglets are indeed mobile agents. For this reason, aglets are often referred to as Java-based mobile agents. Aglets have three important properties: behavior, state, and location. They differ from applets in that applets, once downloaded and instantiated, begin execution in the client machine until all specified tasks are completed, while aglets can travel (either reactively or proactively) with their current state from a participating host to another participating host across a network, including possibly returning to its origin and distribute their tasks among all the hosts in the itinerary. Aglets also differ from servlets in that the latter are uploaded from a client, or from some host in the network, to a Java-enabled web server and get executed in the server during their entire lifetime. The relationship between a web browser and a web server is basically a client-server model. Each running aglet server, however, is a peer-to-peer process.

Specific Aglets for Educational Enhancement. There are many good reasons for using mobile agents. Seven of them are presented in [LaOs99], including the potential for reducing network traffic and overcoming network latency, the ability to encapsulate protocols, execute asynchronously, and adapt dynamically, and the capability of lending themselves to heterogeneous, robust, and fault-tolerant processing. Since aglets are in general mobile agents, they enjoy most of the benefits that can be offered by mobile agents. It should be mentioned, however, that very few problems, if any, that can be handled using aglets cannot be solved using traditional stationary agents or mobile code such as applets and servlets. The question of which type of software should be used certainly depends on several factors: the nature of the application, the latency of the network, the connectivity of the host, the relative size of code transfer vs. data transfer, and the frequency of such transfer, just to name a few. Mobile aglets have many applications on the Internet [KiZi97, KoGr99]. In the following, we briefly describe some specific aglets that need to be developed in order to achieve our goal to enhance distance

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education. These include *a message broadcast aglet, homework assignment distribution aglet, homework assignment collection aglet, grade report aglet, progress monitoring aglet, file transfer aglet, and communication aglet with textual, graphical, audio and video support.*

The *message broadcast aglet* is for the instructor to deliver notices, announcements, and/or other urgent messages to all students simultaneously in a timely fashion, one aglet for each student. Upon receiving such an aglet, the student should respond to the aglet indicating the receipt of such a message. This aglet then carries the response back to its originating host and stores the response information in a log file to let the instructor know if all students have received such a message. The *homework assignment distribution aglet* works in a way similar to the message broadcast aglet, except that the aglet carries the assignment to the student's host in a form of files and store the assignment to a file or files. The announcement of the assignment can be sent using the message broadcast aglet at any convenient time. The *homework assignment collection aglet* is sent to the student's host to automatically collect the assignment conducted by the student when the assignment is due, instead of asking the student to submit their assignments to some specified server. One way of making this automatic collection possible is to specify the use of a unified filename. In other words, all students should perform their work or store their finished work in a file and use the same filename for a given assignment. At the instructor's host, a directory can be created for each student and for each assignment. This directory is used to store the work collected from the student. The *communication aglet* is for message exchanges among students and between students and the instructor. To initiate communications, the user must have one of such aglets ready for use at his/her own host. It is not required, however, that the responding party preinstall that aglet beforehand since the aglet that initiates the communication can carry the necessary functionality to the other party. Therefore, each student can have his/her own favorite communication aglet, if one available to them. This is an obvious advantage over the current communication systems such as NetMeeting, ICQ, or Messenger because the use of them requires pre-installation of the same software by each participating user before a conversation can begin. The tradeoff here is the initial transfer of the aglet itself over the network at each initiation of the conversation. A prototype communication aglet that allows for textual and handwriting message exchanges has been developed in [ChTu01]. In addition to the aglets mentioned above, a *grade report aglet* and a *progress monitor aglet* can also be designed to allow students to obtain their grades at the end of the semester and to allow the instructor to monitor the progress of the student during each homework assignment, respectively.

Conclusion. The Internet has become a ubiquitous environment for resource sharing, data collection, data distribution, information exchange, and global communications nowadays. Most of the software agents currently in use on the Internet, however, are stationary. In this paper, we proposed using aglets to enhance distance learning and administration. Several specific aglets for educational use have been addressed. These aglets offer certain capabilities that are not readily available with stationary agents

References

[ChTu01] Hsin-Chu Chen and Jho-Ju Tu, Mobile agent approaches for developing communication systems with handwriting capabilities, in Advances in Signal Processing, Robotics and Communications (Editors: V.V. Kluev and N.E. Mastorakis), WSES (World Scientific and Engineering Society) Press, 2001, pp.303-309.

[KiZi97] Joseph Kiniry and Daniel Zimmerman. A hands-on look at Java mobile agents, IEEE Internet Computing, pp. 21-30, July.August 1997.

[KoGr99] David Kotz and Robert S. Gray. Mobile agents and the Future of the Internet. ACM Operating Systems Review, 33(3), pp. 7-13, August 1999.

[LaOs98] Danny B. Lange and Mitsuru Oshma. Programming and Deploying Java Mobile Agents with Aglets. Addison-Wesley, 1998.

[LaOs99] Danny B. Lange and Mitsuru Oshma. Seven good reasons for mobile agents. Communications of the ACM, 42(3), pp. 88-89, March 1999.

[URL01] http://www..trl.ibm.com/aglets/

Design of Web-based Adaptive Learning System

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Abstract: Web-based education systems are becoming increasingly popular in recent years; however, most of the systems developed so far use static hypermedia as the manner of representing contents. It's a challenge to develop advanced Web-based education applications that can offer both adaptivity and intelligence. This paper will review some related works in this area and present a design of advanced Web based learning system that support adaptive presentation, adaptive navigation and adaptive help.

Keywords: adaptive hypermedia, adaptive presentation, adaptive navigation, adaptive help, User Model

1 Introduction

Advantages of web-based education systems which are becoming increasingly popular in recent years have been discussed in many papers. Learning resources are becoming unprecedented abundance in the web. This is just the start and the trend is going to last for a long time.

In spite of all the popularities, the uses of web-base educational applications are still at a very low level. According to the authors of [1], web-based education systems can be classified into three levels: Base level, State-of-the-art level and Research level. The majority of education systems currently being used are either base level or State-of-the-art level; multimedia resources, structured contents and multiple navigating ways are the distinct features of these systems. In these systems, however, contents are presented using static hypermedia. The advanced web-based educational systems, which are in research level, inherit some merits from intelligent tutoring system (ITS), hypermedia system and adaptive system. Their distinct features are adaptivity and intelligence. In this article, we refer the former as the first generation web-based education systems and the later as the next generation systems. In fact, researches on web-based instruction theory, instruction model and advanced instruction tools or platforms lagged the progress of the Internet technologies.

Most of web-based education systems in research level have not yet found their way to real-world virtual classroom. There are only a few being used in relatively small classes. There have been many researchers actively involved in this challenging area since 1996. In [2], adaptive and intelligent technologies applied in Web-based education systems were reviewed and grouped by its origin as follows.

- ITS technologies in Web-based education curriculum sequencing, problem solving support technologies.
- Adaptive hypermedia technologies in web-based education: adaptive presentation and adaptive navigation support.
- Web-inspired technologies in Web-based education: these technologies had little use in educational systems before the Internet age. In [2], such technology is called student model matching because the essence of this technology is the ability to analyze and match student models among many students at the same time. Two examples of student model matching were identified, which were called adaptive collaboration support and intelligent class monitoring.

Intelligent problem solving support technologies use AI extensively. These technologies are closely related to application domains and are difficult to generalize, thus they will stay on research level for a long time. On the other hand, adaptive presentation, adaptive navigation support and model matching technologies are relatively easy to implement in web, and general authoring tools can be developed and deployed in large mount of education systems.

This paper is organized as follows: Section 2 gives a brief review of previous researches on adaptive presentation, adaptive navigation support and model matching in web-based education systems. Section 3 introduces some function zones in web-base course pages. Section 4 describes the design procedure of web-based course which utilize the above technologies. These procedures can be generalized and be made into software tools used in all web-based courses.

2 Quick Review of Related Work

The first comprehensive review on adaptive hypermedia system can be found in [3]. In [4],[5], the author continued tracing research progress in this area. In [3], Brusilovsky distinguished two adaptive methods in hypermedia systems: adaptive presentation and adaptive navigation support.

The following techniques for adaptive presentation were mentioned:

- Conditional text
- Stretch text
- Fragment variants
- Page variants
- Frame-based techniques

The techniques for adaptive navigation support listed in [Brusilovsky 1996] [De Bra 1998] are as follows:

- Direct guidance
- Link sorting
- Link hiding, link disabling, link removal
- Link annotation
- Map adaptation (provide personalized overview)

Most of adaptive hypermedia are education hypermedia, Such as [6],[7],[8],[9],[10], which demonstrate some of the technologies mentioned above.

Research on general model of AHS and its formal descriptions can be found in [11],[12]. In [11]], An adaptive hypermedia application is defined as a 4-tuple <DM, UM, TM, AE> where DM is a domain model, UM is a User Model, TM is a teaching model, and AE is an adaptive engine.

Some AHS authoring tools such as Interbook [13], AHA[14] and NetCoach[15] have been developed in recent years. InterBook is a tool for authoring and delivering adaptive electronic textbooks on the World Wide Web. The main feature of InterBookis is that it provides a technology for developing electronic textbooks from a plain text to a specially annotated HTML. AHA is an open Adaptive Hypermedia Architecture whose core is an engine that maintains a user-model based on knowledge about concepts. The content of a page can be adapted by means of fragment variants. The links are annotated by changing the color of the link anchor. NetCoach is designed to enable authors to develop adaptive learning courses without programming knowledge. It provides web-based tools for the teacher to author course structure, exercises and to customize user interface.

As for adaptive collaboration support, an example in this area can be found in [16]. This paper reported an Intelligent Helpdesk system which integrated two cognitive tools: CPR (Cooperative Peer Response)[17] and Phelps(Peer Help System). The former is a discussion forum collaboration tool that is customizable to a particular course, providing peer help and FAQ facilities via the web. Every entry in the discussion forum and FAQ were indexed by a class-specific category or topic. Phelps supports student as they are learning, offers assistance in finding peer helpers by model matching when required, and mediates communication on related topics.

In this paper we will analyze learning environment in web-based course systematically, then propose a design scheme, which integrate adaptive content and adaptive help.

3 Function zones in web-based course

In perspective of function, a page in the most of web-based course can be divided into three zones:

- Function zone: most of learning tools are shown in this zone. It looks like menu or tool bar in application software. The content in this area is almost the same in all pages of this course.
- Navigation zone: it helps users to learn about the structure of the web-based course or to guide them through it. Usually it consists of structuring index table and some navigation buttons.

- Content zone: It comprises material (content, examples, exercises etc.), which is main part of a page. Some navigation buttons are also included.

These zones are separate in frames, and every zone is an independent html file. They can also appear in a single html file with table to separate them.

In the above adaptive hypermedia, the adaptivity is mainly embodied in navigation zone and content zone. For example, in Interbook, adaptive navigation support lies in annotation in index table and direct guidance button in content zone. In AHA, adaptive presentation is shown in content zone hyperlinks in content zone also included.

Besides, we should see that tools in function zone are important parts of the web-based course environment. These tools can be content table, search tool, bookmark, help tool, communication tool, etc. Actually, many other tools can be easily added to the function zone. Most of them are independent and can be designed and implemented individually. When needed, they can be linked into function zone. So, in this paper, we will not discuss design of such tools. What we concerned is only adaptive help tools that share the same User Model and domain model with adaptive hypermedia.

4 Designs.

Our schema is a user-model centered integrated learning system feature adaptive presentation, adaptive navigation support and adaptive help. When a course is delivered via the net, the system structure can be shown as Fig.1.

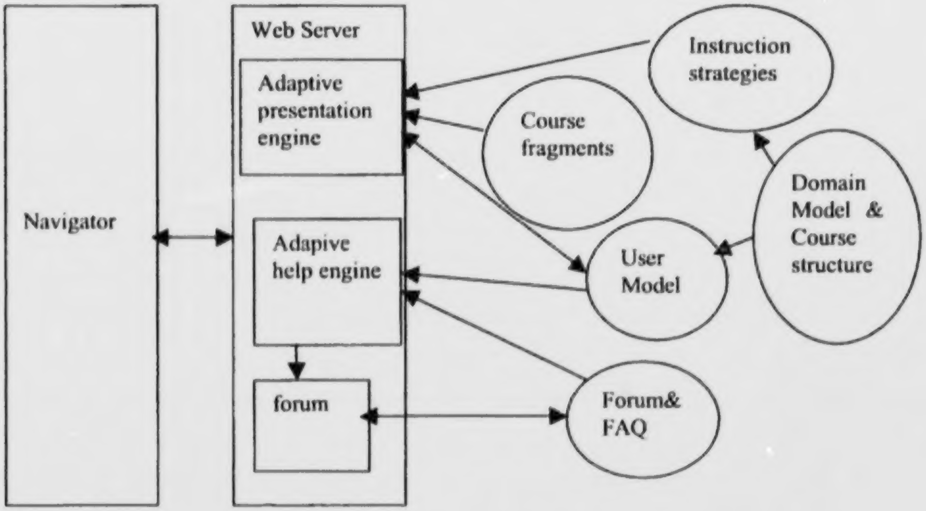

Fig 1 System Structure of Adaptive Learning System

The following are design steps of an online course for a teacher:

1. Extract set of concepts (SCs) from the given domain; set of goals (SGs) and set of background knowledge (SB) are also specified by the teacher.
2. Design curriculum structure. Usually, each curriculum is divided into chapters, sections and points of knowledge; these elements are grouped in a tree structure. Each node of the tree has a corresponding page. These pages are called "virtual pages (VPs)" since they are not real html files, but only comprise structure description of a page.
3. Construct knowledge fragments (KFs). They can be done using web page authoring tools. These fragments can contain all kinds of media as well as hyperlinks. They can be explanations of concepts or examples; each concept can be presented by different explanations and different

examples. Every fragment has a set of attributes (concept, role, object etc.).

4. Virtual Page (VP) consists of knowledge fragments (KFs). In order to make these pages show different contents to different user, construction rules must be applied to these pages. These rules will make sure that different user with different background or different learning goal will see different contents.
5. Each virtual page will have its own sets of prerequisite concepts and output concepts. This information will be used to implement adaptive annotation and direct navigation.
6. There will be one set of tests (STs) for each of the virtual page. These tests will be used to analyze the mastering state of users on these concepts.

The data parts of web based learning system are made up of SCs, SGs/SB, VPs, KFs, STs and User Model. User Model consists of user's knowledge level, learning goals as well as their background. User's knowledge level is an overlay model. For each domain model concept, an individual overlay model stores some value which is an estimation of the user knowledge level of this concept. This can be just a binary value (known-not known), a qualitative measure (good-average-poor), or a quantitative measure, such as a probability that the user knows the concept. An overlay model of user knowledge can be represented as a set of pairs "concept-value", one pair for each domain concept[3].

An adaptive engine will be used to generate web page dynamically based on values in the User Model and other data listed above when the curriculum is delivered via web; the pages demonstrate the features of adaptive content and adaptive navigation. When a user access a virtual page (VP), an adaptive engine will act as following:

Generation of content zone:

1. Generate contents of page (P1): Content of a page consists of KFs. The ways to combine these KFs are decided by page construction rule. Goal value and background in User Model will be used as rule is executed.
2. Analyze hyperlinks in P1; generate a new page (P2) using appropriate annotation. Knowledge level in the User Model will be used in this step to decide how hyperlinks are displayed. For example, if a user is not prepared to visit a page, the link for that page will be hidden or marked in red color; Links to mastered contents will be gray out; Links to accessible pages will be displayed in green.

Generation of navigation zone:

Every page in VPs has a set of prerequisite concepts and ouputt concepts; this makes it easy to mark the index table of curriculum contents separately based on the knowledge level in User Model. User can set the way of marking index table. Index table can be marked in different colors or different icons. It's a good practice to keep the style of index table annotation in line with the marking of hyperlinks in the content zone. The button for next step (direct navigation indicator) can be generated based on information in the User Mode, also.

The final page a user can see is generated after the processing of all information mentioned above.

Maintenances of User Model

The User Model can be maintained based on the way user browsing the pages (including pause time) as well as scores of tests on these contents. The later will be reliable source for judging user's mastering of related concept.

Adaptive help

Information of this kind of Domain Model and User Model can be used to generate adaptive help as well as make class contents and navigation adaptive. Help system is a tool which resides in the function zone (on a page). The help system is a discussion forum; each topic of the forum is indexed by concepts in Domain Model. When user wants to submit a question, the user must select one or more concepts (from the list). The system can use the user input to make sure that all FAQ and contents of discussion forum are correspond to the (user selected) concepts. This approach makes help system more adaptive. When a user click the help button while viewing a page, the help system will act as following:

The system know the page from which the help is required, and then it will know the concepts referred to on that page. The system can generate a help page based on that information.

The indexes of prerequisite knowledge for these concepts are displayed on top of the generated help page. User can visit that prerequisite knowledge by clicking those links.

Answers to questions on the concepts are also displayed on the help page. These answers are extracted from FAQ and discussion forum.

User can resubmit question if the desired help information is not found on the returned page.

Help information from this help system is generated according to the position of current question as well as knowledge level of the User Model. The system utilizes entries indexed by concepts of Domain Model and User Model to generate personalized help information.

Based on what we presented above, there are a lot of works need to be done to design Web based adaptive learning systems. Our goal is to design a set of tools that can be used by teachers to fulfill all those steps mentioned above. These tools include:

- Tools of define domain concepts, learning goal and background knowledge
- Tools of define class structure
- Tools of define rules of page construction
- Tools of define prerequisite concepts and output concepts
- Tools of create exercises
- Adaptive engine
- Help engine
- Discussion group on indexes for domain concepts

The procedures and tools mentioned above are general purpose, they can be used on all kind of online course design and implementation.

5 Progress of the work

There have being more than thirty online universities in China, and thousands of curriculums are offered on line. There are more than fifty online curriculums being constructed in our university. The purpose of our work is to formalize the creation of online curriculums and to improve online education to a higher level. The distinguish feature of our system is adaptive and adaptable. Our work is still in the early phase; we believe that our work will be beneficial to distance education .

References

[1] Brusilovsky, P. and Miller, P. (2001) Course Delivery Systems for the Virtual University. In: T. Tschang and T. Della Senta (eds.): Access to Knowledge: New Information Technologies and the Emergence of the Virtual University. Amsterdam: Elsevier Science, 167-206.

[2] Brusilovsky, P (1999) Adaptive and Intelligent Technologies for Web-based Education. In C. Rollinger and C. Peylo(eds.), Special Issue on Intelligent Systems and Teleteaching, knstliche Intelligenz, 4,19-25.

[3] Brusilovsky, P. (1996) Methods and techniques of adaptive hypermedia. User Modeling and User-Adapted Interaction, 6 (2-3), pp. 87-129.

[4] Brusilovsky, P. (1998) Methods and techniques of adaptive hypermedia. In: P. Brusilovsky, A. Kobsa and J. Vassileva (eds.): Adaptive Hypertext and Hypermedia. Dordrecht: Kluwer Academic Publishers, pp. 1-43.

[5] Brusilovsky, P. (2001) Adaptive hypermedia. User Modeling and User Adapted Interaction, Ten Year Anniversary Issue (Alfred Kobsa, ed.) 11 (1/2), 87-110

[6] Brusilovsky, P., Schwarz, E., and Weber, G. (1996) ELM-ART: An intelligent tutoring system on World Wide Web. In C. Frasson, G. Gauthier, & A. Lesgold (Eds.), Third International Conference on Intelligent Tutoring Systems, ITS-96 (Lecture Notes in Computer Science, Vol. 1086), Berlin: Springer Verlag, pp. 261-269.

[7] P.De Bra and L.Calvi. Towards a Generic Adaptive Hypermedia System. Proc. Second Workshop on Adaptive Hypertext and Hypermedia, Pittsburgh, pp. 5-11, 1998

[8] Kay, J., & Kummerfeld, R. J. (1994). An individualised course for the C programming language. Proceedings of Second International WWW Conference, 17-20 October, 1994. Chicago,

[9] Pilar da Silva, D., Durm, R. V., Duval, E., & Olivié, H. (1998). Concepts and documents for adaptive

educational hypermedia: a model and a prototype . Computing Science Reports, Eindhoven: Eindhoven University of Technology, 35-43.

[10] Specht, M., Weber, G., Heitmeyer, S., & Schöch, V. (1997). AST: Adaptive WWW-Courseware for Statistics. In P. Brusilovsky, J. Fink, & J. Kay (Eds.), Proceedings of Workshop "Adaptive Systems and User Modeling on the World Wide Web" at 6th International Conference on User Modeling, UM97, June 2, 1997. Chia Laguna, Sardinia, Italy, Carnegie Mellon Online. - pp. 91-95,

[11] De Bra, P., Houben, G.J., Wu, H.,
AHAM: A Dexter-based Reference Model for Adaptive Hypermedia, Proceedings of the ACM Conference on Hypertext and Hypermedia, pp. 147-156, Darmstadt, Germany, 1999.
(Editors K. Tochtermann, J. Westbomke, U.K. Wiil, J. Leggett)

[12] Wu, H., De Kort, E., De Bra, P., Design Issues for General-Purpose Adaptive Hypermedia Systems. Proceedings of the ACM Conference on Hypertext and Hypermedia, pp. 141-150, Aarhus, Denmark, August 2001.

[13] [Brusilovsky 1998c] Brusilovsky, P., Eklund, J., and Schwarz, E. (1998) Web-based education for all: A tool for developing adaptive courseware. Computer Networks and ISDN Systems (Proceedings of Seventh International World Wide Web Conference, 14-18 April 1998, 30 (1-7), 291-300.

[14] De Bra, P., & Calvi, L. (1998). AHA! An open Adaptive Hypermedia Architecture. The New Review of Hypermedia and Multimedia , 4 115-139.

[15] [Gerhard 2001]Gerhard, W., Kuhl, H.-C. & Weibelzahl, S. (2001). Developing Adaptive Internet Based Courses with the Authoring System NetCoach. In: P. De Bra P. and Brusilovsky (eds.) Proceedings of the Third Workshop on Adaptive Hypertext and Hypermedia. Berlin: Springer.

[16] Greer, J., McCalla, G., Cooke, J., Collins, J., Kumar, V., Bishop, A. and Vassileva, J. (1998) The Intelligent HelpDesk: Supporting Peer Help in a University Course, In Proceedings *ITS'98*, San Antonio, Texas, LNCS No1452, Springer Verlag: Berlin pp.494-503.

[17] Thomson, J., Greer, J.E. and Cooke, J.E. "The Co-operative Peer Response system: CPR for students", Educational Multimedia and Hypermedia Conference, Calgary, June, 1997, 1239-1244.

Development and Implementation of Web-based electronic Teaching-Learning Unit Systems

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1. Introduction

In 21st century, information and knowledge are the motive power changing our society and the foundation of our country's competitive power. Information-using ability becomes a criterion to decide the competitive power, and the quality of knowledge and information which human and society possess determines the quality of human life. Accordingly, the Ministry of Education and Human resources development decided on the use of ICT (Information and Communication Technology) in education for students to obtain and practically use the fundamental knowledge about information making, processing, treating, analyzing, exploring, etc. Therefore, the Ministry encouraged every school to use 10% of class time at least to teach the knowledge about information in an instruction & learning procedure. Consequently, schools try to reform the classes according to the request of the Ministry and it produces a change of educational environment. As one of these efforts, various instruction-learning procedure ideas are being developed in schools at present.

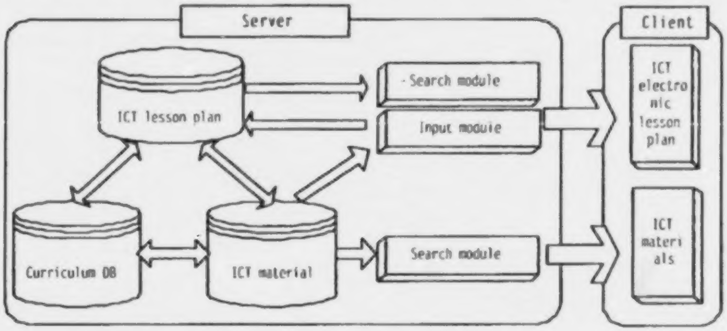
Many contents about education are constructed with web-based type, but the lesson plans have been written out with Word-processor. The Ministry recommends teachers to make a lesson plan using a Powerpoint. It is true that many lesson plans have been made and uploaded with board-type, so they are not saved in database in accord with educational curriculum. For these reasons, in this study, teaching-learning plans were designed as a form using ICT in education and developed as web-based electronic teaching-learning unit system that is available to prepare and use in web.

The contents and methods are following: First, the electronic teaching-learning unit using ICT was designed based on the existing various types of plans. Second, the system which teachers can form the teaching-learning plans in a web-based online situation was reflected to the total construction of this system. Third, according to the 7th educational curriculum and the type of the teaching-learning plans using ICT, the database system was developed for an effective use of ICT materials when one draws out the procedure plans with an electronic teaching-learning unit system. Finally, new electronic teaching-learning unit system was applied in real school fields and through the questionnaire analyses, the effects and improving points of this system were found.

2. Web-based Electronic Teaching-Learning Unit Systems

Design

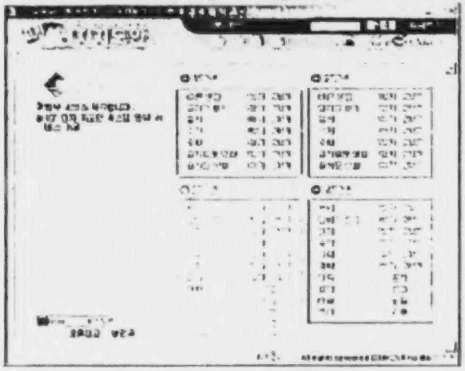
The whole structure of the electronic teaching-learning unit system was constructed as database to make out the lesson plan and a module to manage the completed lesson plans. The database for making a lesson plan was designed as 3 parts, curriculum DB, ICT lesson plan DB and ICT materials DB. Organically related 3 Databases composed of RDBMS. A Client is managed by dividing the electronic teaching-learning unit system and a storehouse of ICT materials and these 2 systems are managed with organic relationship.



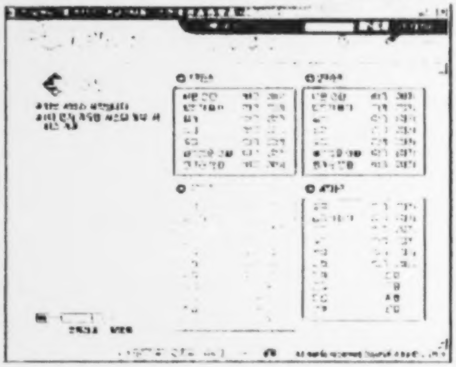
[Figure 1] System architecture

Implementation

To realize this system, Linux server and MySQL were used and in a system driving method, PHP and JAVA script were utilized based on HTML. This shows that many useful programs can be made with GNU Software suggested by GNU Project and utilized in real fields. The system is composed of the ICT electronic teaching-learning unit system and a storehouse of ICT materials. The first screen is following. The teaching-learning unit system and the storehouse system have an interactive and cooperative relationship.

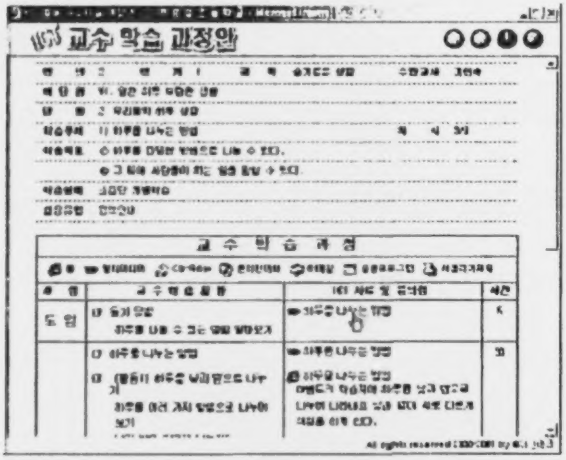


[Figure 2] ICT electronic teaching plan



[Figure 3] ICT materials

The completed lesson plan using this system is like below. The special point of this teaching plan is to make out a lesson plan on the web easily and that there is a list of ICT materials that are supposed to use during the class. These multi-media materials are linked so that teachers can make use of directly. In addition, all materials linked in a lesson plan are stored in database, so they can use only materials and it is easy to share and search them.



[Figure 4] Example of completed ICT electronic teaching plan

3. Advantages

Some elementary school teachers living in Inchon, Korea actually used this electronic teaching unit system to make out their lesson plans. After using this system in the class time, most of teachers showed positive responses.

The result of application of this system is as follows.

The effect of making electronic teaching-learning plan

1) Web-based system of the electronic teaching-learning plan improved convenience to make the lesson plan through making database of current educational curriculum of an elementary school

2) Making the lesson plan and using ICT materials by using this electronic teaching-learning unit system are much easier than by using a word-processor or powerpoint. The system maximized the variety and utilization of ICT materials necessary to make a lesson plan

3) As all teachers made out the lesson plans by themselves using the electronic teaching-learning unit system, ICT application ability in education was improved and a lesson model using ICT was established

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The effect of utilizing electronic teaching-learning unit system.

1) The electronic lesson plan is stored at database in server, so it makes possible to accumulate different types of ICT using lesson plans though they are same lesson. Additionally, it makes available to explore ICT-using lesson plans according to the keyword, chapter and the ICT-using type.

2) By considering both circumstances of teachers' study of teaching aids and actual lesson situation, they can select either 'watching the lesson plan' or 'doing lesson' modes when they use electronic teaching-learning unit system.

3) It is a good try for "Doing lesson" but it needs improvement of interface.

The effect of contents library

1) It is possible to link and upload the various ICT materials and it can accumulate the huge amount of ICT materials

2) ICT referential materials are not fixed but every new material is added automatically. So, lesson plans and a storehouse of materials were interactively related to make this system

4. Discussions

The followings are some suggestions for the growth of this system that was developed for activation of ICT-using education in Korea:

1) This system will be shared by many schools so that more lesson plans can be provided as well as continuously be updated new lesson plans.
2) This system will be modified for teachers to change the procedure steps from 3 fixed steps, introduction, development and adjustment into more 3 steps as well as the names of steps according to the characteristics of each subject
3) When the actual lessons proceed, teachers will be able to choose the time that they want to show ICT materials; therefore they will designate the time in "Doing lesson" module of this system when they make out the lesson plan.
4) By using FLASH not the JAVA SCRIPT for a tool of making a "Doing lesson" module, more polished interfaces will be needed and the "Doing lesson" module will have not one frame but different and various frames of module according to each subject.
5) This system will be modified in English and become a package to use in education practically.

5. Conclusion

Developed web-based system of an electronic teaching-learning unit is practically used in school fields now. It is worth an alternative proposal of the PowerPoint-type plans that the Ministry suggests. The results after the application of this system are following.

Web-based system of an electronic teaching-learning unit is designed to use database in web considering accumulation and use of the data and convenience. It is managed through database not only all learning of 7th educational curriculum, but also ICT materials which are the most necessary to the class, so it is convenient to control the procedure plans easily.

To form the procedure plans easily for users, a module was devised and to make a continually developing system, the materials and the teaching- learning units were organically connected. The development of this system realized the maximization of the teaching-learning plans' share, practical use and storage. In addition, it will be generalized in real school fields and contribute the informatization of school.

References

[1] Department of Education and Human resources development (2001), A White Paper on Information and Communication for Education, Multimedia material center

[2] Department of Education and Hıman resources development (2001) ICT materials for elementary schools, Seoul: Korea Education & Research Information Service (KERIS)

[3] Sefton-Green, J. and Buckingham,D. Digital visions: children's creative uses of multimedia technologies (1996), Convergence 2(2): 47-79 ,

[4] G.Ahanger and T.D.C. Little. Easy Ed: An Integration of tecjnologies for multimedia education(1997), WebNET World Conference 97 15-20,

[5] Biggs, J. B. and Moor, P. J. (1993) The Process of Learning, 3rd edn, Melbourne: Prentice-Hall

Acknowledgement

Actualized sites are as follows and they are written in Korean.
http://hs.edukor.org/ict1/ictpds.html
http://hs.edukor.org/ict1/ictpds.html?dataview=1

The Content Engineering Agent: A TBL-based e-Course Development Tool

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Abstract: With the advance in Internet technology, "e-learning" becomes an active research topic. To make e-learning an effective learning mode, both technology and pedagogy are equally important. However, existing e-learning platforms and tools usually focus on the technology aspect without much investigation on the pedagogical issues. In fact, there is still a big gap between pedagogy and technology. The SPACE Online Universal Learning (SOUL) platform is designed to fill this gap and provide an effective e-Learning platform for e-course providers. In particular, the content engineering agent of the platform is designed for e-course development, which is based on the *Task-Based Learning (TBL)* curriculum development framework. In this paper, we discuss the details of this content engineering agent with the main focus on the Task-Based Learning framework. As a remark, the content engineering agent has already been integrated in the SOUL platform, which is being used by more than 17,000 students.

1. Introduction

With the growth in Internet and the advance in Internet technology, "e-learning" provides an alternative learning model for teachers and students other than traditional classroom teaching and distance learning. And e-learning has become the focus of research by education professionals (Leadbeater, 1999). A lot of e-learning platforms, such as BlackBoard (Blackboard, 2002) and (WebCT, 2002), have been developed by different researchers and vendors (see also Gertner & VanLehn, 2000, Zhou et al, 1996). However, these existing platforms usually focus on the technology aspect without paying much attention to other issues such as pedagogical concerns and quality control. These issues are, in fact, critical in the success of e-learning (Harasim, 1999, Furnell et al, 2001). The following summarizes some of the drawbacks of the existing platforms:

- Big gap between technology and teaching pedagogy: Existing platforms seldom emphasize on this aspect. Consequently, the lack of pedagogy makes these platforms perform like repositories of course materials. They just allow students to retrieve materials from the platform. As a result, they are still far away from traditional face-to-face teaching, not to mention replacing it in the near future.
- Quality control: Existing platforms usually do not have quality control in e-course curriculum development and have poor feedback mechanism to evaluate the effectiveness of the course materials.
- Poor personalization: Truly personalization of individual student's learning path based on individual's studying pace and knowledge background is not implemented in existing platforms. Specific advices for individual students regarding personal learning problems are missing.
- User-friendliness (usability): Teachers are required to take a long time to learn to use the platform and usually a team of technical support staff is necessary for ensuring smooth operations performed by the teachers. And communicating the instructional requirements between teachers and technical teams is the bottleneck of e-course development provided the communication is possible at all.

In order to address these issues, the School of Professional and Continuing Education (SPACE) of the University of Hong Kong set up a team, called the SPACE Online Universal Learning (SOUL) Project team, in 1998. The aim of the project is to provide online support for educational purposes; to develop SPACE online support courses in both Hong Kong and the Mainland China; and to carry out researches related to online learning. The SOUL platform is the major product of the project group.

The SOUL platform is based on the system architecture, called the *PowerEdBuilder*, which will be described in the next section. Different components of PowerEdBuilder will tackle different issues regarding online learning and will work together as a single platform to provide a comfortable and user-friendly environment to teachers, students and administrators. In particular, the *Content Engineering Agent* together with the *Smart Tutor* component, of the PowerEdBuilder are designed to provide pedagogical support for teachers to create e-course as well as tailor-made personalization for students to learn the material. For descriptions of different components of the PowerEdBuilder, one can refer to the publications of the SOUL project team [7]. In this paper, we will focus on the Content Engineering Agent and describe the *Task-based Learning framework* of this component.

The rest of the paper is organized as follows. Section 2 provides an overview on the SOUL platform. The details of the Content Engineering Agent, with focus on the Task-based Learning framework, will be given in Section 3. Section 4 will contain the discussion and conclusion.

As a remark, SPACE is one of the leading adult education providers in Hong Kong providing life-long learning for the public. The number of students registered with SPACE programs is more than 60,000 and the number is expected to grow in a tremendous rate. The SOUL platform has already been put in production while improvement and enhancement are being made continuously. Currently, more than 17,000 students and teachers are using the platform. We are collecting feedback from the users in different aspects which will be used to further improve the platform. These evaluation results will be published in another report once available. We hope that our experience can help the community to build a better e-learning environment for students, teachers, and administrators.

2. The SOUL Platform

The SOUL platform, developed by the SOUL project team, is an online learning platform especially for teachers, students, administrators, as well as alumni of SPACE. Although the platform is tailor-made for SPACE users, the design is general and flexible enough to be adopted by other e-learning institutes. The system architecture, called the *PowerEdBuilder*, of the SOUL platform is shown in Figure 1.

The *Secure e-Course exchange (eCX)* component provides a secure layer for protecting the copyrighted course materials (Yau et al, 2002). The *Communication and Searching Infrastructure (CSI)* provides efficient communication channels among administrators, teachers, and students. The *Content Engineering Agent (CEA)* is mainly used by instructors to create online course materials and launch online courses. The *e-Institute* is the administration center of the platform. Finally, the *e-Learning platform* is where students will interact for studying and downloading relevant learning materials. *Smart Tutor* is one of the major components inside the e-Learning platform (Zhang et al, 2001). Smart Tutor is an intelligent software that can provide guidance to students like a human tutor and is mainly used by students. Expert personalized advice and learning path are given to the student based on student profile maintained. All these functions are the results of application of latest development in the field of artificial intelligent.

Each component in the PowerEdBuilder contains different technologies and is the result from a series of research studies. In this paper, we focus on the Content Engineering Agent and we will mainly describe the Task-based Learning framework of the Agent which helps to fill the gap between the technology and pedagogy.

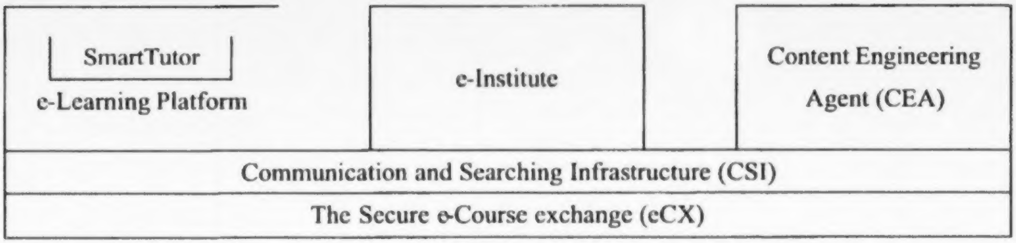

SmartTutor
e-Learning Platform
e-Institute
Content Engineering Agent (CEA)
Communication and Searching Infrastructure (CSI)
The Secure e-Course exchange (eCX)

Figure 1: An Overview of PowerEdBuilder

3. The Content Engineering Agent

Content Engineering Agent is designed to bridge the gap between technology and pedagogy based on a common teaching and learning framework called Task Based Learning (TBL) (Fenstemacher, 1998, Raggatt et al, 1996, Willis, 2000). We will briefly describe the three stages of learning based on the TBL framework in Section 3.1 and show how the Content Engineering Agent incorporate TBL framework in the design in Section 3.2.

3.1 Three Stages of Learning

The Task Based Learning (TBL) framework consists of three stages, namely Pre-task, Task Cycle and Post-task. In our domain, that is, the preparation and development of e-course, pre-task is to define the course aims, the course structure, the relationships among chapters and concepts, and to create the course contents including the Question bank. The task cycle will define the tests and examinations by linking the concepts, course materials, and the question banks, define the weightings of these tests as well as the passing criteria for the task. The actual generation of tests and examinations using the Question bank is done by the Smart Tutor of the e-Learning platform. In the post-task stage, the Content Engineering Agent helps to collect feedback from students and provide analysis of performance of students to teachers in order to identify problems in course materials, students, questions, as well as course structure.

3.2 Details of Content Engineering Agent

Tables 1, 2, and 3 show the summary of activities performed by the Content Engineering Agent as well as the Smart Tutor (for completeness, readers can refer to (Zhang et al, 2001) for details of Smart Tutor) in the pre-task, task cycle, and post-task stage, respectively. Due to the space limitation, we will not give the details of each activity in the pre-task and the task cycle stages, readers can refer to (Cheung & Kwok, 2001) for more information.

Teaching and Learning Activities	**Smart Tutor (Zhang et al, 2001)**		**Content Engineering**	
Start a course which suit the learner's aims	1.1	Get learner profile	1.1	Define course title and aims
Evaluate the profile and learning history of the leaner by teacher	1.2	Get learning history (For new user, learning history is empty)	1.2	Generate chapter (i.e. a set of learning objectives) and hierarchical relationship

Create the course materials and generate the presentation sequence	1.3	Get learning strategy chosen by the learner (strategy available: topic-oriented; walk-through; and review) (Zhang et al, 2001)		
			1.3	Set out relationship of chapter, session and concepts (pre and post-link concepts)
			1.4	Create course contents, including teaching materials and Question Bank
Present the course materials to the learners	1.4	Conduct adaptive learning sessions through simulation of teaching activities		
	1.5	Make use of multimedia (e.g. animation, video) to deliver tutorials		
	1.6	Conduct on-line discussion and question & answer session		

Table 1: Activities of Smart Tutor and Content Engineering in Pre-task Stage

Teaching and Learning Activities	**Smart Tutor**		**Content Engineering**	
Generate assessment, test and exam	2.1	Generate assessment, test and exam through Question Bank	2.1	Define test and exam based on Question bank and materials
Conduct tests (both formal and informal)	2.2	Conduct online tests (both formal and informal)		
Mark the assessment by teacher	2.3	Mark and assess the performance of the learner	2.2	Define weightings of the test or exam
Compare the result with other learners	2.4	Generate assessment result graph with different weightings applied among concepts		
	2.5	Update the learner profile, learning history and cognitive model		
Review the course by teacher	2.6	Review the presentation sequence of sessions		
Inform the learner his/her performance	2.7	Report to learner, in particular, the indications on his concept proficiency		
Make decision on whether the learner should repeat	2.8	Advise the learner whether he should repeat similar task	2.3	Define passing criteria for the task

Table 2: Activities of Smart Tutor and Content Engineering in Task Cycle Stage

Teaching and Learning Activities	**Smart Tutor**		**Content Engineering**	
Review the learning objectives with the learner by teacher	3.1	Review the learning objectives with the learner and if required, learner can select another strategy of topic-oriented; walk-through; and review		
Generate further practice for the learner	3.2	Recommend the learning path by scheduler		

Make decision on whether the learner could proceed	3.3	Advise the learner whether he could proceed	3.1	Refine passing criteria for the course
Evaluate the course in different aspects such as course structure, examination difficulty level etc.			3.2	Provide the following information: - Questionnaire & Written feedback - Group statistics on overall students' performance - Analysis of difficulty level of test, concepts and the failure pattern of students - Identify problematic clusters in course structure - Correlation results on the materials, course structure and students' performance

Table 3: Activities of Smart Tutor and Content Engineering in Post-task Stage

The post-task stage generates useful information which enables the Content Engineering Agent to help the teachers to make decisions on how to further improve the e-course. Besides the useful group statistics on overall students' performance and written feedback, the Agent will analyze and correlate the failure patterns of students against the course materials, the course structure, the difficulty level of test questions. As an example, the Agent will identify clusters of problems/concepts using an rule-based inference engine and data mining technique (see Figure 2 for a sample output). The agent will then help teachers to relate concepts, chapters, sessions that might be missing currently.

4. Conclusion

The SOUL platform depicted in this paper is a joint effort from the SOUL project team and elearning practitioners (teachers, administrators etc.) of the HKU SPACE. In particular, the integration of TBL pedagogy into the Content Engineering Agent provides teachers with a comfortable and user-friendly environment to develop high-quality online courses. The first phase implementation of Content Engineering Agent has been completed. Evaluation on the usefulness and effectiveness of the Agent is being conducted. The evaluation result will be analyzed and used as a guideline for further enhancement of the Agent.

Interested readers can refer to the web site (SOUL, 2002) and other publications of the project group for more information and other technologies used in other components of PowerEdBuilder. We hope that our experience in building these components can help other e-learning researchers

References

C. Leadbeater (1999). *Living on Thin Air: the New Economy* Viking, New York.

A.S. Gertner & K.VanLehn (2000), Andes: A coached Problem Solving Environment for Physics. ***Intelligent Tutoring Systems, 5th International Conference***, ITS 2000, Montreal, Canada.

G. Zhou, J.T.L. Wang, P.A. Ng, et. al. (1996). Curriculum Knowledge Representation and Manipulation in Knowledge-based Tutoring Systems *IEEE Transactions on Knowledge and Data Engineering*, 8 (5), October 1996

Blackboard (2002). http://www.blackboard.com

WebCT (2002). http://www.webct.com

Microsoft Corporation (2002). http://www.microsoft.com

SOUL (2002). The SPACE Online Universal Learning Website, http://www.soul.hkuspace.org/

Fenstermacher, G. D. (1998). *Approaches to Teaching*. 3rd Edition, London: Teachers College Press.

Raggatt, P, Edwards, R., and Small N. (1996), *Adult Learners - Education Training*. London: Routledge.

Jane Willis (2000). *A Framework for Task-Based Learning*. Longman, Oxford, 2000.

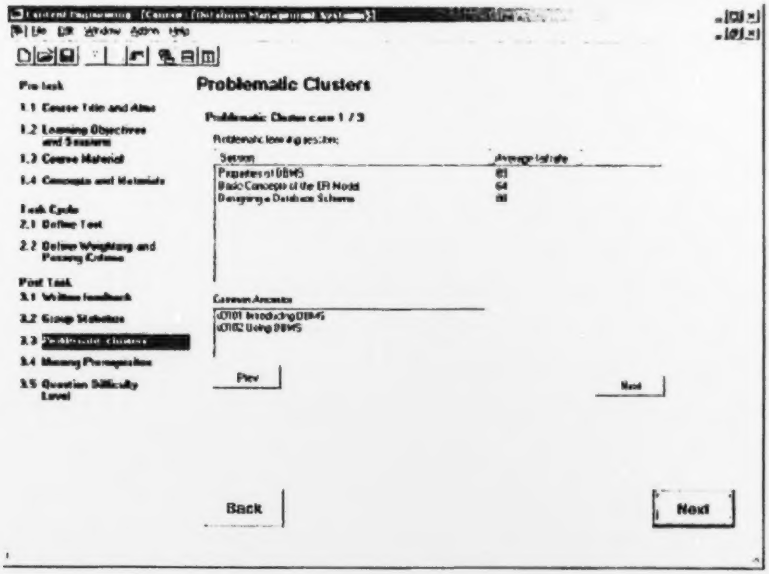
Linda Harasim (1999). A Framework for Online Learning: The Virtual-U. *IEEE Computer*, 32 (9), 44-49.

S.M. Furnell, M.P. Evans, and P. Bailey (2001). The Promise of Online Distance Learning: Addressing academic and institutional concerns. *Quarterly Review of Distance Education*, 1 (4), 281-291.

J.C.K. Yau et al (2002). An Online Course Material Copyright Protection Scheme, *manuscript in preparation*.

Zhang, J., Cheung, B., Hui, L. (2001). An Intelligent tutoring System: Smart Tutor. *In the proceedings of World conference on Educational Multimedia, Hypermedia & Telecommunications 2001 (ED-MEDIA 2001)*, Finland, 2130-2131.

B. Cheung and L.K. Kwok (2001). Course Curriculum Development and Integration – Content Engineering Agent Approach. *Technical Report SOUL-TR-2001-03*, The SOUL Project Team, SPACE, HKU.



Problematic Clusters

Problematic Cluster case 1 / 3

Session	Average
Properties of DBMS	[illegible]
Basic Concepts of the ER Model	64
Designing a Database Schema	[illegible]

Common Answers

c0101 Introducing DBMS
c0102 Using DBMS

File Edit Window Admin Help
Pre-task
1.1 Course Title and Aims
1.2 Learning Objectives and Sessions
1.3 Course Material
1.4 Concepts and Materials
Task Cycle
2.1 Define Test
2.2 Define Weighting and Passing Criteria
Post Task
3.1 Written feedback
3.2 Group Statistics
3.3 Problematic clusters
3.4 Missing Prerequisites
3.5 Question Difficulty Level
Prev
Next
Back
Next

Figure 2: Sample output for post-task stage

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Animated pedagogical agents: Where do we stand?

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Abstract

In this contribution animated pedagogical agents are looked at from an instructional design perspective. A 'support-typology' was constructed based on different dimensions on which support can be described and different roles instructional agents can assume. This typology is used to analyze current available pedagogical agents. This analysis indicates that current pedagogical agents are designed to provide support on content and problem solving aspects of the task and that they are capable of adapting their support to learning paths. The review of research on the relation between pedagogical agents and learning indicates that, although only limited research has been done, certain agent characteristics are relevant to take into account in further research on the effect of agents on learning. It can be concluded that pedagogical agents offer opportunities to be grasped in open learning environments.

Introduction

Open learning environments with a high level of learner control have been argued to foster the acquisition of complex problem solving skills (Jonassen, 1997). However, research indicates that students do not optimally use these support tools (e.g., Clarebout, et al., 2000; Land, 2000). It is wondered in this contribution whether pedagogical agents might be able to enhance the optimal use of support devices in open learning environments.

Pedagogical agents are animated characters designed to operate in educational settings for supporting learning. They can provide non-verbal feedback through means of facial expressions and gestures (Johnson, et al., 2000).

Adapting support to the need of individual learners is an important issue in designing learning environment, since providing either too many or too less support may be detrimental for learning (Clark, 1991).

In order to explore different ways in which pedagogical agents can adapt support to learning needs and enhance the use of support devices, currently available agents were analyzed, using a 'support' typology. After presenting this typology, the analysis of the pedagogical agents is discussed in the second part. A final part presents an overview of research with respect to pedagogical agents and learning. This part gives insight in the extent pedagogical agents have been proved to be beneficial to learning. The discussion and conclusion summarizes the results of the analysis and tries to provide an answer to the question whether these agents might enable to enhance the optimal use of support devices in open learning environments.

Support typology for pedagogical agents

Elen (1995) proposed a scheme with five dimensions to describe support initiatives: amount, formal object, topical object, delivery system and timing of support. This scheme was adapted and elaborated to construct the support typology for pedagogical agents. The support typology has 6 dimensions that look as follows (see Figure 1):

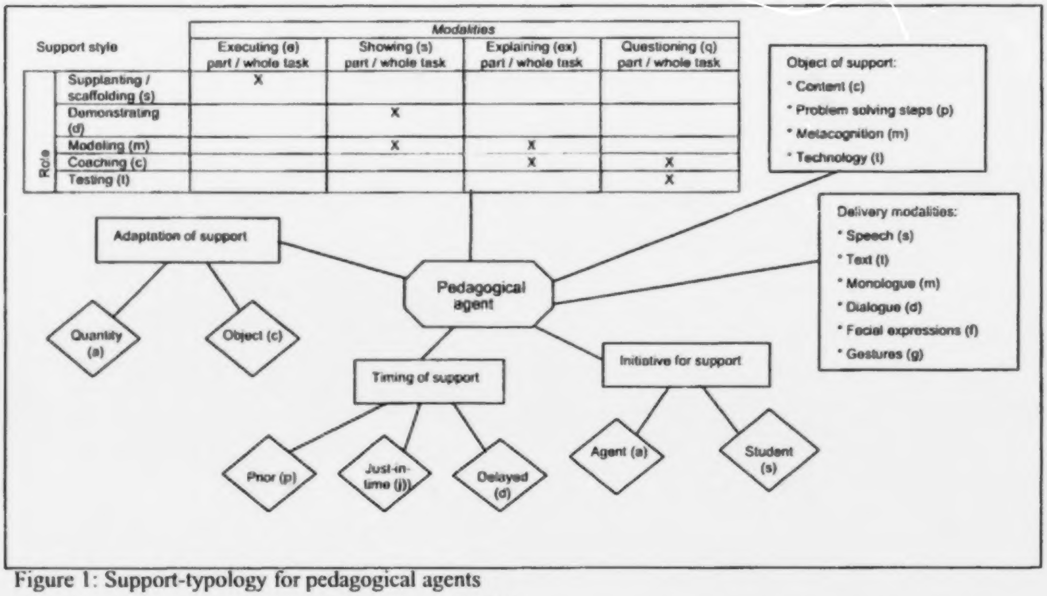
- *Object of support*: support can be directed to different aspects involved in solving complex problems (see also Hill & Hannafin, 2001): content of the task, problem solving steps, metacognitive strategies and handling the technology.
- *Learner control with respect to support:* open learning environments imply by definition a great deal of learning control (Hannafin, 1995). However, since students seem not always capable of making adequate choices with respect to their learning process (e.g., Large, 1996) and given that reviews on learner control do not reveal a consistent positive effect (see for example Niemic, et al., 1996) this aspect requires further investigation. Pedagogical agents can initiate support delivery, students may request support or decisions about support provision can be shared.
- *Adaptability of support:* learners differ with respect to the amount of support needed, depending on their prior knowledge (Ross, et al., 1980) and other learner characteristics such as aptitude and metacognitive skills (Clark, 1990). However, not only the amount of support might be adapted, also the object of support. Learners might need support on the level of the content of the task or on a more metacognitive level. Change in quantity and object of support can be determined by the agent and / or the learner.
- *Delivery modalities:* Pedagogical agents can entail different delivery modalities, which might affect their effect (Moreno, et al., 2000). Pedagogical agents can communicate verbally or non-verbally. Reeves and Nass (1996)

indicate that students view the interaction with a computer (c.q. pedagogical agent) as a social interaction in which three features are essential, namely: image, voice, and personalized language. Pedagogical agents have by definition an image. Hence, this distinction is not included in the typology. The other two features are. A distinction will be made between pedagogical agents using verbal (text or speech) and / or non-verbal language (head nods, gestures, facial expressions). Pedagogical agents can also communicate in a personal way, engaging in a dialogue, or in a more formal way, trough a monologue.

- *Timing of support:* support can be delivered at different moments during the learning process. van Merriënboer (1997) distinguishes between information relevant to recurrent aspects (rules, procedures, prerequisites) and to non-recurrent aspects (system, approaches, heuristics). Support for recurrent aspects should consist of just-in-time information and immediate feedback on the quality of the performance. Support for non-recurrent aspects should consist of both information presented up front and delayed. A pedagogical agent can deliver support either up front, just-in-time or delayed.
- *Support style:* this dimension refers to different roles and modalities instructional agents, in this case pedagogical agents, can assume. Literature suggests six typical roles for instructional agents:
  - supplanting: instructional agents take over the tasks and perform them for the learners. The learners observe the instructional agents (e.g. Salomon, 1994);
  - scaffolding: instructional agents perform those parts of the task that the learners are not yet able to perform independently (e.g., Jonassen, 1996);
  - demonstrating: instructional agents show how a task if performed after which they observe how the learner performs the task (e.g. Merrill, 1994);
  - modeling: instructional agents show how a task is performed while revealing and explaining their reasoning process. They solve a task while they articulate how problems are solved, what strategies are used and what mental models are necessary to understand the task (e.g., Jonassen, 1996);
  - coaching: instructional agents provide hints and feedback, activate learners when they perform the task. Instructional agents observe the learners and provide guidance when they experience difficulties (e.g., Barab & Duffy, 2000), and
  - testing: instructional agents tests the learners' knowledge about certain aspects of the task in order to guide the learning process (e.g., Martens & Dochy, 1997).

These roles can be characterized by (a combination of) four analytical modalities: executing, showing, explaining and questioning. For instance, if the role of the instructional agents is coaching, support can consist of a combination of explaining and questioning. Executing means that an instructional agent performs the task for the learner. Learners observe the instructional agent but do not perform the task themselves. Showing involves the demonstration of the task by an instructional agent after which the learners perform the task themselves. Explaining involves an instructional agent who clarifies the task while the learner performs it. Questioning means asking questions about the task to the learner.

These different modalities may involve the task or part of it and instructional agents may shift between different roles for different parts of a task.



		Modalities			
Support style		Executing (e) part / whole task	Showing (s) part / whole task	Explaining (ex) part / whole task	Questioning (q) part / whole task
Role	Supplanting / scaffolding (s)	X			
	Demonstrating (d)		X		
	Modeling (m)		X	X	
	Coaching (c)			X	X
	Testing (t)				X

Figure 1: Support-typology for pedagogical agents

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Analysis of different pedagogical agents

Methodology

To identify current available pedagogical agents, ERIC, PSYCINFO and the Internet (using the Google-search engine) were searched. Reference lists in texts generated through these searches were also used to find more information (snowball-method). This resulted in the agents presented in Table 1. Key words used to find information on these agents were 'pedagogical agent', 'animated agent', 'agent and virtual reality', 'agent and multimedia', 'personal digital agent'. Only agents used in educational setting were selected. Previous reviews of pedagogical agents have been presented by Johnson et al. (2000, 2001). They came to a similar list, although their review was not restricted to agents operating in educational settings and was focussed on the technological aspects of these agents. In the following a short description is provided of the different agents, the actual analysis is presented in Table 1.

Description of the different pedagogical agents

Adele (Shaw et al., 1999; Ganeshan, et al. 2000): Adele supports distance learning in the domain of medicine and dentistry. She exists in three different interaction modes. In the advisor mode, she observes the students when performing an action. She interrupts and makes suggestions when there is an inconsistency with the standard practice. In the practice mode, Adele provides advice only on request of the student. A final mode is the examination mode where she provides only an evaluation after the students have finished. Recent developments made Adele more focussed on guiding students in their problem solving process.

*Steve (*Johnson et al., 2000): Steve is an acronym for Soar Training Expert for Virtual Environments. He demonstrates 'skills' involved in a specific task. The student can walk around in the environment while Steve demonstrates part of the tasks and explains what he is actually doing (modeling). The student can interrupt the agent and ask to finish the task.

Herman the Bug (Lester, et al., 1999a): Herman is an alien with human-like movements and facial expressions. He inhabits a learning environment called 'design-a-plant' for the domain of botanical anatomy and physiology. Herman gives advice, encourages students and provides feedback.

Cosmo (Lester, et al., 1999b): Cosmo inhabits the Internet Advisor learning environment for the domain of Internet packet routing. Cosmo provides advice to learners and explains content and problem solving related issues.

WhizLow (Johnson et al., 2000; Grégoire, et al., 1999): WhizLow inhabits CPU City, a three dimensional learning environment representing a motherboard. Students are given programming tasks. WhizLow carries out instructions given by the students and traces misconceptions of students that are corrected by providing advice.

PPPersona (André et al., 1999): The PPPersona agent, is an animated agent for presenting on-line instruction. The agent guides learners through web-based materials, he demonstrates the information.

Jacob (Evers & Nijholt, 2000): Jacob instructs and assists users performing a task in a virtual environment (e.g. tower of Hanoi). Jacob gives feedback on the user performance and can demonstrate the task if necessary.

Gandalf (Cassell, & Thorisson, 1999): Gandalf is an expert in the solar system and the user can ask him questions about specific planets. Gandalf will virtually travel to these planets when a question is asked and give an explanation when the student asks for it.

Autotutor (Graesser, et al., 1999): Autotutor is designed to assist college students in learning the fundamentals of hardware, operating systems and the Internet. Autotutor presents questions to the students to test their knowledge.

In Table 1 the analysis of these different agents is presented following the support typology.

Table 1: Analysis of different pedagogical agents

	Modality	Role	Object	Adaptation	Delivery modality	Control	Timing
Adele	ex, q	c	c, p, t	a, o	s, t, d, m, f, g	a, l	j, d
Steve	s, ex	d, m, c	c, p, t	a, o	s, d, m, f, g	a	p, j
Herman the Bug	ex	c	c, p	a, o	s, d, m, f, g	a	j
COSMO	ex	c	c, p	a, o	s, d, m, f, g	a, l	j
WhizLow	e, ex	s, c	c	a	s, m, d, g	a, l	j
PPPersona)	s	d	c	-	s, m, f, g	a	-
Jacob	s, ex	d, c	p	a	t, d, f, g	a, l	j
Gandalf	s, ex	d, c	c	a	s, m, d, f, g	l	j
Autotutor	t, ex	q	c	-	t, m, d, f, g	a	-

The analysis reveals different aspects:

1. Most agents are designed to act as a coach. The agent provides hints and feedback while the learner solves a problem. Sometimes demonstration of parts of the task is also included (e.g. Steve).
2. Explaining is most frequently used as a modality, complemented by questioning.
3. For all agents, except for Jacob, the main object of support is the content. Some of the agents also provide support on the level of problem solving. Jacob for example provides only support on the level of problem solving. Steve and Adele also support the use of the environment.
4. All agents are technologically able to communicate both verbally and non-verbally. Most agents use speech. Some use both speech and text. Dialogue as communication is mostly used.
5. Just-in-time support is used frequently.

Research results

The analysis of pedagogical agents reveals that agents are already used in learning environments to support learning. In this part an overview is presented of empirical research about the relationship between learning and pedagogical agents. Lester, et al. (1997) performed a study to measure agents' affective effects on learning. Five 'clones' of Herman the bug were studied: 1) a fully expressive one, giving principle-based animated advice as well as task-specific audio-advice, 2) one who gave only principle-based animated advice, 3) a clone who gave principle based but only verbal advice, 4) one giving task-specific verbal advice, and 5) a mute one. All other features remained identical. Results show that all students performed significantly better on the posttest. The smallest and highest increase in performance was for the students in the 'mute' and the fully expressive condition respectively. Results on an assessment questionnaire show significantly higher scores for the personal assessment of the agent (utility of the advice and feedback of the agent). Given also the increase on the post-test for the 'mute' condition, Lester et al. conclude that there exists a persona-effect. The merely presence of an agent increases the scores. This persona-effect however was not found by André et al. (1999), who created two versions of their learning environment, one with PPPersona and one without.

Moreno, et al. (2000) compared two groups of students working in a discovery learning environment. One group had a pedagogical agent (Herman the Bug), while the other received text-based information. No significant difference was found for retention. For a transfer test a significant difference was found in favor for the group with the pedagogical agent. This group showed also a greater interest and motivation. In a follow up study Moreno et al. (2000) experimented with pedagogical agents varying on the three features of social interaction mentioned by Reeves and Nass (1996): image, voice, and personalized language. The studies indicated that the condition in which an agent with voice was used instead of text resulted in better results for retention and transfer. The sheer presence of an image of the pedagogical agent had no effect. The kind of communication (dialogue versus monologue) influenced the results for the retention test in favor of the dialogue mode (see also Moreno & Mayer, 2000). In other experiments, Moreno, et al. (2001) experimented with the type of image. The image of Herman was compared to a video-based image of a real person. No effects were found for this variable on retention and transfer.

In addition to these quasi-experimental studies two, more informal, evaluation studies can be mentioned. The first one relates to an evaluation of Steve (Johnson, et al., 1998). It suggests that interacting with agents in a virtual environment be perceived as more natural than using conventional text-based tutoring interfaces. The second study deals with Adele (Shaw et al., 1999). Students indicated in a survey to appreciate the support provided by Adele. Moreover, students preferred to hear a rationale only when they asked for it (practice mode). Nevertheless experience suggests that students do not ask for advice when given the choice.

Discussion and conclusion

An analysis was made of current available pedagogical agents. To do this analysis, first a support-typology was constructed. This typology provides a common framework to describe and discuss pedagogical agents. The analysis reveals that most pedagogical agents act as coaches and provide support on the level of the content and problem solving. Most of the pedagogical agents are capable of adapting quantity and object of support to learners' action. It can be concluded that pedagogical agents are capable of adapting support to the needs of the learner by reacting to the learning path followed.

However, none of these pedagogical agents provide metacognitive support, while such support has been recognized as important (Hannafin, 1995, Shuell, 1992). This might be explained by the origin of pedagogical agents. Pedagogical agents evolved from research on intelligent tutoring systems (Shaw et al., 1999), which are systems focussing strongly on the acquisition of domain specific knowledge (Shute & Psotka, 1996). These tutoring systems were developed, starting from teaching goals and aiming at how to replace a human tutor by an intelligent tutoring system (Derry & Lajoie, 1993) and mostly work with well-structured problems for which one solution exists. The analysis of pedagogical agents demonstrates that, even now, most agents are used in situations that do not require students to solve complex problems but rather procedural tasks for which an optimal solution exists (e.g. Jacob, PPPersona). So, the answer to the question 'where do we stand?' would be that pedagogical agents provide a more sophisticated intelligent tutoring system. However, to develop pedagogical agents able to operate in open learning environments in which students have control over their learning and work on a complex task, a different perspective might be indicated. Rather than starting from a teacher-oriented perspective (how to model a good tutor), a student-oriented perspective might be advocated. Rather than starting from focussing on the acquisition of domain specific knowledge, and representing a complete domain-model, metacognitive processes could be focussed upon to enable students to monitor their own learning process.

Pedagogical agents operating in open learning environments and delivering support on a metacognitive level might encourage learners to make more ample and deliberate use of support in open learning environments. Hill and Hannafin (2001) for example argue that students lack the necessary skills to monitor their learning and to make appropriate choices with respect to support devices in the learning environment.

Research on intelligent tutoring systems focussed on whether these systems were a 'good' replacement of a human tutor (e.g., Schofield, et al., 1994), research on pedagogical agent should focus on the influence of these agents on (aspects of) the learning process, considering research findings with respect to agent characteristics (Lester et al., 1997; Moreno et al., 2000) and learner variables (Shaw et al., 1999).

Taking a more learner-oriented perspective into account in the development of pedagogical agents and focussing on supporting students on the level of their metacognitive skills could result in pedagogical agents able to enhance the (optimal) use of available support devices in open learning environments.

References

André, E., Rist, T., & Müller, J. (1999). Employing AI methods to control the behavior of animated interface agents. *Applied Artificial Intelligence, 13*, 415-448.

Barab, S. L., & Duffy, T. M. (2000). From practice fields to communities of practice. In D. H. Jonassen, & S. M. Land (Eds.), *Theoretical foundations of learning environments* (pp. 1-23). Mahwah, NJ: Lawrence Erlbaum Associates.

Cassell, J., & Thorisson, K. R. (1999). The power of a nod and a glance: Envelope versus emotional feedback in animated conversational agents. *Applied Artificial Intelligence, 13*, 519-538.

Clarebout, G., Elen, J., Lowyck, J., Van den Ende, E., & Laganà, S. (2000, June). *KABISA: A computer-based training program for diagnostical reasoning: An evaluation*. Poster presented at the ED-MEDIA conference, Montreal, Canada.

Clark, R. E. (1990). *The contributions of cognitive psychology to the design of technology supported powerful learning environments*. California: University of Southern California.

Clark, R. E. (1991). When teaching kills learning: Research on mathematantics. In H. Mandl, E. De Corte, N. Bennett, & H. F. Friedrich (Eds.), *European research in an international context: Vol.2. Learning and instruction* (pp. 1-22). Oxford, NY: Pergamon Press.

Derry, S. J., & Lajoie, S. P. (1993). A middle camp for (un)intelligent instructional computing: An introduction. In S. P. Lajoie, & S. J. Derry (Eds.), *Computers as cognitive tools* (1-11). Hillsdale, NJ: Lawrence Erlbaum Associates.

Elen, J. (1995). *Blocks on the road to instructional design prescriptions*. Leuven: Leuven University Press.

Evers, M., & Nijholt, A. (2000, October). *Jacob an animated instruction agent in virtual reality*. Paper presented at the 3rd International Conference on Multimodal Interaction, Beijing.

Ganeshan, R., Johnson, W. L., Shaw, E., & Wood, B. P. (2000). Tutoring diagnostic problem solving. In G. Gauthier, C. Frasson, & K. VanLehn (Eds.), *Proceedings of the fifth International conference on Intelligent Tutoring Systems*. Berlin: Springer-Verlag.

Graesser, A. C., Wiemer-Hastings, K., Wiemer-Hastings, P., & Kreuz, R. (1999). AutoTutor: A simulation of a human tutor. *Journal of Cognitive Systems Research, 1*, 35-51.

Grégoire, J. P., Zettlemoyer, L. S., & Lester, J. C. (1999). Detecting and correcting misconceptions with lifelike avatars in 3D environments. In *Proceedings of the Ninth World Conference on Artificial Intelligence in Education* (pp. 586-593). Le Mans: AI-ED-society.

Hannafin, M. (1995). Open-ended learning environments: Foundations, assumptions, and implications for automated design. In R. D. Tennyson, & A. E. Barron (Eds.), *Automating instructional design: Computer-based development and delivery tools* (pp. 101-129). Berlin: Springer-Verlag

Hill, J. R., & Hannafin, M. J. (2001). Teaching and learning in digital environments: The resurgence of resource-based learning. *Educational Technology, Research and Development, 45*(1), 65-94.

Johnson, W. L., Rickel, J. W., & Lester, J.C. (2001). *Research in animated pedagogical agents: progress and prospects for training*. Marina del Rey: USC / ISI.

Johnson, W. L., Rickel, J. W., & Lester, J. C. (2000). Animated pedagogical agents: Face-to-face interaction in interactive learning environments. *International Journal of Artificial Intelligence in Education, 11*, 47-78.

Johnson, W. L., Rickel, J., Stiles, R., & Munro, A. (1998). Integrating pedagogical agents into virtual environments. *Teleoperators and Virtual Environments, 7*(6), 523-546.

Jonassen, D. H. (1996). *Computers in the classroom: Mindtools for critical thinking*. Englewood Cliffs, NJ: Prentice Hall.

Jonassen, D. H. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational Technology, Research and Development, 45*(1), 65-94.

Land, S. M. (2000). Cognitive requirements for learning with open-learning environments. *Educational Technology, Research and Development, 48*(3), 61-78.

Large, A. (1996). Hypertext instructional program and learner control: A research review. *Education for Information, 14*, 95-106.

Lester, J. C., Converse, S. A., Kahler, S. R., Barlow, S. T., Stone, B. A., & Bhoga, R. S. (1997). The persona effect: Affective impact of animated pedagogical agents. In *Proceedings of the CHI97 conference* (pp. 359-366). New York: NY: ACM Press.

Lester, J., Stone, B., & Stelling, G. (1999a). Lifelike pedagogical agents for mixed-initiative problem solving in constructivist learning environments. *User Modeling and User-Adapted Interaction, 9*(1-2), 1-44.

Lester, T., Towns, S. G., & FitzGerald, P. J. (1999b). Achieving affective impact: Visual emotive communication in lifelike pedagogical agents. *International Journal of Artificial Intelligence in Education, 10*(3-4), 278-291.

Martens, R., & Dochy, F. (1997). Assessment and feedback as student support devices. *Studies in Educational Evaluation, 23*(3), 257-273.

Merrill, M. D. (1994). Prescriptions for an authoring system. In M. D. Merrill (Eds.), *Instructional design theory* (pp. 331-347). Englewood Cliffs, NJ: Educational Technology Publications.

Moreno, R., & Mayer, R. E. (2000). Engaging students in active learning: The case for personalized multimedia messages. *Journal of Educational Psychology, 92*(4), 724-733.

Moreno, R., Mayer, R. E., & Lester, J. C. (2000). Life-like pedagogical agents in constructivist multimedia environments: Cognitive consequences of their interaction. In J. Bourdeau, & R. Heller (Eds.), *Proceedings of ED-MEDIA2000* (pp. 741-746). Charlottesville: AACE.

Moreno, R., Mayer, R. E., Spires, H. A., & Lester, J. C. (2001). The case for social agency in computer-based teaching. Do students learn more deeply when they interact with animated pedagogical agents? *Cognition and Instruction, 19*(2), 177-213.

Niemiec, R. P., Sikorski, C., & Walberg, H. J. (1996). Learner-control effects: A review of reviews and a meta-analysis. *Journal of Educational Computing Research, 26*(1), 11-29.

Reeves, B., & Nass, C. (1996). *The media equation.* New York: Cambridge University Press.

Ross, S. M., Rakow, E. A., & Bush, A. J. (1980). Instructional adaptation for self-managed learning systems. *Journal of Educational Psychology, 72*(3), 312-320.

Salomon, G. (1994). *Interaction of media, cognition, and learning.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Schofield, J. W., Eurich-Fuker, R., & Britt, C. L. (1994). Teachers, computer tutors and teaching: The artificially intelligent tutor as an agent for classroom change. *American Educational Research Journal, 31*(3), 579-607.

Shaw, E., Johnson, W. L., & Ganeshan, R. (1999, May). *Pedagogical agents on the web.* Paper presented at the third international conference on autonomous agents, Seattle. Available: http://www/isi.edu/isd/ADE/papers/agents99/agents99.htm

Shuell, T. J. (1992). Designing instructional computing systems for meaningful learning. In M. Jones, & P. H. Winne (Eds.), *Adaptive learning environments. Foundations and frontiers* (NATO-ASI Series, Series F: Computer and Systems Sciences 85) (pp. 19-54). Berlin: Springer-Verlag.

Shute, V. J., & Psotka, J. (1996). Intelligent Tutoring Systems: Past, present and future. In D. H. Jonassen (Ed.), *Handbook of Educational Communication and Technology* (pp. 570-600). New York: Macmillan Library Reference.

van Merriënboer, J. J. (1997). *Training complex cognitive skills: A four component instructional design model for technical training.* Englewood Cliffs, NJ: Educational Technology Publications.

Design Considerations for Computer-based Simulations in Education

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Abstract: Computer-based simulations have the potential to enhance the transfer of learning by providing students with surrogate learning environments. However, the success of simulations to a certain degree depend on their designs. In order to ensure learning, simulations should be constructed based on instructional design principles. As Clark (1985) points out, effective learning depends on the design strategies implemented in a delivery system rather than on the system itself. Although different designers have different perspectives when making design decisions (Goosen, 2001), there are common issues faced by designers at large. Serving to provide recommendations for practitioners who will engage in designing and developing effective educational simulations, this paper surveys examples of simulations, examines design issues concerned with computer-based simulations and synthesizes design guidelines suggested in literature.

Introduction

Designing and developing simulations can be complex and costly, and thus it is crucial to consider thoroughly beforehand if simulations should be used for particular educational purposes. Once it is determined that simulations can help to reach specific learning objectives, to better represent the selected phenomena, and to fit the instructional level of the target students, the next step is to consider the design aspects. Although different designers have different perspectives when making design decisions (Goosen, 2001), there are common issues faced by designers at large. In this paper, major design considerations affecting the nature and the effectiveness of simulations are discussed. The considerations include the advantages of simulations over other instructional alternatives, fidelity levels, and student support.

Simulations vs. Other Instructional Alternatives

Simulations can be used when there is no better alternative method to approach a significant learning objective. Simulations offer opportunities for students to understand phenomena which are otherwise inaccessible because of the costs, dangers, or time constraints involved in reality (Dennis & Kansky, 1984). For example, by participating in a financial management simulation, students learn how to invest money and discover the consequences of their actions in a short time. They do not need to raise fund for the investment, take the risk of losing their capital, nor wait for months or even years to figure out the results.

The advantages of simulations over tutorials and drills include: (a) better transfer of learning, (b) opportunities for active exploration, and (c) motivational appeal (Alessi & Trollip, 1991; de Jong, 1991). Simulations teach skills or knowledge in an environment similar to the real situation to which the skills or knowledge can apply. Moreover, in simulations students can actively explore the content domain and therefore as active participants they become more motivated. Once a simulation is chosen as the appropriate instructional mode, designers need to consider two major aspects of simulation design: fidelity and student support.

Fidelity

Fidelity is concerned with to what degree a simulation replicates reality (Alessi, 1988). Unlike the scientific models in which high fidelity is always desirable, in instructional simulations high fidelity is not always a better choice over low fidelity (Levin & Waugh, 1988). Theoretically, the relationship of fidelity and learning should be linear. That is, the closer a simulation is to the situation being simulated, the more learning transfer would occur in reality. However, research findings indicate that high fidelity does not always enhance learning for two reasons: (a) high fidelity demands more memory load and cognitive abilities of students, and (b) instructional techniques which are beneficial to novices usually decrease fidelity (Alessi, 1988). Details of more realistic simulations might distract students' attention or generate memory overload, especially when students are in the initial stages of learning.

Nevertheless, the claim that high fidelity is not always desirable in instructional simulations does not imply that simulation design should aim for low fidelity. Rather, the claim indicates that different levels of fidelity are needed in the design. Furthermore, the fidelity concern is about when and how these fidelity levels should be adjusted. Alessi (1988) suggests that the level should increase appropriately as students progress from novices towards experts. Levin and Waugh (1988) propose that a range of fidelities be provided in a simulation in which a content domain is divided into different sections. These sections can be on the same or different difficulty levels. As students progress, they deal with more sections of the same difficulty level or with more challenging aspects of the domain.

Student Support

A simulation must include appropriate support in order to guide students to reach specific learning goals (Steinberg, 1991). Without the support, students are not likely to learn the concepts or principles embedded in the simulation when they freely explore on their own. They might ignore more important aspects intended for them to learn and focus on rather insignificant details. They might not be able to find solution paths and thus the benefit they obtain from the simulation is minimized. Moreover, for a simulation that has high cognitive demands to be effective, appropriate support is a must. Although the support is sometimes offered by an instructor, it can be included in the simulation program itself as well (de Jong, 1991).

Two types of support could be helpful to students: (a) directions about how to interact with the simulation, and (b) guidance about how to learn from the simulation (Steinberg, 1991). For the quantity of support available to students, Levin and Waugh (1988) suggest that the notion of "dynamic support" be applied to simulation design. As students advance from novices towards experts, the amount of support they need decreases. Therefore, the amount of support provided by a simulation program should be varied according to students' instructional levels. In the initial level, the program should offer more extensive support. As the students become more experienced in the content domain of the simulation, the support can be gradually reduced.

Summary

Drawing upon research findings and examples of educational simulations, this paper synthesizes simulation design guidelines including fidelity and student support. In contrast to other modes of computer-based instruction (e.g., tutorials and drills), simulation environments are much more complex in terms of design and use. However, well-designed simulations can assuredly minimize the complexity of use and enhance their educational effectiveness. The design considerations can assist designers in planning and constructing simulations that facilitate learning.

References

Alessi, S. A. (1988). Fidelity in the design of instructional simulations. *Journal of Computer-Based Instruction, 15*(2), 40-47.

Alessi, S. M., & Trollip, S. R. (1991). *Computer-based instruction.* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Clark, R. E. (1985). Confounding in educational computing research. *Journal of Educational Computing Research, 1,* 137-148.

Dennis, J. R., & Kansky, R. J. (1984). *Instructional computing: An action guide for educators.* Glenview, IL: Scott, Foresman and Company.

de Jong, T. (1991). Learning and instruction with computer simulations. *Education & Computing, 6*(3,4), 217-229.

Goosen, K. R. (2001). Purpose and learning benefits of simulations: A design and development perspective. *Simulation & Gaming, 32*(1), 21-37

Levin, J. A., & Waugh, M. (1988). Educational simulations, tools, games, and microworlds: Computer-based environments for learning. *International Journal of Educational Research, 12*(1), 71-79.

Steinberg, E. R. (1991). *Computer-assisted instruction: A synthesis of theory, practice, and technology.* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

The Effect of Elaboration Strategies in a Hypertext Environment on Learning

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Abstract: This study investigated Charles Reigeluth's Elaboration Theory in a hypertext environment. An Elaboration-Theory-Based hypertext was designed to compare with a linear hypertext that does not employ any instructional design theories and principles. Thirty-three college students in a large U.S. university participated in the study. The research results showed statistically significant differences between the control group and the experimental group in terms of students' achievements on learning facts and concepts. Further research agenda is proposed according to the results of item analysis in the test.

Introduction

While creating hypermedia environments is becoming part of the mainstream in the implementation of educational media in most of educational settings, the design and development of hypermedia materials are still heavily based on technical issues or simply designed by intuition (Chen & Dwyer, in press). One of the most referred and applied instructional theories, Charles Reigeluth's Elaboration Theory (ET), is the target of investigation in this study. According to Reigeluth (1987), Elaboration Theory prescribes a macro level of instruction by sequencing information in a simple-to-complex approach. More specifically, the theory prescribes that instruction starts with an epitome that teaches a few simple, general ideas in order to link to learner's prior knowledge (or experience). The remainder of the instruction presents progressively more complex ideas in order to elaborate on the ones previously presented. The purpose of this study is to investigate whether Elaboration Theory strategies are still able to serve as effective guidelines for designing hypermedia materials with the latest emerging technologies.

The study is primarily designed to compare an Elaboration-Theory-Based hypertext with a linear hypertext that does not employ any instructional theories and principles. The investigated instructional treatment is to design a unit of hypertext materials by using one of the major elaboration strategies proposed by Reigeluth (1987): *sequencing* the instructional materials using a simple-to-complex format. In compliance with the purpose of the study, this research study is to determine whether the Elaboration-Theory-Based hypertext, designed by using Reigeluth's instructional strategies, more effective than a non-theory hypertext in facilitating student achievement of different educational objectives.

Instructional Treatments: The instructional content used for designing the instructional treatments is the 2000-word heart content module developed by Dwyer and Lamberski (2000).

1. Control Group: Linear hypertext as a control group

In this design of treatment, the original heart content was converted into HTML format and put onto the World Wide Web. Learners determined their own learning paces by dragging the scrolling bar up and down on the right side of the browser.

2. Experimental Group: Elaboration-Theory-Based hypertext

This treatment employed one of the major elaboration strategies: sequencing the instructional materials by using a simple-to-complex format. The first frame (lesson) of the instruction was designed to represent central theme of the instruction. One epitome was created to serve as an advanced organizer to provide learners with the most relevant and inclusive introductory materials. The subsequent frames (lessons) were designed to elaborate on different parts of the epitome.

Research Design

The research design in the study is a randomized posttest with a control group design. The independent variable is the type of hypertext. The dependent variables are three criterion tests: terminology test, identification test and comprehension test that are given immediately after the students finish reading the online instructional treatments. A t-test statistics measure is used to analyze collected data.

Procedure and Data Analysis

Thirty-three college students participated in this study. Sixteen of them were randomly assigned to the control group, seventeen in the experimental group. The results of the study (see Table 1) indicate statistically significant differences between the control group and the experimental group. That is, treatment designed by using elaboration theory, was superior to the control treatment (non-theory and linear hypertext) for the identification and terminology tests, but not for the comprehension test.

Table 1: Results of the study

Measures	Mean Score (Control: 16)	Mean Score (Experiment: 17)	p-value
Identification Test	11.67	15.76	*0.0077 (< .05)
Terminology Test	7.06	11.50	*0.0163 (< .05)
Comprehension Test	8.20	11.15	0.1804

* indicates the significant differences found between the two treatments

Concluding Comments

According to the above results, the Elaboration-Theory-Based hypertext indeed improved students' learning achievements in terms of identification and terminology tests. However, it did not enhance students' comprehension capabilities. To investigate potential solutions to the aforementioned problem, item analysis for the comprehension test was conducted. The results indicated the item difficulties of 11 out of 20 items were not desirable (less than 0.5). Therefore, a more thorough unit of hypertext instruction designed by using more elaboration strategies should be further investigated to improve those identified comprehension items.

References

Chen, W.F. & Dwyer, F.M. (in press). Hypermedia Research: Present and Future. *International Journal of Instructional Media. 30*(2).

Dwyer, F.M. & Lamberski, R. (2000). *The human heart: Parts of the heart, circulation of blood and cycle of blood pressure.* Unpublished lecture handout, Department of Adult Education, Instructional Systems, and Workforce Development and Education, College of Education, The Pennsylvania State University.

Reigeluth, C.M. (1987). Lesson blueprints based on the elaboration theory of instruction. In C.M. Reigeluth (ed.), *Instructional Theories in Action: Lesson Illustrations Selected Theories and Models.* Hillsdale, NJ: Lawrence ErlbaumAssociates.

Computer Based Virtual Field Trips

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Abstract: This paper will discuss Computer Based Virtual Field Trips that use technologies commonly found in public schools in the United States. The discussion will focus on the advantages of both using and creating these field trips for an instructional situation. A virtual field trip to Cumberland Island National Seashore, St. Marys, GA will be used as a point of discussion for the technologies involved and the value of their use for instruction in a science classroom. While this field trip is being used as a discussion point, the techniques and advantages identified can be applied over a P-16 grade range in all subject areas. If the decision is made by an instructor to create a virtual field trip, the technologies used can be as simple as using digital pictures and text in Microsoft PowerPoint or Hyperstudio or as complex as using digital video and panoramas in Macromedia Director. The level of complexity will depend on the technology available and skills of the developers.

Virtual field trips are a hot buzzword for integrating technology into the curriculum. If one does a web search using "Virtual Field Trip" as a key phase, hundreds of sites will be identified. These sites are overwhelmingly web based and provide an abundance of pictures with limited information about locations that are deemed to have educational value. Krupnick, states that, "The Web is now crowded with sites that are considered 'Virtual Field Trips' and they vary a great deal in content and usefulness." She further states that, "For teachers who already have a curricular unit assembled and are looking for online enhancements, these are adequate. But for teachers who are looking for a source of new and exciting curriculum such sites are only a starting point. In order to make them useful, an instructor would need to develop curriculum." (2000, p. 43)

The approach taken in this paper is that a virtual field trip is much more than a web-based presentation of a location. Our focus is to show how to design a field trip based on curriculum content that allows the student to "learn" from the field trip in a way that is similar to actually taking the field trip. Coulter states, "The key is for (instruction) to drive the technology implementation and not vice versa, despite pressures to integrate technology into the classroom.... virtual field trips ... enable students to refine and extend their growing understanding as they explore other parts of the world." (2000, p. 49)

In educational situations actual field trips need to be more than "just a day away from school," with limited tangential educational purpose. They should be as real a connection to the "real world" as possible. A normal day field trip does not offer sufficient time to take full advantage of all a site has to offer. Bellan and Sheurman (1998) discuss ideas about actual and virtual field trips and state pitfalls of both. Their article outlines the teacher involvement necessary to alleviate some of the pitfalls. Among these are a teacher visiting both the actual and virtual sites, the teacher's plan for student use of a virtual site, student use of the virtual site before visiting actual sites, and follow up instruction using both the virtual and actual trip experiences. Taking the field trip on the computer does not eliminate all the concerns about how field trips are used. The virtual field trip is usually not sufficient by itself. Pre-planning the trip and the follow-up experiences should be addressed as part of the teacher's curriculum. In addition we suggest a virtual field trip should be developed by the teacher to be used in connection with an actual field trip to the site.

Definition of a Virtual Field Trip

Virtual field trips as referred to in this paper, are computer-based simulations of an actual field trip, which allows the user to vicariously experience the environment of the intended location. They provide the teacher and learner the opportunity to explore aspects of an actual trip without leaving the classroom. They should include all elements of a well-designed field trip and provide the student with experiences that are beyond those that could be obtained from a pamphlet about or a photo display of the location. Stainfield, Fisher, et. al. (2000) feel that virtual refers to "digital alternative representations of reality" and that a virtual field trip is not an attempt to create a virtual reality.

The Power of Instructor Designed Virtual Field Trips

Instructors can create their own virtual field trip with their students by using a digital camera. By planning what they would like to include, the field trip can be designed to meet the objectives of the specific instructional situation. The site used for the virtual trip can be one that is within the student's local community. Choosing a site that can be visited by the class or a student's family will vastly increase the educational value of the experience. This requires that teachers must have control in creating the trip to meet their curricular needs. Student involvement in the creation of the virtual field trip can give power to the experience. This can take the form of; collecting information at school, using aspects of the technology in the construction of the product, taking the actual field trip and gathering the images and information that is presented in the virtual field trip. This type of involvement focuses student's attention and learning on the intricate aspects of the content presented. In addition it provides ownership by the students of the project and focuses their learning of the curricular content. Last, but not least, it provides opportunities for students to use the technology in a real world situation, which addresses the NETS standards by preparing them to function in a technology rich information society.

Advantages of Creating a Virtual Field Trip

The main advantage of a virtual field trip is that it can be used to meet the objectives of the curriculum and the needs and ability levels of the students. Other advantages include:

- providing opportunities for repeated visitations to the site for continued study.
- allowing the teacher to focus on one specific aspect of the trip at a time.
- providing for the presentation of a wider variety of experiences than may be possible on one trip.
- illustrating time sensitive issues that could not be viewed on a single actual trip.
- allowing classes in a different geological location to visit and compare with resources in their own area.
- providing integration of the multiple aspects of the field trip into a number of different curriculum areas.
- allowing for commonality of experiences by all participatents.
- allowing students to take a closer look at areas that could not be fully explored during an actual field trip.
- using for assessment purposes.
- sharing with colleagues and parents.

- using repeatedly by the teacher year after year.

When teachers use a virtual field trip in conjunction with an actual field trip to the same site, a virtual trip can serve as a motivator for the trip, or as an advanced organizer for the day's activities. It also encourages learners to plan and prepare for activities to be carried out on the trip or can provide a simulation for students who may not have been able to attend the actual field trip.

Limitations of a Virtual Field Trip

There are two major limitations to using a virtual field trip. The first is the availability of a field trip that meets the objectives of the curriculum. Commercially available and Web based field trips are designed for a large audience and may need to be adapted to meet an individual instructors curriculum needs. The second limitation focuses on the designer's expertise in the content area and appropriate pedagogy for the field trip.

Barriers, and the Paths over Them

The main limitation in creating a virtual field trip is the time needed to create the experience. The teacher who wants to create a virtual field trip needs to find ways of involving others such as; colleagues, community members; students and parents. If the teacher views the design of the field trip as dynamic, constantly evolving, construction of both the actual and virtual field trips will grow over time.

Because curriculum design requires content expertise, another limitation is the creator's knowledge of the content area of the field trip and the curricular objectives. As teachers become involved with the design they often need to extend their content knowledge, thus increasing the time necessary to design the experience. On the positive side, they can get so involved that their personal knowledge increases and it becomes a professional development experience.

A third limitation is the availability of the technology. However with the increasing availability of technology in the schools, homes and work places this is becoming less of a barrier. Coupled with the availability of the technology is the teacher's ability to use the technology effectively. Again this can become a learning situation and thus increases the time to create the product. This limitation can be minimized by the involvement of colleagues, community members, students and parents.

Creating a Virtual Field Trip

The general steps for creating a virtual field are:

1. Examine objectives of the course and choose a field trip that includes experiences that fit within the realm of the objectives and enhances learning.

The purpose of a virtual field trip may meet multiple objectives: to learn specific content, to experience a new venue, or to develop skills in documenting experiences and using technology.

2. Create a concept map of the experiences to be included in the fieldtrip.

A concept map provides an overview of all the elements to be included in the virtual field trip and acts as an organizing framework to build upon in construction of the final product. The concept map should not be considered the final blueprint for the field trip; rather it should be seen as a dynamic overview and a starting point from which the product evolves.

3. Select the appropriate technology to be used based on the content and the curricular objectives of the trip. The technology includes the organizing program and tools for collecting and presenting data.

The equipment and software used will depend on the complexity of the trip and the grade level of the students. Virtual field trips can vary in their complexity based upon the experience of the creator with the technology available.

4. Collect and organize materials to be included based on the curriculum objectives to be accomplished and the concept map.

Examples of desired materials might be: a) still pictures, both digital and photographs; b) videos; c. text; d) databases and graphs; and e) sound clips.

As materials are collected and organized decisions must be made. For example, panoramic videos can be used to give an overview of the location. If panoramas are to be used, decisions will have to be made beforehand as to the location and the concept to be illustrated.

5. Convert all materials to digital format.

When converting materials to digital format the question of designing for dual platforms (Windows and Mac OS) must be considered. While designing for dual platforms is not more difficult or time consuming, the decisions made about the format of the individual parts (pictures and text) must be considered to insure that they are appropriate for the platform(s) chosen. Making these decision early eliminates converting work later. Materials not in digital format need to be digitized.

6. Assemble all elements in the organizing program based on the concept map.

Here decisions on the format that the field trip will be presented in must be made. Will it be one stand-alone program presentation or a series of parts that can be accessed separately? Also, before assembling the materials one must consider the platforms that can present the materials. Will the field trip best meet the needs of the teacher if it is dual platform or is one platform sufficient? These decisions along with the assembler's knowledge of presentation programs will determine if Macromedia Director, Hyperstudio, Power Point or any of the other available authoring programs meet the needs of the designed field trip. The choice of the authoring program used is often the assemblers personal choice based on familiarity and skill with the program.

7. Evaluate the finished product to be sure it meets the objectives.

In a teacher created product, evaluation should be formative in nature, providing a continuously changing and evolving product. There will always be questions of; how could we do this better? what can be added to it? what are the differing needs of the learners using it? and how can each learner group add to the information presented?

When evaluating the effectiveness of a virtual field trip one should consider both the appropriateness and the effectiveness of the technology used in the presentation of the content. Children frequently experience learning situations indirectly thought technology by the use of pictures, time-lapse photography and interactive non-linear experiences that allow the learner to follow their interest and to revisit locations in the program as their interest grows. Technology should not be seen as a replacement for experiences but as an enhancement of these experiences. Technology can be used to enhance the senses, build interest and excitement or to review and analyze experiences. Digital cameras provide the technology necessary to; record experiences for later analysis without damaging the environment, document cause and effect relationships, record changes over time, document unique events, record images that give historical perspectives, open vistas of limited access to all learners, and reviewing and analyzing experiences.

We chose to illustrate the process of creating a virtual field trip within a course for Middle Grades pre-service teachers. Its objectives are to prepare the pre-service teachers to; 1) design and use field trips effectively in their classrooms, 2) effectively develop technology use and skills in their students and 3) illustrate an integrated curriculum approach to learning.

The *Cumberland Island National Seashore: Virtual Field Trip* (Clark, et al, 2002) has been effective in motivating our middle school pre-service teachers in several ways. The students actually look forward to getting up at 5 a.m. for a 6 a.m. departure and walking in the sun/rain/wind/heat/cold for twelve or more hours before returning home. The students are more attuned to the sites they will see and participate in activities on the island. For example;

- upon reaching the beach instead of thinking of swimming, they look for live buried shells.
- they have thought about the mathematics of figuring out a tree's canopy coverage, or a fountain's volume, and proceed with the task.
- they know what plants and animals are to be found and set about searching for them.
- they know how to use the digital camera to document necessary aspects of an unknown phenomena for later study or life form for later identification in their field manuals.
- they look for signs of man's influence on the environment and history of the area.
- they look for signs of the destructive effects of the feral horse and hog population on the environment.
- in the marsh and bogs they look more closely at the smaller forms of wildlife.
- they have a stronger awareness of what goes into a quality learning experience.
- upon returning from the actual trip they note what they saw, what they did not see, and organize their data and experience into a technology enriched presentation.

Conclusion

We feel that a virtual field trip that resides on a storage medium and not on the WWW has advantages in its effectiveness. The program is not dependent on access to or the vagaries of the Web, it runs faster, it is always accessible, and it focuses the student's attention on the task at hand.

This paper uses the terms teacher created, creator, and assembler in an apparently interchangeable manner. This is due to the principle that while the teacher is the driving force in the design and creation of the virtual field trip; the tasks can be done in conjunction with students, parents, interested community members and colleagues. The technologies used to develop and create virtual field trips are commonly found in public schools today. This process of creating virtual field trips can be as simple as using digital pictures and text in Microsoft Power Point or Hyperstudio or as complex as using digital video and panoramas in Macro Media Director. The technology skills necessary in the creation of the field trip all are within the scope of the National Educational Technology Standards (NETS) for Teachers, and many are within the scope of the NETS for students.

References

Bellan, J.M., & Sheurman, G. (1998). Actual and virtual reality: Making the most of field trips. *Social Education, 62(*1), 35-40.

Clark, K., Hosticka, A., Schriver, M., & Bedell, J. (2002). Cumberland Island National Seashore: Virtual Field Trip [Computer software, CD-ROM]. Atlanta: Georgia Middle School Association.

Coulter, B. (2000). What's it like where you live*? Science and Children, 18*(6), 48-50.

Krupnick, K. (1998). Dog sleds online: Creating a virtual field trip. *Social Studies Review, 38*(1), 43-46.

Stainfield, J., Fisher, P., Ford, B., & Solem, M. (2000). International virtual field trips: A new direction? *Journal of Geography in Higher Education, 24*, 255-262.

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A Typology for Identifying Teachers' Progress in ICT uptake

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Abstract: This paper describes the design of an instrument to help identify teachers' level of ICT uptake. The instrument takes the form of a typology matrix comprising four stages in ICT uptake across a continuum describing teachers' levels of dependence. Identification of teachers' positions in the typology matrix is determined by their affective, cognitive and demonstrated states of ICT application and use. The paper describes the process of determining the position of two elementary school teachers within the typology and discusses the reliability and validity of the instrument and the placement process.

Introduction

Schools and teachers are in midst of massive changes since the pressure to use information and communication technologies (ICT) began in the late 1980s. Addressing teachers' needs has become an important element for many school and educational systems around the Western world (Elmore, 1992). Unfortunately educational institutions under pressure to utilise ICT, have often found it easier to see the technology issues rather than the human ones (eg. Hodas, 1993; McClintock, 1988; Papert, 1998). The resulting outcomes have tended to be applications of ICT based on motives and directions that often fail to capitalise on the opportunities and affordances the new technologies can bring to teaching and learning.

The Need For a Scale of ICT Uptake

Much of the professional development for educators to aid in their ICT uptake has not had the expected effect, even though there have been many attempts at providing support for teachers during their ICT progression and many attempts at describing various ICT diffusion or uptake processes (Cheung, 1999; Christensen, 1997; Mahajan & Peterson, 1985; Marcinkiewicz, 1994; Russell, 1995; Sandholtz, Ringstaff, & Dwyer, 1992). Holloway (1996) suggests the processes may be too techno-centric and need to consider a more humanist perspective.

Writers concerned with change in education argue that most effective approaches to professional development consider both the whole system, and the people in it (eg. Fullan, 1999). Part of the challenge of orchestrating any significant and sustained change in educational systems is that these entities have significant natural inertia, and much of the change is illusory and confused with movement —the never-ending and sometimes chaotic movement that is characteristic of large organizations (Huberman, 1992). Teachers need to learn and adapt in such an environment. In fact Fullan (1999) argues "that learning occurs on the edge of chaos, where a delicate balance must be maintained between too much and too little structure" (p.ix). This makes the argument that improving the balance between individual teachers needs and their professional development is important, since the divergence of an individual's circumstances, pressures, resources and abilities could be vast.

One of the problems that often faces professional development for ICT uptake is that teachers come to the programs with vastly differing backgrounds and predispositions to learning. Their previous experiences and existing expertise plays a large part in influencing the form of professional development they need. Currently it is difficult to know how to differentiate among the teachers so that appropriate learning settings may be contrived (eg. Knowles, Holton, & Swanson, 1998). A number of researchers have discussed the training needs of teachers looking to use ICT as aids to their teaching and described strategies that can take teachers beyond their current zones of comfort (eg. Schrum, 1998). Within much of this discussion is an implicit understanding of the need to be able to identify teachers' current development level with respect to ICT uptake along some typology. It was this need that provided impetus to the project described in this paper which sought to develop and validate such a typology.

The Research Setting and The Model

The principal aim of the research reported in this paper was to develop a framework by which teachers' pedagogies and capabilities with ICT could be mapped onto some multi-stepped scale as part of assessing their ICT uptake. The study was undertaken with interested teachers in two metropolitan elementary schools in Western Australia, over the second semester of their school year. This paper reports the four-stage typology of ICT uptake which was developed.

The typology was derived from a series of models of learning described by Brundage (1980) and Boud (1988) and with considerable input from studies of teachers and their teaching practices with ICT. In this sense it was grounded in the teachers' data as well as reliant on previous research. The model describes four stages: Dependence, Counter-Dependence, Independence and Interdependence (shown as Figure 1). These stages reflect typical phases through which all learners pass through as they achieve mastery on a new topic. ICT is simply another topic for learners to master, in this less techno-centric conception of ICT uptake as a learning issue.

Dependence *Counter-Dependence* *Independence* *Interdependence*

Figure 1: The four stages for learning new material (from Boud, 1988) and adapted to this model of ICT uptake

Within each stage of the model, the relevant literature provides descriptions that can help to identify how teachers feel and react. Through these descriptions it would seem possible to allocate any teacher to a location on the scale. To improve triangulation and to ensure consistency of reaction from teachers, descriptions for the typology were further developed to provide a more sensitive means to identify teachers' positions. Three domains were developed for each of the stages to enable different aspects of teachers' experiences and predispositions to inform their placement. These three domains are described as: feelings, understandings and behaviours. The domains were chosen to match the domains of human activity proposed by Bloom in the 1950s and still a useful distinction (Krathwohl, Anderson, & Bloom, 2001). The stages describe teachers' affective states, their cognitive states and the ways these are manifest in their actual teaching. If these stages were truly distinct and credible, then it was expected in developing the typology that teachers would be located at one stage, with their ratings for feelings, understandings and behaviours falling roughly into roughly the same stage.

Following this line of reasoning, the typology seemed to promise a means by which, in theory, ICT uptake could be measured by progress along the four stages and within the three domains simultaneously. The typology was presented as a 4x3 matrix (Figure 2) with cells defining the basic layout. It was named the ADL uptake model in an attempt to capture the role of Autonomy, Dependence and Learning in the ICT uptake process.

Stage / Domain	Dependence	Counter-Dependence	Independence	Interdependence
Feelings				
Understandings				
Behaviours				

Figure 2: Four stages of ICT uptake proposed as the ADL model

To enable the typology to be applied within general settings, distinct and unique descriptions for each of the cells were developed. These descriptions needed to provide ways to describe teachers across the 4 stages within the 3 domains. Fig. 3 demonstrates Descriptors taken from the *Understandings* row across the 4 stages.

Understandings	Survival issues with ICT dominate; Concerned more with own mastery and learning	Limited/local thinking about ICT; Teaching oriented	Directed, focussed ICT thinking; Teaching and learning oriented	ICT thinking, usage now second nature; Learning oriented, student focussed

Figure 3: Example of Descriptors for the four stage model, in this case over the domain 'Understandings'

Each cell of the 4x3 table was further elaborated with Pointers that are representative of that stage and domain. For example at *Dependence*, the teachers' *Understanding* might typically include some but probably not all of

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these: *Wary of ICT's flexibility, instability; questions own role; cannot yet comprehend ways to use ICT broadly; believes ICT is an object to be examined, learned, taught about; seeks explicit even unequivocal standards, regards explicit step-by-step guidance as critical; prefers single solutions.*

These Descriptors and Pointers are not indicative of fixed immutable steps that every learner passes through but general and overall predictable patterns to their feelings, thoughts and behaviours, which are representative of each stage. Some will pass through them more quickly than others for example, but the distinctions are, in Brundage & MacKeracher's terms, "an aid to analysis and … not meant to reflect universal, absolute differences"(1980, p. 11)

Mapping the Data—Two Teachers' Records

To test the utility and efficacy of the typology, a number of elementary teachers were interviewed and observed whilst teaching as a means to discover their understandings, feeling and behaviours in relation to their use of ICT in the classroom. The teachers were then mapped into the various cells of the typology and their positions investigated.

Using the data obtained for each of the teachers in the study, the ADL matrix was completed and teachers' positions noted. It was a relatively simple process to fit the teachers into the four-stage ICT uptake scale and thus to give them some form of quantitative index that could be compared at a later date to ascertain if progress in terms of advancing their positions could be determined.

The findings indicated that credible roles like novice through to sustained ICT user were categories that could be identified for teachers fitted to this typology, although it was decided to avoid using role names as the interest was on classifying their current location or stage, and allowing them to move stages as they needed and as they progressed.

It was found that the quickest way to rate the teachers was to review their data record from interviews, notes etc and decide which cells represented them best. For validation purposes in the study, the teachers were mailed a copy of the completed table and each was asked to circle positions on the table which they felt were relevant and descriptive of themselves. Positions where the teachers marked multiple pointers provided sufficient evidence to suggest that they perceived themselves to be 'in' that cell. Remarkable commonality between the researchers' predicted and teachers' own ADL matrices was found.

Teachers' positions within the typology were indicated on summary charts in which the cells that represented their status were shaded grey. For example a novice might have a chart (called their *ADL location chart*) with all the left column shaded, and nothing else (see Fig. 4).

	Dependence	Counter-Dependence	Independence	Interdependence
Feelings	▨			
U'standings	▨			
Behaviours	▨			

Figure 4: Sample ADL location chart of ICT uptake for a Novice ICT-using teacher

Using The Typology

The following sections describe several teachers who were investigated and whose ICT uptake was judged and located on the ICT uptake location chart.

Teacher A: Paula.

At the end of the research period Paula was very much in control of her learning environment. She had realised a few years earlier that she was becoming irrelevant, and decided that she wasn't prepared to continue unchanged in her teaching. When asked if the advent of the computer lab in her school had put extra pressure on her, she replied:

> PAULA:I can only speak for me but it should have put pressure on everybody. It did to an extent, but on myself…because of my age... I wanted to last the distance, and I saw a lot of people {here at school} that I didn't want to be like. I didn't want to have their attitude, and I knew that I haven't perfected the craft of teaching because it is always changing... according to the demands of society. A lot of them haven't noticed that! {Int1:line56}

This became the impetus for her to rethink her whole approach to teaching. She started telling her students that school was their job, not hers. She began to attend professional development courses that were going to help her change the way she thought and taught, and it had a kick-back effect on her usage of ICT:

> *INT: So you agreed to a plan that put a block of computers into a lab first, and class machines later? And you thought that was a good idea, but then...?
> PAULA: It still is, but it is frustrating having to wait. With the way I think, and maybe a few others think, as subjects become more integrated and we go that way, and we bring aboard thinking skills, allow the kids to learn how to think, to set their goals and so on. Whatever. It means that.they have to work more independently, they need to be more self-motivated, and given the opportunity to set their own goals. This is as opposed to someone playing entertainer, and pulling surprises out of a hat for the students each day. As kids set their own goals they learn to start saying I want to search on the Internet for something, I want to scan this picture in for this project, takes some digital photos and so on. Now, over three years we have gone from *a* lesson in the computer lab -- and it was really my lesson I was the one on the learning journey -- and now it's them telling me what they are doing and planning. {Int1:line86}

By the time Paula assembled her ICT uptake location chart, she was not only making use of ICT as a learning tool in her class, but she was also encouraging her students to do the same. In fact some of her Year 4 students were the school experts on various pieces of ICT:

> PAULA: In my class there was a handful who were experts at taking photos, printing and down-loading. Another little kid decided he was interested in scanning. Now I haven't got a clue how to do those... I know they're not hard... but why should I bother? So I handed over to them. It's more of, me standing back, getting time to understand and observe {while they do the work}. The kids know that I can't down-load pictures. It might take me just five minutes to learn, but it's not as important to me as it is to them. When I get my own digital camera then it will be. So the kids don't come along [to school] to watch me work, instead I stand back and watch them. They are more in control of what they do.
> {Int1:line 212}

Although she could be described as highly student-centric in her approach, she had become a competent user of ICT; and it was harder still to fault her use of it in her teaching. She was willing to share ideas with others, was a mentor to Nora, the adjacent Year 3 teacher, and they left the room divider open permanently, so that they could share students, ideas and support.. Her ICT planning and usage had become second nature to her, and she was focussed on her students' performance not her own. Her use of the Internet and e-mail as tools were indications that she had become not only Independent but also Interdependent in her ICT usage. Her ICT uptake bcation chart was very predictable (see Figure 5).

	Dependence	Counter-Dependence	Independence	Interdependence
Feelings			▨	▨
U'standings			▨	▨
Behaviours				▨

Figure 5: Final ICT uptake location chart for Paula

Very few of the teachers chose pointers in more than two columns, and very few did not choose all the cells in a column either. These facts provided support for the principle that there was some underlying pattern to the categorisations.

Nevertheless, this did not explain all the charts. Some teachers' charts did clearly cover two columns—perhaps Paula's chart, Figure 5, was an example of this—and it was felt that there could be an explanation for this. Teachers who straddled multiple categories along the scale, it was decided, might be in the process of transition between categories. Support for this notion was strengthened by the observation that teachers rarely straddled more than two stages when they completed their chart. In Paula's case she may be showing evidence that she was covering two categories, or stages, but the fact that she was performing at the upper of the two stages (in other words, she had circled sufficient pointers in her *Interdependence behaviours* cell, the one at the bottom right of her chart) was good reason to allow her this categorisation. David was a better example of someone in transition.

Teacher B: David

Although he was negative about ICT, David bought a computer during the research period and began to make use of it at home. His interest levels were higher than his performance levels, as he found them initially confusing and was unwilling to try any but the most mundane activities with his students. He believed that the school and the Department of Education (his employer) expected him to teach students about ICT, and that they had never provided enough support to help him even start the process. He admitted that his usage was unsystematic, and felt that he was exp ected to show high levels of skill with computers all the time:

> DAVID: Oh, I'm quite sure that I'm required to have every kid completely computer literate, and doing very complex computer type things, I'm sure that's happening here. {Int1:line 46}

Not only does he have unrealistic expectations of his own use, he puts pressure on himself as well. When one parent offered to help on Fridays, he was pleased and pressured in equal measures:

> DAVID: .... I had the head of the P & C in my classroom, an absolutely wonderful person called Jaccques, very very computer literate, and he's actually been in the classroom on Friday mornings, taking loads of kids doing word processing...
> *INT: I saw your thanks to him in the newsletter.
> DAVID: yes, but, I can see in his eyes, that he knows I don't know what the hell I'm doing. He's done extra things like buying a set of headphones, brought in a few CDs; and every Friday morning I wonder what the hell am I going to get Jacques to do on computers. So I feel pressurised there, I feel anxious and worried... (Int1:line70)

It is apparent that David feels that he must provide all the direction when it comes to computer use. It is a focus of his attention and not a tool or a conduit to a learning purpose. These are the characteristics of a Dependent person on the ICT uptake typology. At the same time he admits that computers definitely have a place in schools, and that he would like to improve. He doesn't know how he will become an adopter of computers in his class, but he has some ideas which seem to simultaneously guide and stress him:

> *INT: So how will you become this person moving from considering to adopting?
> DAVID: ... I don't know. I don't have a clear idea in my head, or goal, of how the computer can be used in the classroom. To me it's always been a token gesture. Where you're rostering a child on a computer, and we were seen to be doing some something, but I can't see how it's integrated into the learning environment. I do actually like the idea very much of using it for remedial purposes, like teaching phonics, that sort of stuff. And I like the idea of using the Internet in the classroom.... ahhh, open-ended research type stuff; and I like the idea of being able to network with other teachers through the Internet. {inr1:line91}

David, with no clear idea of how computers can be used, and who regards their usage as part of a 'token gesture', is relatively low on the typology of ICT uptake.

In summary he perceives it as a novelty or even a threat, is defensive about his lack of progress and seems unlikely to make any progress without specific and localised support. His understanding is limited, but as well as views about ICT as a teaching tool, he also envisages some more flexible and open-ended uses of ICT which suggests that his thinking at least is a little more towards Counter-Dependence than either his Feelings or his Behaviours. Hence his chart has a peak as shown in Figure 6.

	Dependence	Counter-Dependence	Independence	Interdependence
Feelings				
U'standings				
Behaviours				

Figure 6: David's Initial ICT uptake location chart

Discussion

The placement of the teachers on the chart provided a number of interesting findings which merit some discussion. In the first instance, the typology was found to provide quite consistent descriptions for the participating teachers. The teachers' positions in the table tended to be within the discrete stages across the 3 domains being used. There was a high degree of consistency in this suggesting that the typology was able to reliably place teachers in a stable position.

Furthermore there was a high degree of consistency between the positions which the researchers placed the teachers and where they placed themselves. This consistency provided some sense of triangulation of the data and provided some assurance that the typology could accurately place teachers.

In a number of instances teachers were found to sit in one stage but to have some connection with a cell in an adjacent stage. These instances tended to suggest teachers whose position on the typology was not stable and was indicative of a teacher who was perhaps moving along the typology to an advanced level of ICT uptake. This finding was confirmed on several occasions when such teachers were found to have moved positions along the typology to stages indicative of greater levels of ICT use and uptake.

Summary

This paper has described the design of an instrument to help identify teachers' level of ICT uptake. It was less techno-centric than many previous versions, and was shown to have some utility. Two aspects of describing a teacher's location were evident. Some fitted easily to the three domains of a category suggesting that they were characterised by that stage and some stability; others tended to straddle two (but rarely more) stages, suggesting that they were in the process of change.

All the possibilities for placement on the scale were expected to describe people with very different needs about ICT and expectations about ICT training. In fact it was evident that these teachers with their diverse views and different ratings ion the ICT uptake typology, had quite different support needs and diverse professional development needs, even though they may have been in the same schools and similar circumstances.

It was supposed that teachers other than those in the two case schools would be undergoing similar stresses and also need a variety of support and professional development services. Thus the typology could be applied more widely. A useful next step could be the development of an instrument or questionnaire to investigate an alternative way to finetune the placement of people onto the grid, as the current one might provide too many cues to users who had seen it before.

The typology appears to provide a reliable and valid way to determine teachers' positions as users of ICT in their teaching and learning. Further study will be carried out to ensure the typology can be used effectively in mainstream settings. If and when this is possible, the typology would appear to provide considerable assistance as a means to helping to ensure that professional development programs can be targeted in meaningful ways to the recipients based on their needs and their current capabilities as users of ICT in their teaching.

References

Boud, D. J. (1988). *Developing student autonomy in learning* (2nd ed.). London: Kogan Page; Nichols Pub. Co.

Brundage, D. H., & MacKeracher, D. (1980). *Adult Learning Principles and their Application to Program Planning* (ED181292). Toronto: Ontario Dept. of Education.

Cheung, M. Y. M. (1999). The process of innovation adoption and teacher development. *Evaluation and Research in Education, 13*(2), 55-75.

Christensen, R. R. (1997). *Effect of technology integration education on the attitudes of teachers and their students (information technology).* Unpublished PhD, University Of North Texas; 0158.

Elmore, R. (1992). Why restructuring alone won't improve teaching. *Educational Leadership* (April), 44-48.

Fullan, M. (1999). *Change forces: the sequel*. London: Falmer Press.

Hodas, S. (1993). *Technology refusal and the organizational culture of schools, 2.0* [web page]. ObservETory on Educational Technology. Retrieved Nov 1, 2001, from the World Wide Web: http://www.observetory.com/hodas.htm

Holloway, R. E. (1996). Diffusion and adoption of educational technology: a critique of research design (Ch. 37). In D. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 1107-1133). New York: Simon & Schuster MacMillan.

Huberman, M. (1992). Critical introduction. In M. Fullan (Ed.), *Successful school improvement* (pp. i-vi). Buckingham: Open University Press.

Knowles, M., Holton, E., & Swanson, R. (1998). *The adult learner: the definitive classic in adult education and human resource development* (5th ed.). Houston, TX: Gulf Publishing Company.

Krathwohl, D. R., Anderson, L. W., & Bloom, B. S. (2001). *A taxonomy for learning, teaching, and assessing : a revision of Bloom's taxonomy of educational objectives* (Abridged ed.). New York: Longman.

Mahajan, V., & Peterson, R. A. (1985). *Models for innovation diffusion.* Beverly Hills: Sage Publications.

Marcinkiewicz, H. R. (1994). Computers and teachers: factors influencing computer use in the classroom. *Journal of research on computing in education, 26*(2), 220-237.

McClintock, R. O. (Ed.). (1988). *Computing and education: the second frontier.* New York: Teachers College Press.

Papert, S. (1998, 30 Aug). *Technology in schools: to support the system or render it obselete?* [web page]. Milken Exchange. Retrieved Sept, 1998, from the World Wide Web: http://www.milkenexchange.org/feature/papert.html

Russell, A. L. (1995). Stages in learning new technology: Naive adult email users. *Computers & Education, 25*(4), 173-178.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1992). Teaching in high-tech environments: classroom management revisited. *Journal of Educational Computing Research, 8*(4), 479-505.

Schrum, L. (1998). On-line education: a study of emerging pedagogy. *New Directions for Adult and Continuing Education* (78), 53-61.

Action Learning: Applications in Technology Training and Professional Development

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Abstract: Action learning is effective learning and development through the use of real life context based problems, applications, and solutions. At Grant MacEwan College, in Edmonton, Alberta, Canada, emphasis in faculty instruction is on practical, real life situations that faculty encounter in their classrooms and in teaching. Moving from a program of presentations and passive participation, professional development at Grant MacEwan now incorporates practical, hands-on experiences that reflect the current needs of faculty through action learning. This new directive for professional development focuses on making changes to the learning environment rather than forcing a personal change in the faculty members teaching style.

Action Learning began in the corporate sector as a method for solving real life problems in a creative and practical manner. It moved into educational settings, fitting well into graduate level programs that based their course activities on constructivist and situated cognition learning theory (Ritland-Bannan, 1999). Similarly, it fit well with educators attempting to implement changes to their teaching methodology (Beaty, 1999: Gold, 2001). Action learning is based on a team approach whose function it is to solve real problems by trying various solutions, reflecting upon the impact of those solutions, and creating improvements to those solutions.

If action learning can help companies solve problems, students learn through practical experience, and teachers try new learning methodologies, can it help college instructors learn new ways of teaching with technology? Grant MacEwan College educational technology designers thought it could.

Formerly a program of occasional one or two day presentations and passive participation, faculty training in using technology for teaching and learning now focuses on practical, hands-on experiences that reflect current needs of faculty. Using principles of action learning, college, program, and individual faculty needs are addressed through continuous workshops and individual consultations that incorporate (a) Context -based learning, (b) team support, (c) reflective questioning and (d) action based solutions.

A key concept in action learning is that of working on real problems with real people, in real situations (Gallant, 2000). Workshops are marketed as possible solutions to problems faculty may be facing. For example, the workshop on Web-based discussion forums is described in terms of addressing the problem of promoting greater interactivity, deeper levels of analysis, more critical thinking, and improved collaboration in course discussions. Instructors who attend these workshops come in response to a problem they want to address. Attendance at these workshops is often a response to "just-in time" support required for a project need. However, faculty members can and do request immediate one-on-one support if the workshop schedule does fit their needs. This is not only required to meet the immediate need of a project. It is also desirable because of the many different skill levels found within members of a team. Faculty members have to feel comfortable asking for remedial as well as advanced skill development in the use of technical applications (Schifter, 2000). Much of the training that goes on at MacEwan is comprised of office visits to give immediate support and training to group and individual technology initiatives. Our motto is "Yes, we make house calls!"

Context-based learning. Training is hands-on. Participants sit down at computers and work with actual applications, with content they can use in their own teaching projects. The sessions are not demonstrations but rather a combination of sequential skill building and peer assistance that enables them to use a certain technology to solve their teaching problems. An illustrated manual is produced for each workshop; however it may or may not be used by all participants. It is not uncommon to see one or two members in each group trying things out by trial and error and ignoring the manual and the facilitator completely. Regardless of learning styles, the goal for all participants is to leave the session with a usable product that they can test, make changes to, and implement in their courses (Baylor, 2000).

Team support. This brings up the concept of teamwork and community. Whether instructors are in the same program or not, the experience of planning new actions to address a problem bind them. One of first activities in a Grant MacEwan workshop is getting to know the people around you in the training room. What program are they in? Where are their offices? What are they doing to solve a common problem? What are they trying? What is working? What is not? How are they using technology to solve this problem? Participants are given a list of the colleagues who attended the workshop so they can go back down the hall a few days later, and ask that person, "How did you do that thing in WebCT to allow your students to post their assignments again?" Forming a supportive network of colleagues is part of the plan in faculty training. When training is given to specific programs, a team approach is used to identify problems and evaluate solutions.

Reflective questioning and action based solutions. Faculty training based on action learning requires a team to constantly think about the results of a decision and how it will impact learning. MacEwan training is based on decisions that programs and instructors make and the actions that are taken as a result of that decision. Furthermore, once an action is implemented, instructors question and reflect upon the effectiveness and efficiency of that decision. Problems and mistakes are shared within workshops as learning opportunities. Because teaching with technology is new and unfamiliar to most faculty members, questions must be raised so that fears and concerns are addressed. Reflection about decisions, and changes to those decisions, are based on questions and consultation with team members. Final decisions, if there ever is such a thing, are made within the context of the instructors' real situation after questions and reflection about initial actions.

As facilitators and trainers for our faculty, we try to be the contact that instructional teams use for linking to other groups. We try to be the catalyst to move them to evaluate their current mode of teaching. We try to monitor their process to see when and where our intervention can help. We try to set a climate that encourages trust and willingness to try new initiatives. And we try to be coaches who encourage and support faculty to take responsibility for their own professional development in the field of educational technology. This facilitation model (Marquardt, 1999) required by action learning principles helps faculty try new methodologies in teaching....new methodologies that incorporate technology and that are based on action learning.

References

Baylor, A. L. (2000, June). Cognitive strategies for training with technology. *TechTrends*, 44, 13-15.

Beaty, L. (1999, Fall). Consultation through active learning. *New Directions for Teaching and Learning*, 79, 51-58.

Gallant, G. M. (2000, Winter). Professional development for web-based teaching: Overcoming innocence and resistance. *New Directions for Adult and Continuing Education*, 88, 69–77.

Gold, S. (2001, May). A constructivist approach to online training for online teachers. *Journal of Asynchronous Learning Networks*, 5, 35–57.

Marquardt, M. J. (1999). *Action learning in action: Transforming problems and people for world-class organizational learning.* Palo Alto, CA: Davies-Black Publishing.

Ritland-Bannan, B. (2000). Teaching instructional design: An action learning approach. Retrieved March 1, 2002 from http://itech1.coe.uga.edu/itforum/paper37/paper37.html

Schifter, C. (2000, March-April). Faculty motivators and inhibitors for participation in distance education. *Educational Technology*, 43-46.

Promoting Peer-to-Peer Discourse for Collaborative Mathematics in Canadian Grade 7 Classrooms

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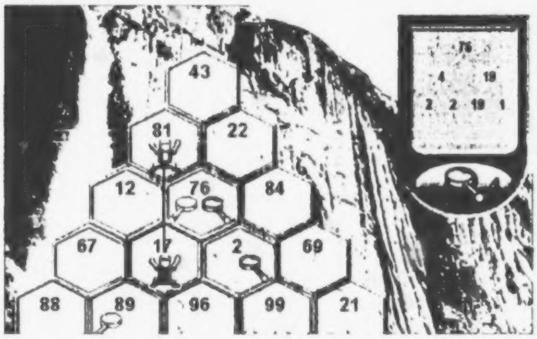
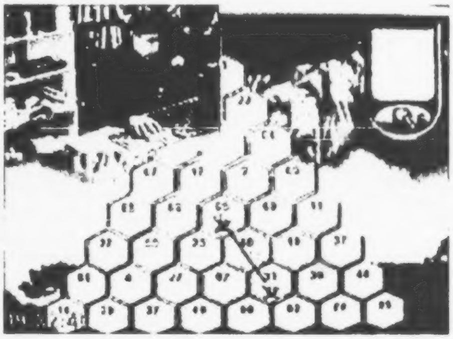
Abstract: Whereas traditional research on collaborative educational systems has primarily focused on how to define better modes of digital interaction, this approach is found lacking when applied to developing collaborative systems for elementary school aged children. It is creatively and collaboratively restrictive to filter the enthusiastic interactions of these excited 12-year-old children through progressively more complicated GUIs. Current E-GEMS research examines design factors of educational systems that recognize and facilitate the social context of the classroom and hopes to encourage peer-to-peer social discussion. By correlating observed interactions in the digital domain with those in the social domain, we hope to shed light on design factors of collaborative systems that can be an integral and exciting part of a child's mathematical education. This paper describes the vessel of E-GEMS research into socially engaging design factors – the collaborative educational game PrimeClimb.

Introduction





PrimeClimb, as shown in the left image, is a collaborative game in which a pair of children attempt to climb to the top of a mountain of numbers together. In order to reach the top of each mountain, students must collaboratively avoid falling – a feat accomplished by recognizing shared common factors between the numbers on which they stand. Collaboration is reinforced through the fact that in order to reach the goal each player must observe their partner's number in order to move without falling. There is a tool – the magnifying glass – that can be used to shed light on the factors of any number. Magnifying glasses are hint-giving resources that are limited and shared amongst the two players. Our observation sessions were used to provide feedback in developing the current design factors of the magnifying glass.

The Study

The sessions of the study proceeded as follows: the pairs of children were first given a pre-questionnaire to access their mathematic factorization skills and general attitudes toward collaboration in math and computer games. They then played PrimeClimb together for 20 minutes and the session ended with a post-questionnaire that reassessed their math skills and attitudes. The focus of the PrimeClimb study has been to

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analyze the social context of collaboration in a digital environment in terms of verbal and non-verbal interactions. Our data capture and analysis methodology must reflect this focus. Each play session was computer-logged and video-recorded. In order to correlate the digital events in the computer log with social discussion and interactions, an absolute clock was displayed on the game screen at all times. Each video captured a player's upper body along with her game screen; thus two tapes were produced from each session (see the right image, the figure has been blurred to preserve the subject's identity). Captured audio transcripts have proved successful in correlating digital events to facilitate design analysis in ethnography (Suchman, 2000) and math education research (Pirie, 1996). We hope to use our captured video data to correlate the social interactions with the PrimeClimb game events.

The detailed analysis of the PrimeClimb study data is underway. A brief glance already reveals a couple of encouraging signs. Firstly, different categories of social interactions of children playing PrimeClimb are becoming increasingly clear. As in past research from mathematics education, the categorization of peer-to-peer discussion in a mathematical context must take place first and foremost before the analysis of the pedagogical values of those categories can be carried out (Pirie, 1998). A few possible patterns of interactions have emerged that include: a player explaining to the other player why a move is not allowed using mathematical language, a player explaining the reason for a failed move using mathematical knowledge and a player strategizing and logically planning a series of moves. An example of the latter is when a player states that he/she is on a prime number and encouraging her partner to move as high as possible (this is an easy strategy but could prove faulty as multiples of prime numbers share common factors). We hope to apply this categorization and consequent analysis of peer-to-peer discussion about math to our computer supported collaborative environment. Secondly, we have noted that all the children had very little difficulty grasping the interface to the game – a result of multiple prototype sessions that have shaped the game interface. This means PrimeClimb is able to be a stable foundation upon which other research questions about collaboration can be launched. It has been argued that educational games should not be specially designed for girls at the risk of marginalizing them, instead games should be designed non-gender specifically in which the players can seek their own identities through collaborative tackling of the challenge at hand (Cassel 2000). PrimeClimb seems to have succeeded in this respect so far as boys and girls employed a vast array of strategies and were all readily accommodated by the game.

Conclusion

The data collection part of the PrimeClimb study has been completed and the data analysis has begun with promising signs. Our ultimate vision is to build collaborative educational systems that fit seamlessly into and facilitate the social context of the classroom – this study has so far shown that ethnography and math education research have methodologies that can provide valuable insights.

References

Pirie, S. E. B. (1996). *Classroom video recording: When, why and how does it offer a valuable data source for qualitative research?* Paper presented at the 18th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (Panama City, FL.). ERIC ED 401 128, 17 pages.

Pirie, S.E.B. (1998). *Working towards a design for qualitative research.* In A. Teppo (Ed.), *Qualitative Research Methods in Mathematics Education.* Journal of Research in Mathematics Education Monograph Series, Reston, VA: National Council of Teachers of Mathematics, pp. 79-97.

Suchman, Lucy A and Trigg, Randall H. (2000). *Understanding Practice: Video as a Medium for Reflection and Design.* Taken from Baecker et al. *Readings in Human-Computer Interactions: Toward the Year 2000.* Morgan Kaufmann.

CASSELL, J. (2002). *Genderizing HCI* in *The Handbook of Human-Computer Interaction.* Mahwah, NJ: Lawrence Erlbaum

Distance Learning Instruction: A New Model of Assessment

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Background

Distance learning is rapidly gaining acceptance as a valid means of course delivery in educational institutions across the country. With distance learning becoming an accepted form of instruction, these institutions are struggling to enhance the quality of teaching, learning and scholarship over the Internet while trying to effectively integrate this type of instruction into the curriculum. Increasingly educational institutions are employing this type of learning as part of their course offerings; in addition, many "virtual universities" sponsored by state departments or through commercial endeavors are offering a variety of programs and degrees via computer-mediated distance learning courses. Is this an effective way to offer instruction? What is the best way to assess this type of instruction?

As more and more institutes of higher education start offering computer-mediated distance learning courses, it becomes increasingly important that these courses are evaluated effectively. This new paradigm of learning requires a new model of assessment. This paper presents a model that focuses on six constructs that computer-mediated distance learning courses should examine: Teaching and Learning, Developing a Community of Learners, the Instructor, The Student, Implementation of the Course, and Technology Use. These constructs become important elements in the design and evaluation of distance learning classes.

The Model for Assessing Distance Learning

When looking at the first construct, *Teaching and Learning*, research supports that students of all ages who are provided easy access to well-crafted computer-mediated distance learning classes generally have a positive experience taking this type of course (Abbott and Faris, 2000; Baron and McKay, 2001; Gagne and Shepherd, 2001; Mitra and Steffensmeier, 2000). However, these studies also point out that an increase in positive attitude is directly related to instructional approaches used, meaningful assignments required, supportive faculty, and involvement in meaningful discussion groups (Abbott and Faris, 2000). As Baron and McKay (2001) point out, having the requisite computer proficiency also affected students' perceptions of the course.

Research also suggests that distance learning can provide the same level of academic excellence as courses taught in traditional modes. Moore and Thompson (1990, 1997) reviewed much of the research from the 1980's and 1990's on the effectiveness of distance learning, which included not only computer-mediated learning, but two-way interactive video and a variety of other technologies, as well. They concluded that distance education was considered effective when measured by the achievement of learning, by the attitudes of students and teachers, and by return on investment.

Developing a Community of Learners is the second construct to consider when assessing distance learning instruction. Educators are increasingly emphasizing the importance of electronic communities in distance learning courses as a key to effective implementation (Creed, 1996; Herrmann, 1998; Illinois Online Network, 2000; MacKinnon, 2000; Palloff and Pratt, 1999; Poole, 2000). As Palloff and Pratt (1999) say: "In distance education, attention needs to be paid to the developing sense of community within the group of participants in order for the learning process to be successful" (p.29). The role of the community is an essential component for the success of any distance learning class.

When considering the third construct, *The Instructor*, in an online distance learning course, the role of the instructor needs to be examined. The instructor no longer stands in front of the room imparting information, directing all interaction, and facilitating activities. Instead, instructors must take advantage of the constructivist online course and create an environment that is learner-centered, collaborative, and egalitarian in approach. The governing principle is that learning is an active process in which learners construct rather than acquire knowledge and the instructor's role is to support that construction rather than impart knowledge (Grossman and Wagner, 2000). Palloff and Pratt (1999) categorize the various tasks and roles required of an online instructor into four general areas: pedagogical, social, managerial, and technical. In the pedagogical area, the instructor must know how to design and implement an effective hands-on course and create an environment, which promotes interaction and exchange between all involved. In the social area, the instructor must direct all social intercourse that occurs online and ensure that communication is not just between instructor-student but is a multifaceted pattern, involving student-student-instructor. In the managerial area, the instructor must know how to manage a multitude of tasks and organize a multitude of files. Oftentimes, the managerial function can become overwhelming and an effective instructor utilizes organizational skills and timesaving techniques. Lastly, in the technical area, the instructor must be technically proficient so that the course runs smoothly. The instructor must provide technical feedback to students on basic requirements for exchanging and reading files, and using software, browsers, and operating systems. In a distance learning course, the role of the instructor changes dramatically.

In reviewing the next construct, *The Student*, the role of the student also changes significantly in a distance learning course. Many students will find the transition to this new type of online learning to be difficult, especially if they are used to a more traditional course where they are "fed" knowledge and evaluated using a test. Students in an online course must be active and engaged in knowledge generation. They cannot sit passively and expect the course to be given to them by the instructor. Palloff and Pratt (1999) categorize the role of the leaner in an online course into three areas: knowledge generation, collaboration, and process management. In knowledge generation the student must learn how to construct and generate his/her own knowledge base. In collaboration, the student must learn how to collaborate electronically with other students via e-mail and discussion forums. In process management the student must take the responsibility for managing his/her time, as well as taking the initiative for researching topics and concepts. The student must learn how to manage the process of learning in a constructivist online course. This is an important construct to consider in assessing distance learning courses due to the low completion rate of students enrolled in computer-mediated distance learning courses.

One of the more important aspects of computer-mediated distance learning is effective implementation of the course which in the fourth construct, *Implementation*. This covers the basic instructional design of the course, the infrastructure available to support the course, the quality of the access to the course, and the level of technical support available. These factors affect each student's ability to access and successfully complete an online course.

The last construct, *Technology Use*, looks at how often students use various components of the course, and find each component useful. It is highly recommended that different aspects of the course be assessed for frequency of use and degree of usefulness. Such aspects that could be assessed are: the Discussion Forum, the Announcement Feature, the chat room, the white board, the Student Drop Box (where assignments are uploaded), the learning links, the lecture notes, the schedule of assignments, the syllabus, and the e-mail feature. This information will be very useful in the revision and implementation of the course.

Discussion

Computer-mediated distance learning involves a whole new array of factors to consider in the teaching-learning process. However, although distance learning courses involve various new factors to consider in their design and assessment, distance learning courses are fundamentally the same as any other course offered to students-- the basic denominator is effective instruction. The modality of delivering the course may change, but the basic tenants of good pedagogical theory remain the same. Although we are transforming education into a 21st century enterprise that utilizes the latest technological advances, the basic issues remain constant: what is effective instruction and how can we best teach to students who possess different learning styles and different competencies? How can we better prepare instructors to be effective? These are the questions we need to keep in mind as we conduct further research into the field of distance learning. In terms of effective course design, distance learning continues to represent one point along a continuum of design options, one other mode of delivery to consider.

The constructs outlined in this paper are those that should be considered in all courses; they are applied in somewhat different contexts within a distance learning course. As we move forward technologically, our theories of learning and instruction need to be applied consistently and persistently to the development of all courses, and our attention needs to be on the quality of the instruction, not on the modality of delivery. This "new" paradigm of learning needs to be grounded in time-tested and research-based theories of learning to ensure that our students receive the quality instruction they deserve.

Overview of This Session

The session at Ed-Media will present this new model of assessment by examining what the research recommends for each construct. A visual model will be presented and each construct will be reviewed according to what is recommended to assess this area. The session will demonstrate an assessment form that has been developed to assess the author's distance learning class, Literacy and Technology Across the Curriculum, that is being offered at Fairleigh Dickinson University. The assessment form will be examined and copies will be distributed to participants. Preliminary data collected from the course will be presented. Specific examples of how this model helped the author to design and implement this course will be demonstrated. Questions and discussion on assessment in distance learning instruction will conclude this session.

References

Abbott, J. and Faris, S. (Winter 2000). Integrating technology into preservice literacy instruction: A survey of elementary education students' attitudes toward computers. Journal of Research on Computing in Education, 33(2), 149-161.

Baron, J. and McKay, M. (April 2001). Designing and delivering an online course for k-12 educators. T.H.E. Journal, 28 (9), 68-75.

Creed, T. (1996). Extending the classroom walls electronically. Adapted from Campbell, W. and Smith, K. (eds.) New Paradigms for College Teaching. Edina, MN: Interaction Book Co. Retrieved March 15 2001 from the World Wide Web: http://www.users.csbsju.edu/~creed/techno3.html

Gagne, M and Sheperd, M. (April 2001). Distance learning in accounting; A comprarison between a distance and a traditional graduate accounting class. T.H.E. Journal, 28(9), 58-64.

Grossman, C. and Wagner, J. (2000). Assessing learners online. Practitioner File. ERIC/ACVE. Retrieved on May 4, 2001 on the World Wide Web: http://ericacve.org/docs/pfile03.htm

Hermann, F. (1998). Building on-line communities of practice: An example and implications. Educational Technology, 38(1), 16-23.

Illinois Online Network (2000). ION Resources: Synergy in the classroom. Retrieved March 15, 2001 from the World Wide Web: http://illinois.online.uil…IONresources/confstrategies/synergy.html

MacKennon, G. (2000). The dilemma of evaluating electronic discussion groups. Journal of Research on Computing in Education, 33(2), 125-131.

Mitra, A. and Steffensmeier, T. (Spring 2000). Changes in student attitudes and student computer use in a computer-enriched environment. Journal of Research on Computing in Education, 32(3), 417-431.

Moore, M. and Thompson, M. (1990). The effects of distance learning: A summary of literature. ERIC Document Reproduction Service No. ED330 321.

Moore, M. and Thompson, M. (1997). The effects of distance learning (ACSDE Research Monograph No.15). University Park, PA: American Center for the Study of Distance Education, Pennsylvania State University.

Palloff, R. and Pratt, K. (1999). Building learning communities in cyberspace. San Francisco, CA: Josey-Bass.

Poole, D. (Winter 2000). Student participation in a discussion-oriented online course: A case study. Journal of Research on Computing in Education, 32(2), 152-177.

Learning and Retention in Data Structures: A Comparison of Visualization, Text, and Combined Methods

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Abstract: Numerous studies have been conducted to evaluate the effect of animated visualizations on students learning data structures, but few have attempted to evaluate the retention of information gained from visualizations. Our work focuses on comparing different media used for teaching data structures, particularly as they affect the learning process over time. Results from our empirical studies suggest that a combination of text and visualization helps students retain knowledge better than either approach alone.

Introduction

In computer science education, algorithms and data structures are complex topics and difficult for students to learn. Animated visualizations that graphically depict the processing steps of data structure operations are frequently developed as instructional media to help students learn. Many studies have been conducted to evaluate the effectiveness of these visualizations for learning (see Hundhausen 2002 or Wilson 1996 for a review). However, results have generally been negative, typically showing no significant difference between visualizations and traditional teaching methods. Minor design features seem to have major impact on effectiveness. Furthermore, few studies have attempted to evaluate students' long-term retention of information gained from data structure visualizations, the ultimate goal of education. A related study (Palmiter 1991) found that animated demonstrations to teach software user interfaces improved student performance over a textual manual in the short term, but did not maintain performance in the long term. It is possible that students merely mimicked the steps of the animations at first without actually understanding the steps as required for long term retention. We present a series of studies aimed to examine these issues.

Results

The goal of the first study was to compare different interaction strategies of data structure visualizations. 60 undergraduate CS students studied the AVL Tree data structure for 15 minutes using one of 3 methods: (1) a textual material derived from Shaffer's textbook (2001), (2) the Arsen visualization (Gogeshvili 2001) which simply animates the tree operations initiated by users, or (3) the BinaryTreesome visualization (Gustafson 1998) which quizzes students to perform the operation steps themselves while providing hints. Students then answered a 15-minute closed-book test containing 3 procedural questions about the 'insert', 'delete', and 'find' tree operations, and 2 conceptual questions about higher-level concepts.

The data (table 1) indicate that all 3 methods resulted in similar student performance on the test questions, except for the 'delete' operation question which had significantly better scores from the students who used the text material ($p<0.05$). This may be due to the open-ended nature of the visualization tools, which required users to discover and explore their full functionality to learn all the AVL tree operations. Many students simply may have forgotten to explore the 'delete' operation in the visualizations or ran out of time, whereas the text ensured coverage of the material and helped students to pace themselves. This indicates that open-ended visualizations should be accompanied by guidance material, and led to our examination of a combined text and visualization approach in the next study. The Arsen visualization received significantly better subjective satisfaction ratings from students than the other two methods ($p<0.05$) and a weak effect over BinaryTreesome on the 'delete' question ($p<0.1$), indicating some advantage of the simple animated visualization method.

	(1) Text	(2) Arsen	(3) BT
Test	73%	66%	57%
'delete'	40%	15%	0%
Subj. Sat.	66%	87%	77%

Table 1: Mean scores and ratings, 1st study.

The goal of the second study was to examine the effect of data structure visualization on longer-term knowledge retention. 49 undergraduate CS students studied the Depth-First and Breadth-First Search graph traversals for 20 minutes using one of 3 methods: (1) a textual material from Shaffer's textbook, (2) Saraiya's visualization (Saraiya 2001) which lets users step through the operations, or (3) the combination of (1) and (2). Students then answered a 10-minute closed-book test containing 3 procedural and 2 conceptual questions. After a period of 15 days, students again answered a second, similar test without reviewing the study material.

Overall, students scored similarly on the first test across all methods (table 2). Significant effects between methods were not found on either test. However, on average, students' scores decreased on the second test by 21% with the text method, by 11% with the visualization method, and by only 7% with the combined method. The 15-day waiting period had a significant effect on test scores ($p<0.05$). It had a significant detrimental effect on the text users ($p<0.01$) and a weak effect on the visualization users ($p<0.1$). No effect was detected for the combined method users. This data indicates a non-significant trend towards the combined method providing better retention. In future work, student tests should contain many more questions to enable higher resolution scores and more conclusive statistics. Strangely, on one conceptual analysis question, students' scores actually increased remarkably by 25% on average for the visualization and combined methods, while the text method scores remained constant. In subjective satisfaction ratings, the text method was the clear loser ($p<0.01$). On average, students most preferred the combined method.

	(1) Text	(2) Vis.	(3) Comb.
Test 1	74%	73%	75%
Test 2	53%	62%	68%
Subj. Sat.	62%	80%	87%

Table 2: Mean scores and ratings, 2nd study.

Conclusions and Future Work

For teaching data structures, we recommend a learning method that combines visualization and text. Students are clearly dissatisfied with usual text materials, but visualization alone can lead to gaps in knowledge. Since subjects perceive that visualizations are very helpful, visualizations will stimulate and motivate them to learn new topics. Visualizations can help to drive concepts into long-term memory. Accompanying text will ensure adequate coverage of the concepts. This approach simultaneously enables focus as well as open-ended exploration by students. Even in time pressure learning periods, students were able to juggle both learning methods to produce good performance, including taking time to learn the visualization tool itself.

Current research in algorithm visualizations suggests that actively engaging students while they are watching visualizations can increase their effectiveness (Hundhausen, et al. 2002). This would support our hypothesis that the visualizations in the first experiment failed because students were not guided to study the 'delete' operation. One approach to active engagement is to supply guide questions to be answered while the visualization is being studied. In addition to active engagement, we believe that there is an identifiable set of key features that are incorporated into nearly all successful visualizations. We currently hypothesize that this feature set includes: User control of the pace of the visualization animation; the ability to test hypotheses by allowing users to enter input; display of both logical and physical views of a data structure; the ability to backup the animation to replay critical steps; and a pseudocode display of the algorithm, keyed to the steps being visualized. We are presently conducting studies to measure the magnitude of the contribution of each of these features using a controlled visualization toolset.

References

Gogeshvili, A. (2001). AVL Tree visualization applet. http://www.seanet.com/users/arsen/avltree.html.

Gustafson, B., Kjenoli, J. (1998). BinaryTreesome. http://www.binarytreesome.com/.

Hundhausen, C., Douglas, S.A., and Stasko, J.T. (2002). A meta-study of algorithm visualization effectiveness. To appear in the *Journal of Visual Languages and Computing*.

Palmiter, S., & Elkerton, J. (1991). An evaluation of animated demonstrations for learning computer-based tasks. *Proceedings of the ACM Conference on Human Factors in Computing Systems*, (pg. 257-263).

Saraiya, P., Shaffer, C. (2001). DFS and BFS visualization. http://infovis.cs.vt.edu/.

Shaffer, C. (2001). *A Practical Introduction to Data Structures and Algorithm Analysis*, Prentice Hall.

Wilson, J., Aiken, R., and Katz, I. (1996). Review of animation systems for algorithm understanding. *Proceedings of the conference on integrating technology into computer science education*, (pg. 75–77).

New Pedagogies and Re-Usable Learning Objects: Toward a Different Role for an LMS

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Abstract While the idea of reusing objects in digital learning environments is not new, continual strides are being made toward improving the prospects of reusability. A major trend in company training settings is to think of reusability in terms of a LMS (learning management systems), but where instructor use and pedagogies are little considered. We describe an approach to re-use based on a pedagogical model that puts learner interaction and contribution in the driving role and which sees LMSs and LCMSs as tools for the instructor or learner.

LMSs, LCMSs: Where is the Instructor?

There is currently much attention in the business world to the re-use of learning objects. Frequently this occurs in the context of the introduction of "e-learning" where the latter runs separately from "classroom courses". E-learning is typically seen as being instructor-free or -neutral, in order to capitalize on an "any time, anywhere" motivation. Complex systems, called learning management systems (LMSs) and learning content management systems (LCMSs), are proliferating, generally based on the underlying assumption that the system itself will select and deliver the learning experience, based on some level of sophisicated user modelling. LMSs are defined as systems "to manage learners, keeping track of their progress and performance across all types of learning activities" while LCMSs manage content or learning objects to "serve up to the right learner at the right time" (Chapman & Hall, 2001, p. 11). LCMSs typically include content-development tools, being in effect a new iteration of the long series of attempts to bring authoring tools into mainstream use for computer-supported learning. "Content assembly" and "publish learning" into different "output formats" are key tasks of LCMSs (Chapman & Hall, p. 16).

Meanwhile at the same time as commercial LCMSs and LMSs are being taken up for "e-learning" in company training settings, the use of Web-based course-management systems, also called online educational delivery systems (Landon, http://www.c2t2.ca/landonline/), continues to grow in importance particularly in support of instructor-led courses with or without a classroom component. Course-management systems (CMSs, not to be confused with content-management systems, also sometimes called CMSs) integrate content delivery, communication, learner activities, collaborative work support, feedback, testing, portfolio development, groupware tools, and administrative tools for the instructor. Selection of content objects is only part of the use of an online educational delivery system, and in many cases a minor part.

The relationship of LMSs and LMCSs to instructor-led classroom or blended learning is not yet much studied. Partially this is because the use of LMSs and LCMSs is still new, and most companies making these major purchases are still in the phasing-in stages. More fundamentally, it is because those responsible for LMS and LMCS use in the organization tend to operate separate from the "business as usual" instructor-led courses which are typically the candidates for extension via an online delivery system. The fundamental issue is: Where is the heart of the learning process? In the delivery of pre-made learning objects or in the support of learning activities involving human interaction and problem solving in workplace contexts making use of in-house experience? We believe that in a company learning context the emphasis should be on the latter (Collis, 2001; Collis & Winnips, 2001). When we start with a pedagogy based on the solving of real workplace problems ("authentic learning", Harrington, Reeves, & Oliver, 2001) where the interaction with others is critical we come to a different view on reusability, and the technologies that support it. This relationship is part of a research project involving the Faculty of Educational Science and Technology at the University of Twente and the Shell Learning Centre. This paper will discuss some aspects of the on-going work.

Pedagogical Base: Focus on Contribution Intended for Reuse

What is a pedagogical aim that is highly related to re-use? We offer the proposition that it is not an aim primarily related to finding "instructional" content from elsewhere, but rather one with a strong orientation toward learning from experiences, from one's own and from those of others. This involves a pedagogical shift, away from an emphasis on learning as acquisition of predetermined content, toward a balance that includes or even emphasizes learning as participating and contributing to the learning experience in a way which can be captured and reused by others (Collis & Moonen, 2001; Collis & Strijker, 2002; Sfard, 1998). The basis of this pedagogy is educational (see also for example, Kearsley & Shneiderman, 1998) but it also is based on strategic and practical considerations. By an approach in which participants themselves contribute resources in a way that is intended for use by others during the course itself and in subsequent cycles of the course, a large collection of locally relevant resources is accumulated on an on-going basis based predominately on the work of the participants and thus less on the preliminary work of instructor or learning-object designer. This involves shifting of the costs in terms of preparation time, from the content producer or instructor to the participants (Collis & Moonen, 2001). The resources accumulated fit with the style and level of the local participants (avoiding the "not invented here" problem), and in the company setting particularly, the tacit knowledge of the participants is made available to others in the institution (Collis & Winnips, 2001). An important point in this pedagogy is that many of the reusable resources are not to be seen as professionally made self-contained study materials; their creation, use, and reuse comes from the way the instructor or learner sees them as helpful for learning activities based on actual workplace problems.

The reuse of submitted contributions however is not automatic simply because the contributions are available to all in the course environment. Their reuse comes primarily from the pedagogy used by the instructor. As an example, participants can be asked to study one or more of the contributions of others in the current course or previous courses if available for reuse, and as the next activity compare and contrast their own workplace situations with those of their peers. Many such guided activities have been in use at the University of Twente for several years (De Boer & Collis, 2001); in the company context the pedagogical experience is only at the starting point.

For the products of such activities to be reusable as digital resources in other learning settings, the underlying database and system technology as well as the user interface must meet several requirements.

Technology Requirements

The technology required for support of this pedagogy requires an underlying object-oriented database. We suggest that gradually, an *experience management* architecture (Layton, 1999) will need to integrate the now-familiar course management systems with systems such as LMSs and LCMS as well as others. Figure 1 shows the architecture that we are currently researching.

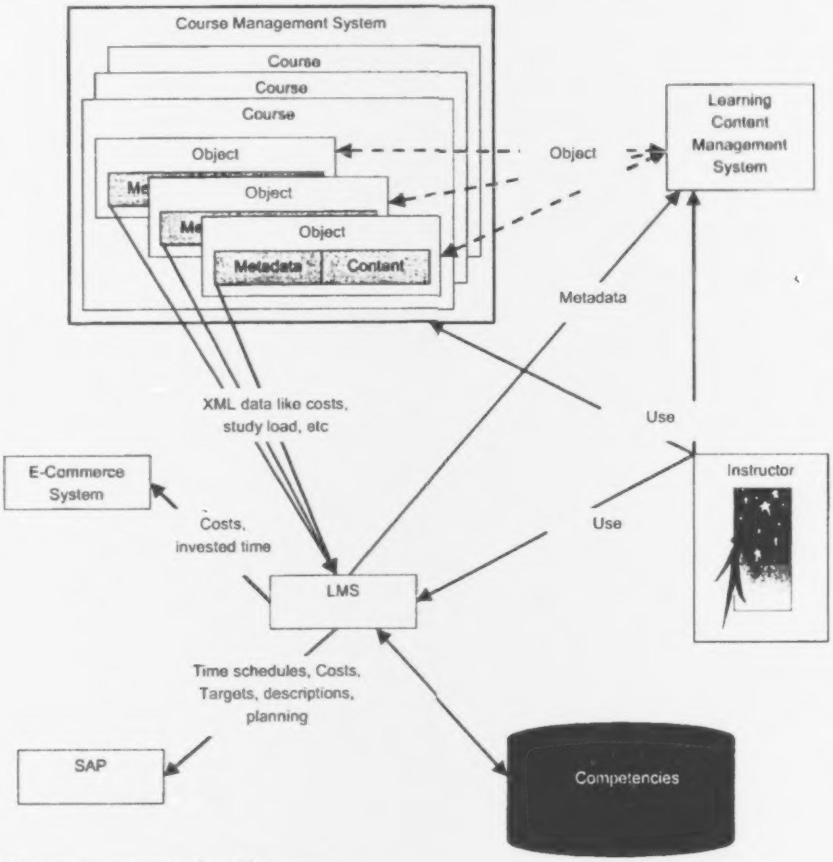
Course Management System
Course
Course
Course
Object
Object
Object
Metadata
Content
Object
Learning Content Management System
Metadata
XML data like costs, study load, etc
Use
Use
Instructor
E-Commerce System
Costs, invested time
LMS
Time schedules, Costs, Targets, descriptions, planning
SAP
Competencies

Figure 1. Integrated architecture

For contribution-based reusability to grow in an institution, specific technical tools and user interface functionalities are critical. First, there must be a simple way for participants (instructors and learners) to enter new resources into a common database. Figure 2 shows one of the templates we make directly available in the course environments running under our local *TeleTOP* course-management system.

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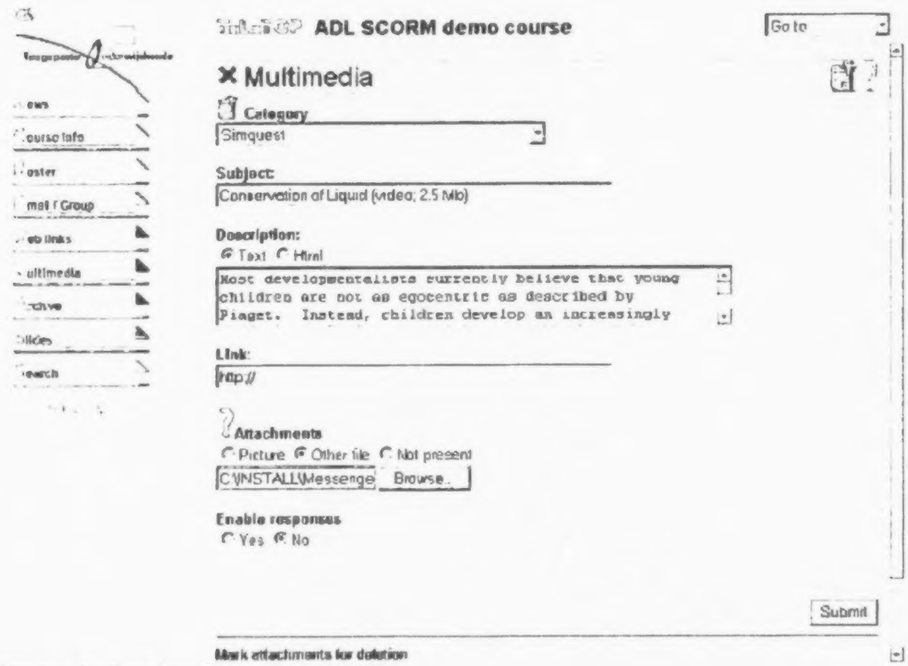

ADL SCORM demo course

Multimedia

Category
Simquest

Subject:
Conservation of Liquid (video; 2.5 Mb)

Description:
● Text ○ Html
Most developmentalists currently believe that young children are not as egocentric as described by Piaget. Instead, children develop an increasingly

Link:
http://

Attachments
○ Picture ● Other file ○ Not present
C:\INSTALL\Messenge

Enable responses
○ Yes ● No

Figure 2. Template for resource creation

At the moment that an object is thus submitted into the database, metadata based on SCORM standards can be automatically assigned for some of the SCORM fields. A new document containing a metadata record is created automatically for each submitted item and stored in a metadata database.

In the TeleTOP system, the submitted items can be directly made available to all course participants for re-use in subsequent learning activities. The instructor decides this, and can decide that all participants have direct read and write rights at one extreme, or at another, that only an object chosen by the instructor is re-used in a read-only format at the other extreme.

For the submitted objects to be reused outside of the immediate course context as well as within it, the instructor needs to make a selection of which materials are good candidates for reuse. For these selected objects, the instructor can then add a broader range of metadata to help in the later retrieval process. Figure 3 shows the combination of automatically affixed metadata and the possibilities for local entries.

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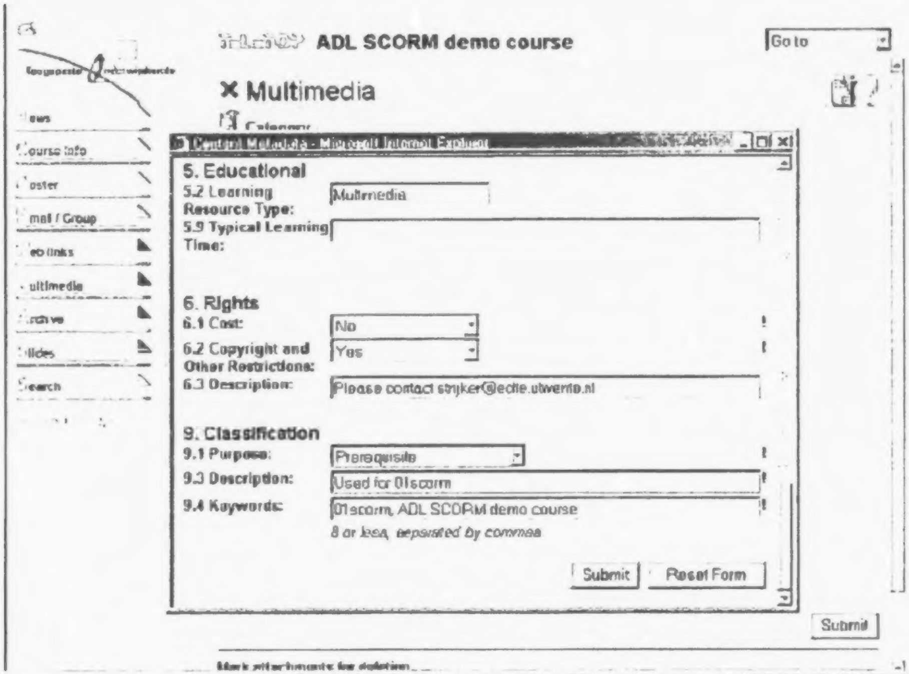

5. Educational

5.2 Learning Resource Type: Multimedia

5.9 Typical Learning Time:

6. Rights

6.1 Cost: No

6.2 Copyright and Other Restrictions: Yes

6.3 Description: Please contact strijker@edte.utwente.nl

9. Classification

9.1 Purpose: Prerequisite

9.3 Description: Used for 01scorm

9.4 Keywords: 01scorm, ADL SCORM demo course

8 or less, separated by commas

Figure 3. Metadata supplement template, ready for submission

Note that it is not every item submitted during the course which requires this localizing attention; only the relatively select and small sample that the instructor sees as good candidates for reuse. There is automatic XML representation of metadata documents generated within the TeleTOP system.

Subsequent searches of the objects in the database to look for candidates for reuse are made via the metadata document forms, which are in turn related to the actual submitted objects and can faciliate their being copied into the next desired environment. A simple interface is available to support the search process using any keywords on the metadata documents, and to facilitate the copying process, to move the items selected for reuse into a new course environment. In the instructor-led course, it is the instructor, not a LCMS or LMS, that makes these decisions. The LCMS can help the instructor be aware of resources that are available and the LMS can help the instructor be better attuned to the learning histories of the participants. But, in this sort of contribution approach, it is the instructor (or course manager or facilitator or even the learner) who decides what learning objects are most helpful for the problem-based activities that form the heart of the course.

Through the combination of these sorts of technologies and pedagogies, and in the implementation context of a course as a activity and contribution-oriented setting, a number of the barriers limiting the potential reuse of digital resources can be addressed, particularly those that relate to fit with the local context. In a (multinational) company training setting, the reuse aspect also brings a gradual increase in the sharing of in-house knowledge and experience (Collis & Winnips, 2001).

References

Chapman, B., & Hall, B. (2001). *Learning content management systems*. Sunnyvale, CA: Brandon-Hall.com.

BEST COPY AVAILABLE

Collis, B. (2001, 26 June). Xx. Presentation at ED-MEDIA, 2001, Tampere, Finland.

Collis, B., & Moonen, J. (2001). *Flexible learning in a digital world: Experiences and expectations*. London: Kogan Page. [Supplemental material available via the Web at http://education1.edte.utwente.nl/00FlexibleLearning.nsf/FramesForm?ReadForm]

Collis, B., & Strijker, A. (2001). IJETS (in press).

Collis, B., & Winnips, K. (2001). *Two scenarios for productive learning environments in the workplace.*

De Boer, W. F., & Collis, B. (2001). *JCHE*

Herrrington, J., Reeves, T., & Oliver, R. (2001).

Kearsley, G., & Shneiderman, B.(1998). Engagement Theory: A framework for technology-based teaching and learning. *Educational Technology, 38*(5), 20-24.

Layton, W. (1999). *Electronic performance support systems and knowledge management: The merging ground.* University of Brighton, UK. Available via the World Wide Web at http://www.boyblue.freeserve.co.uk/wjlonline/dissertation2_files/content.html (accessed 23 March 2001).

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher, 27* (2), 4-13.

Fostering Inquiry-based Learning in Technology-rich Learning Environments: The Inquiry Page in the GK12 Fellowship Program

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Abstract: This paper analyzes the uses of the Inquiry Page (www.inquiry.uiuc.edu) in the National Science Foundation GK-12 Fellowship Program*, where scientist-fellows and K-12 teachers partner to integrate the use of computer-based modeling, scientific visualization, and informatics in science and mathematics education. The Inquiry Page is a web-based, knowledge-building tool that facilitates and fosters real-world application of inquiry-based learning. By creating "Inquiry Units" teachers and learners collaboratively engage in the inquiry path, building new knowledge as well as a resource for other teachers and learners. By offering structures for inquiry teaching and learning, a-synchronous community-building is occurring with teachers/learners being able to draw upon and share their own applications of inquiry-based teaching. The Inquiry Page, then, becomes the nexus between theory and application. It emerges as a "portal" for the scientist-fellow, teacher, and students in the classroom; facilitates communication between the teacher/scientist team and other educators both at the school and in the larger education community; supports inquiry-based teaching in the real world of the classroom; and nurtures the development and professional growth of the teacher and scientist/fellow by engaging in reflective educational theory and practice.

**The EdGrid GK-12 Fellowship Program supports annual teaching fellowships for graduate student scientists from the University of Illinois, Urbana-Champaign and is administered by the National Center for Supercomputing Applications.*

Evaluation methods: The GK-12 Evaluation team is adopting a situated evaluation approach to gathering data at each high school site, using online formative and summative evaluations of students, teachers, and fellows in addition to observation, videotaping, and interviews. Teacher and fellow reflections are thus captured quantitatively and qualitatively. Artifact/products of students, teachers, and fellows are reviewed. Key to the evaluation process is an understanding of and sensitivity to each site's context and dynamics. Of particular interest for the Inquiry Page is identifying its uses and utility, and this is determined by units created and interviews with teachers/fellows.

Sites: **Site 1** is located in a suburb of a large city. It was formed to offer alternative (i.e., vocational) education for students grades 10-12 to supplement their regular high school curriculum. **Site 2** has approximately 2,325 students and offers a traditional college-preparatory high school curriculum. It is located in a comparatively wealthy cosmopolitan suburb of a large city. **Site 3** has approximately 1600 students and is located in an industrial district. The school offers a diverse curriculum that includes two "academies" specializing in medical science or math/engineering/information technology for accelerated students. **Site 4** is located in a twin-city that is home to a large university. It offers a traditional college-preparatory curriculum.

The Inquiry Page: The Inquiry Page (www.inquiry.uiuc.edu) is a five-year-old project developed initially as a supportive tool for teacher development by Dr. Bertram Bruce at the

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University of Illinois, Urbana Champaign. It has since evolved into a web-based tool and collaboratory to facilitate inquiry-based learning and teaching within much broader contexts. Evaluators, teachers, and scientist-fellows participating in the GK-12 Program have used the Inquiry Page, identifying its utility for their needs.

Facilitating Inquiry in Teaching/Learning: Each site differed in its adoption of the Inquiry Page. Two of the fellows found it unusable in their specific classrooms: one fellow noted teacher disinterest in learning methodologies or new technology, while another fellow noted a sense of it not being relevant to his/her teachers' subject/learning context. Each of the other fellows, however, employed the Inquiry Page as (1) a lesson planning tool for teachers, including tutorials, resources, and personal reflections in their role as fellow/teacher in the classroom; (2) an archive for their own work and reflections on their particular GK-12 site, including site-specific resources; and (3) as a way to more deeply understand inquiry-based learning and engage in a "co-learner" relationship with their teacher. The model identified by the fellows in their mid-year evaluation as most successful was one in which the teacher and fellow worked collaboratively in teaching/learning. The Inquiry Page facilitated this type of relationship in and out of the classroom; with units serving as new points of communication with educators both within and outside of the individual district/sites. The GK-12 Evaluation team initially thought the Inquiry Page could be used to document their observations; however, they found that it was more useful as an artifact of the teacher/fellow teams' evolving teaching models. Unexpectedly, the Inquiry Page has been used as a presentation tool with the units being demonstrated at NSTE, NABT, TeachIT, and various district meetings. Perhaps most interesting is the Inquiry Page's role in introducing inquiry-based learning to the fellow/scientists and giving a "name" to what teachers were already doing or wanted to do in the classroom. Although all had heard the term, and had an intuitive sense of what it meant, it was during the process of creating units that points of recognition and understanding of real-world application occurred. Essential features of classroom inquiry in the sciences as defined by the National Research Council are identifiable at each of the sites; particularly at one site, where the scientist fellow/teacher/students are generating new research questions that are being incorporated into the scientist-fellow's dissertation work. The Inquiry Page is bridging the gap between education pedagogy and real-world applications in the classroom, creating a framework for scientists and teachers to collaborate—to the benefit of both.

References:

Mehra, B., Bruce, B.C., Harnisch, D., Comstock, S. & Takahashi, A. (forthcoming) Complexities in Development of Educational Collaboratories as a Socio-Technical System: A Situated Study of the GK-12 EdGrid Graduate Teaching Fellowship Program. Proceedings of The 6th World Multi-Conference on SYSTEMICS CYBERNETICS AND INFORMATICS SCI 2002, Orlando, Florida, (July 14-18, 2002).

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Who's Teaching Whom? Scientist/Teacher Teams and Administrative Strategies

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Abstract: As one of the research university teams participating in the National Science Foundation (NSF) GK-12 Fellowship Program•, site educators and scientists are realizing collaborative, technology-rich learning environments that have implications for teacher development, administrative planning for technology and curriculum, and the professional growth of young scientists. Scientist fellows in biology, chemistry, mathematics, computer and information science are strategically partnering with high school teachers and administrators, integrating the use of problem-based learning (PBL), scientific visualization, and informatics in science and mathematics education. Initial data thus collected by the GK-12 Evaluation Team of six teams at four sites across Illinois offer context and contrast in professional development, support, planning, and implementation. This paper addresses the evolving collaborations between administration strategists, the science and mathematic teachers, and scientist-fellows at these sites and the implications for success.

•The EdGRID GK12 Fellowship Program supports annual teaching fellowships for graduate student scientists from the University of Illinois, Urbana-Champaign and is administered by the National Center for Supercomputing Applications.

Evaluation methods: The GK-12 Evaluation team is adopting a situated evaluation approach to gathering data at each high school site, using online formative and summative evaluations of students, teachers, and fellows in addition to observation, videotaping, and interviews. Teacher and Fellow reflections are thus captured quantitatively and qualitatively. Artifact/products of students, teachers, and fellows are reviewed. Key to the evaluation process is an understanding of and sensitivity to each site's context and dynamics.

Sites: Site 1 is located in a suburb of a large city. It was formed to offer alternative (i.e. vocational) education for students grades 10-12 to supplement their regular high school curriculum. **Site 2** has approximately 2,325 students and offers a traditional college-prepatory high school curriculum. It is located in a comparatively wealthy cosmopolitan suburb of a large city. **Site 3** has approximately 1600 students and is located in an industrial district. The school offers a diverse curriculum that includes two "academies" specializing in medical science or math/engineering/information technology for accelerated students. **Site 4** is located in a twin-city that is home to a large university. It offers a traditional college-prepatory curriculum.

Roles and relationships thus identified in the GK-12 Project partnerships that are addressed here are that of the **(1) educators and fellows as teachers/learners** and **(2) administrative decision-makers and their role in planning and support.**

Educator and Fellow Relationship: Each site differed in the roles the teachers and the fellows adopted. The model identified by the fellows in their mid-year evaluation as successful, is one in which the teacher and fellow are peers, collaboratively learning and teaching. This model allows for the educator and fellow to both be learners and teachers; and, in one problem-based learning (PBL) environment, for the students to be "teachers." Initial data indicates that successful partnerships are less rigid, allowing for role boundaries to change and accommodate professional growth. Math and science visualization tools, course-specific technology, and computers were real-world points for collaborative learning by both the teachers and fellows.

Administration's Role in Planning and Support: The sites differed drastically in the role that administration has played in both implementing technology in the science curriculum, and the support it offers its educators. For example, at one site, the principal was not aware of who the scientist-fellow was or what s/he was doing there, meeting only once during an eight-month period. This colored the relationship the teacher had with the fellow, and appeared to be a block to introducing new ways to integrate computer-based learning (CBL) and PBL. Another site lacked communication avenues between the teacher, the administration, and the fellow, with the administration adopting a *laissez faire* approach. This put the responsibility for implementing CBL and PBL in the classroom on the shoulders of the scientist-fellow with little guidance from the administration.

These sites contrast with one site where the administrative team has taken a pro-active role both in district-wide strategic planning and long-term support. The district is invested in learning how the GK-12 program fits into the professional development models that already exist; is growing a teacher-to-teacher mentoring program, building a culture of continued professional growth; sees data gathering as critical to informing the decision-making process; and actively seeks funding to accommodate the needs of a technology-rich science curriculum. The administration genuinely solicits teachers' input, meeting formally and informally with teachers and fellows; and sends teachers to national conferences (i.e., NABT, NSTE, & NCTM). In practical terms, the administration demonstrates their support by arranging schedules to allow teachers "extra" time in order to plan and become comfortable with new digital tools in order to integrate PBL methods.

References:

Jakobsson, E., & Braatz, R. (2001). GK-12 EdGrid Graduate Teaching Fellowship Program. Proposal to National Science Foundation (NSF) Graduate Teaching Fellows in K-12 Education Program Solicitation (NSF 02-042).

Mehra, B., Bruce, B.C., Harnisch, D., Comstock, S. & Takahashi, A. (forthcoming) Complexities in Development of Educational Collaboratories as a Socio-Technical System: A Situated Study of the GK-12 EdGrid Graduate Teaching Fellowship Program. Proceedings of The 6th World Multi-Conference on SYSTEMICS CYBERNETICS AND INFORMATICS SCI 2002, Orlando, Florida, (July 14-18, 2002).

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An Architecture for integrating Adaptive Hypermedia Services with Open Learning Environments

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ABSTRACT

Adaptive Hypermedia Systems are capable of delivering personalized learning content to learners across the WWW. Learning Environments provide interfaces and support services to aid tutors in course construction and aid learners in navigating those courses. However, most Learning Environments deliver content sourced from local repositories. This content tends not to offer adaptive features that Adaptive Hypermedia Systems are capable of delivering. Adaptive Hypermedia Systems, which are generally Web-based, could be viewed as personalized content services, with the capacity to deliver content to many Learning Environments. However, in order to co-ordinate the correct cooperation of the Adaptive Hypermedia Service and the Learning Environment knowledge and information models need to be exchanged, e.g. learner profile, assessment information, pedagogical constraints. There does not exist, however, a standardized mechanism for integrating Adaptive Hypermedia Services with Learning Environments.

In this paper the requirements for the generic integration of Adaptive Hypermedia Services with Open Learning Environments is explored. The main aim of such integration should be to work within a framework that allows for minimal impact on current Adaptive Hypermedia Services and Learning Environment implementations, while allowing for maximum standards-based interworking. This paper proposes an architecture and interface to support the collaboration of Adaptive Hypermedia Service and Learning Environments.

Categories and Subject Descriptors
D.2.2 [**Tools and Techniques**]: Modules and interfaces

General Terms
Human Factors, Standardization.

Keywords
Adaptive Hypermedia Services, Learning Environments, Integration, e-Learning, Content Interworking, Data Model

1. INTRODUCTION

In the current educational electronic landscape the most prevalent architecture for delivering content to a learner is via a Learning Environment. These environments (sometimes referred to Learner Management Systems or Courseware Support Systems [13]) holds all the content centrally and delivers it to the learner over the Internet, typically via web browser technology

Developers and publishers of content must design their content for a particular Learning Environment (LE), restricting the reuse and marketability of that content. Typically this restriction is based on the local repository used by the LE or the content management services offered by the LE, e.g. TopClass, WebCT. Advances are being made in the packaging of content to facilitate reuse and integration of content into different Learning Environments (see Section 4.3 IMS Content Packaging), but these advances are concerned currently with static content. If developers of content wish to produce material with complex play rules or high levels of learner interaction they are restricted to the facilities provided by individual Learning Environments.

An alternative is to produce stand alone Adaptive Hypermedia Services (AHS) which are capable of providing these rich play rules and learner interaction. These services would reside as separate servers on the Internet. The benefit in integrating LEs and AHSs lies in combining the strengths of both systems. LEs provide administration and support facilities, while AHSs provide better quality education, personalization and pedagogical control to learners.

This paper explores how current open specifications may be used to achieve seamless integration between such AHSs and LEs. Section 2 discusses the Learning Environments requirements which an AHS should meet to integrate with the LE. In section 3 Adaptive Hypermedia Services and their information requirements are discussed. Section 4 deals with current standards and specifications which may be utilized and enhanced to enable integration between LEs and AHSs. Section 5 continues to propose an architecture for this integration. In section 6 the implementation of an example system is discussed. Section 7 provides a summary of the aspects discussed in the paper.

2. LEARNING ENVIRONMENTS

Most current Learning Environments [3] integrate and store all content to be delivered to learners into a proprietary data storage format. Publishers of content have to author their content for a particular LEs proprietary format or import it into that format. For many of the LEs the content is static, interspersed with assessments. Some LEs use the learner's performance in the assessment information as a control mechanism to determine the flow of the content. Few LEs, however, modify the flow of content through monitoring the learner's progress through non-assessment material, i.e. they do not generally take time factors or multiple visits to a piece of content into account. Lack of

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standardization on how these content flow mechanisms are represented leaves the publisher of content with a problem – they can either author content with complex play rules for a specific LE and risk making it unfeasible to export that content to other LEs or they can author static content that is easily exported between different LEs with no play rules.

This static approach to the content leads to a 'one size fits all' approach, where the learner's are all presented with the same course content and assessments. The main advantage that LEs offer over the classroom situation is that the learner can set a pace that best suits their learning. In academic and commercial learning situations it is rarely preferable that the learner decides the pace at which they digest the material fully, as constraints such as formal examinations, which tend to occur at fixed points in time, dictate when material needs to be learned by.

Some LEs offer facilities to include remote content, i.e. the content resides on a remote (probably HTTP) server. These LE do not, however, offer standards-based mechanisms to the remote server to request or pass information back to the LE. This facility is usually used to include static content from a remote server because for a remote server to provide adapted content requires integration with a proprietary communications protocol.

From a pedagogical perspective LEs do not offer many services to assist the learner in how they learn. They do tend to offer good management facilities to the course coordinator, such as –

- Learner and class management
- Course assembly and publishing
- Learner tracking across courses
- Summative assessment information

The Learning Environment, therefore, can offer learner management facilities to the Adaptive Hypermedia Services.

2.1 Requirements of the Learning Environment

2.1.1 Control Information

The Learning Environment needs to be informed of when the learner pauses their learning within the Adaptive Hypermedia Service. This control information may be used by the LE to determine whether the learner should be launched back into the AHS upon logging into the LE next time. Some LEs operate on a free navigation system, where the learner can browse to any section within the course and the course is only considered complete when the learner has received an assessment for each section.

LEs using a content management API (see 4.4 Content Interworking below), such as that in ADL SCORM v1.1 [15] have access to the required data model element cmi.core.lesson_status to indicate whether the content has been completed. The AHS can cater for learners that have completed the assessment aspects associated with their required objectives and received an assessment score from the AHS, but have not completed their optional objectives yet by setting the value of this data model element to incomplete (which is part of the restricted vocabulary for this element).

2.1.2 Assessment Information

Learning Environments tend to gather assessment information on the course section level. As different content may return assessment information in a variety of ways the LE often requires the assessment score to be normalized. The AHS may have to return assessment information in a particular format.

3. ADAPTIVE HYPERMEDIA SERVICES

Adaptive Hypermedia Services allow hypermedia content to be delivered to learners in an adaptive manner. In order to be called a service the AHS must facilitate ease of integration in order that learners are able to seamlessly launch, through any LE, and use the AHSs adaptive content. This process, as far as the learner's interaction with the LE is concerned, should appear no different from regular static content. It may be the case that the learner is studying content from both static and adaptive sources to achieve a learning objective. The AHS may, therefore, be called as part of a larger course.

3.1 Requirements of an Adaptive Hypermedia Service

AHS information requirements depend on the type of adaptivity it is providing and on whether it insists on gathering this information for itself. The AHS may require course objectives, learner information and assessment information from the Learning Environment in order to successfully produce content specific to the learner's and tutor's requirements.

3.1.1 Objectives

An Adaptive Hypermedia Service may be capable of delivering more content than the tutor requires the learner to study in order to achieve particular learning objectives within a curriculum. It is necessary that the AHS be able to determine what the required learning objectives are before generating a body of content for the learner.

Learners tend to prefer systems where they maintain control of their learning [10]. If learners have total control over their objectives they may ignore elements of the content that are required within the curriculum. To cater for both approaches the AHS could support two levels of objectives – required and optional. When the learner has completed (and been successfully assessed on) all of the required learning objectives set by the tutor they are considered to have completed the AHS courseware. They may have selected optional objectives which are of interest to them, or that they feel aid their learning. They may continue to interact with the AHS until all of these objectives are also completed.

This two-tiered approach to objectives gives the learner control of their learning, while assuring the tutor that they have, at least, coved the core objectives.

3.1.2 Learner Information

There is a large amount of information that could be passed between the Learning Environment and the Adaptive Hypermedia Service regarding the learner. The main difficulty in passing this information is to represent it in a way that all AHSs and LEs can understand. Candidate specifications include PAPI [12] and IMS Learner Information Packaging (LIP). As yet neither of these specifications deal with the representation of pedagogical aspects of the learner, such as learning styles, prior knowledge or life long learning goals (i.e. career path). Even if there was a recognized standard for passing this information there is no common vocabulary to which AHSs could adhere to process the information. Individual AHSs will however have their own mechanisms and vocabularies for storing pertinent learner information.

The primary requirement of the LE with respect to learner information is, therefore, that they can uniquely identify learners within the AHS. Globally unique identifiers of any nature is a non-trivial problem. The approach suggested here is similar to most 'solutions' to this problem – if the LE is running from a given URL and has internal identifiers for learners, then the AHS could use a combination of the LEs URL and internal learner identifier to produce an identifier for internal AHS use. This approach does have one major shortcoming – if the learner is enrolled in a number of LEs the AHS has no mechanism to recognize that the learner may have accessed it from another LE. IMS's LIP Information Model [9] document discusses this issue concluding that the source of the information record is responsible for the uniqueness of the learner identifier and that the 'uniqueness of the source (the LE) label is outside of the scope of this specification'.

Another issue with which the AHS may have to contend is whether the learner is already engaged in another course which also utilizes this AHS. If they are the AHS will need to differentiate between the two by asking the LE for a section identifier of some description. This will allow the AHS to use the correct set of objectives required and optional) for the learner.

If the LE cannot reasonably be asked to pass pedagogical information about the learner to the AHS then it is the responsibility of the AHS to pre-test the learner to acquire this information. This pre-test is used to determine the learners competencies (e.g. prior knowledge) and learning preferences (e.g. learning styles and display preferences). This is where the importance of identifying the learner comes to the fore. If we can identify the learner then if they re-enter the AHS we do not need to perform a full pre-test as some of the information determined in previous tests is domain independent, such as some learning preferences. Assessment information may also be used to aid the determining of the learner's competencies.

3.1.3 Assessment Information

As mentioned above in 2.1 Requirements of the Learning Environment LEs generally require summative assessment information from each section of a course. In [14] one of the sixteen design guidelines for courseware is 'specifying entry level learner competencies' for the content. Within the Adaptive Hypermedia Service, however, there are no fixed competencies required as the AHS delivers content that best suits the learner's competencies. The AHS must, first of all, determine these competencies.

The AHS can use assessment information to determine at what level to pitch the competency pre-testing of the learner. If the AHS can ask the LE for the assessment information of both the learner and their peers for sections of the course completed then it is possible for the AHS to determine how the learner is performing in relation to his peers and thus gauge the difficulty of the pre-test. Assessments should not be too difficult at the beginning of the course or they will discourage the learner [6]. It is also undesirable for prior knowledge assessments to be too easy for the learner as the assessing of the learners prior knowledge may take longer, thus increasing the time before the learner feels they are learning new (relevant) material.

The aim of using previous assessment information is to determine the point within a difficulty scale at which the pre-testing should beginning. At this point certain assumptions may be made about the learners prior knowledge. The task of the pre-test is to confirm these assumptions and determine if the learner has further (non-assumed) prior knowledge that is pertinent to their objectives and the content the AHS will be presenting. Ideally this start point should be positioned just below where the learner's competencies actually lie, so as to confirm the learner possesses these competencies and determine where the boundary of their competencies lies.

4. STANDARDS AND SPECIFICATIONS

4.1 IMS Learner Information Package

The IMS Learner Information Package [9] specification address interoperability between internet-based learner information systems. Learner information concerns Learners (individual or group) or Producers (creators, providers or vendors). LIP includes facilities for the Learner to determine which aspects of their information are sharable with other systems. LIP has been designed with four basic requirements in mind – Distributed Information, Scalability, Privacy and Data Protection and Flexibility and External References.

The last requirement is described in [9] as Learner information includes many constructs, such as learning objectives and learning history, which are in practice represented by different structures in different contexts. Learner information data models must be flexible enough to accommodate this need. An external reference may, in the future, be used by both Learning Environments and Adaptive Hypermedia Services to share learning objectives and learning style information. IMS LIP v1.0 is currently available as a public draft.

4.2 PAPI

PAPI [12] is the IEEE Public and Private Information Specification which is a standard format for the representation and communication of student profiles. The purpose of the specification is to allow the creation of student records which can be communicated between educational systems over the lifetime of a learner.

The PAPI specification is divided into four areas – Personal Information, Preference Information, Performance Information and Portfolio Information and it also incorporates the Dublin Core metadata element set. The information used to construct the user profile is inferred by the system, directly input by the user or is constructed by the user and system in collaboration. PAPI also intends to address the privacy and security issues involved in the storage and communication of user profile [3]

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4.3 IMS Content Packaging

IMS Content Packaging is an interoperability specification to allow content creation tools, learning management systems and run-time environments to share content in a standardized set of structures. Version 1.1 of the specification is focused on defining interoperability between systems that wish to import, export, aggregate, and disaggregate packages of content [8].

The primary goal of the IMS Content Packaging specification is to provide a mechanism which, once implemented by producers and vendors, will allow content to be exported between systems with the minimum of effort. Version 1.1 of this specification is currently available as a public draft.

4.4 Content Interworking

The Content Interworking API was initially developed as part of the AICC CMI, more recently developed as part of ADL SCORM and the University for Industry Content Interworking Specification.

It is proposed that the IMS Content Management group will adopt the Content Interworking API as specified in the AICC CMI specification v3.0.1 and currently under implementation by the ADL [15] and by the University for Industry [16].

4.4.1 Aviation Industry CBT Committee Computer Managed Instruction Guidelines

The AICC guidelines [1] provide a method for seamless data flow between different computer based training (CBT) lessons and Computer Managed Instruction (CMI) systems, between different CMI systems, and from CBT lessons created with different authoring systems to a common data store and off-the-shelf analysis tools.

The driving force behind the development of the AICC CMI was to allow content developed by different authors to be used with any CMI system that supports the guidelines. To this end an API was designed that allowed the content to connect to the CMI system. The API principally facilitates the getting and setting of data in the CMI systems data model.

There are two aspects of the AICC approach to enabling interoperability of CMI systems with different CBT systems –

1. Lesson launch: The CMI should have a standard approach to CBT lesson initiation, and
2. Communication: The CMI should have a standard approach to providing information to the CBT lessons, and receiving information from the CBT lessons.

4.4.2 Advanced Distributed Learning SCORM

ADL SCORM [15] (Sharable Courseware Object Reference Model) is based on the AICC CMI guidelines. ADL was established with the purpose of developing a (US) Department of Defense wide strategy for using learning and information technologies to modernize education and training. Version 1 of SCORM defines a reference model to facilitate the interworking of Learning Management Systems (LMS) and content providers material. (LMS is used in the SCORM documentation in place of CMI). The SCORM is based directly on the runtime environment.

The ADL collaborated with AICC members and participants to develop a common Launch and API specification.

4.4.3 IMS Content Management

The IMS Content Management [7] specification is currently under development. The goal of the IMS Content Management specification is to establish a standard for data interchange and communication between instructional content and run-time environments. This specification should provide cost-effective content interoperability for platform, tool and content developers when implementing the specification in their products.

It is proposed that the Content Interworking API to be used within IMS Content Management will also be based on AICC SME guidelines and ADL SCORM.

5. ARCHITECTURE

The mechanisms required of an open architecture for integrating Adaptive Hypermedia Services with Learning Environments are standards-based approaches to –

- Importing the location of the AHS into the LE
- Launching the AHS from the LE
- Communicating between the AHS and LE

A commonly understood data model is also required to facilitate the communication of learner information, learning objectives and assessment information.

5.1 Importing the AHS location into the LE

IMS Content Packaging will provide a mechanism for static content to be integrated into a Learning Environment. By importing content as part of an IMS Content Packaging archive, with an XML manifest included, it is envisaged that the content can be automatically installed into the LEs content repository.

With Adaptive Hypermedia Services the content is not shipped in discrete units of material. The AHS is a remote service that the LE has an entry point to. As the LE, such as Microsoft's LRN [11], may already have an IMS Content Packaging import facility a reasonable approach would be to utilize this and enhance it to allow for the *importing* of the location of the AHS as part of an IMS Content Package. This could be imported into a LE in a similar way to static content. The manifest would describe the adaptive service and also contain a URL which the LE would use to launch the service.

Another consideration on the importing of the Content Package is that the learning objectives that the AHS is capable of achieving should also be imported into the LE. Provision should be given to the tutor to specify which learning objectives they would like the learners to achieve within the AHS.

5.2 Launching the AHS from the LE

When the Adaptive Hypermedia Service is launched from the Learning Environment the content it delivers will be coming form a different server than the Learning Environment. The AHS firstly initializes its connection with the LE. The AHS needs to then determine if the learner has been engaged in this course component before. If they have then it can rebuild the adaptive course component for the learner from a snapshot taken prior to the content being paused.

If the learner has not utilized this adaptive course component before then the AHS must determine two things – what the learning objectives are for the learner and whether the learner has been engaged in any course component offered by the AHS before. The learning objectives are used by the AHS to determine the required objectives for the content it is about to deliver. Optional objectives can also be offered based on the required objectives and the learner's prior knowledge. If the learner has used the AHS before from the launching LE this will alleviate the necessity to determine the learning style and possibly some prior knowledge aspects of the learner. It will still be necessary to pre-test the learner as their assumed prior knowledge may have degraded with time and/or they may have learned further relevant knowledge.

5.3 Communication between the AHS and the LE

Communication between the Adaptive Hypermedia Service and the Learning Environment can be achieved using the SCORM Runtime Communication API as used in SCORM v1.1. A subtle modification to the HTML frame layout is required at the AHS to enable calls to API functions residing on the LE from AHS content. The actual API calls used are the same as those used in SCORM v1.1 as the API is designed to get and set values that are separately defined by an external data model [15].

Figure 1. The AHS accessing the LE data model using the Content Interworking API

The remote AHS calls the Content Interworking API to access the data model on the LE using the following process –

a) The learning content (right browser frame) and JavaScript API (left browser frame, hidden) are delivered to the learner's browser.

b) An API function, in the left hand API frame, (e.g. LMSGetValue("cmi.core.leason_status")) is called from the content frame.

c) The API frame communicates the request to the Learning Environment.

d) The Learning Environment returns the value (in this case of cmi.core.leason_status) to the API Frame.

e) The function returns the value to content frame.

f) The value may be passed back to the Adaptive Hypermedia Service.

5.3.1 Common Data Model

The data model required for AHS/LE interaction is similar to that proposed in SCORM v1.1. The key requirements of the data model for this interaction are –

- Learning Environment identifier (to uniquely identify the LE, possibly it's URL).
- Learner identifier (to uniquely identify a learner from a LE).
- Section identifier (to determine, using the elements above, whether the student has attempted this content in the AHS before).
- Section status (completed, incomplete, attempted etc.)
- Section objectives (allows the AHS to query the LE for the learning objectives the tutor wishes learners to achieve).
- Score information (across all sections, for the learner and averages for all enrolled students).
- Score range (the LE may not use percentile scoring and the AHS may need to normalize the scores).

The number of SCORM data model elements has been significantly reduced between version 1.0 and version 1.1. This reduction was to aid harmonization between independent developments of the Content Interworking API (see 4.4 Content Interworking), i.e. many groups where using the same API, but had subtly different data models. Many of the optional elements defined in SCORM v1.0 had not been implemented by other consortia. A complete list of the data model changes between SCORM versions is available [15].

Most of the required data model elements for AHS/LE interaction already exist in some guise in the CMI data model used in SCORM v1.1. Learner identifier, section identifier, section status, section objectives and score range all have equivalents. The LE identifier and summative score information is not available within the data model.

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6. IMPLEMENTATION

The mechanism for interfacing LEs and AHSs described in this paper has been implemented using Fretwell-Downing Education's LE [5] and Trinity College, Dublin's AHS [3] within the European Commission funded EASEL [4] project. The data model used is based on SCORM v1.1 [15] with the addition of LE identifier and summative score elements. Using this model it is possible for the AHS and LE to interact, sharing information about the learner including, but not limited to –

- Learner Identification
- Interface Preferences
- Pedagogical Preferences
- Performance Information

The first piece of information that is requested by the AHS from the LE is the LE identifier. This should be unique, possibly URI based, and allows the AHS to contextualize all further communications. For example, when it asks for the learner's identification it might assume that this identifier is unique within the LE, but not across other Learning Environments.

Learner identification enables the AHS to ascertain if the learner has visited the service before and if they have determine whether it is necessary to pre-test them. For example, if the learner completed another course within the AHS already then it should have pedagogical information that is sufficient to adapt to the learners requirements and abilities. If the AHS has no information, or no appropriate information about the learner then it is necessary to pre-test.

Prior to administering the pre-test the AHS can query the LE for assessment scores for any material the learner has attempted in the course (assuming the AHS is a component of a larger course) and also request the assessment scores for the learner's peers in the course. These values are returned in as normalized values in a range specified by the LE. Using this information the AHS can determine the difficulty at which to set the pre-test, if it has multiple pre-tests aimed at increasing levels of knowledge. Such a pre-test can be used to determine the prior knowledge about a domain before generating the personalized course.

Other extensions that may be made to the LEs data model could cater for – Cultural Background, Preferences & Learning Culture, Communication Style and Needs, Cognitive and Learning Style, Prior Knowledge & Expertise, Communication Style & Needs, Learning History and Objectives and Goals.

The primary constraint to adding these complex elements within the data model is that of a commonly understood and accepted vocabulary to describe each extension. This is why the approach taken within EASEL was to allow the Adaptive Hypermedia Service to use a proprietary vocabulary internally, but to return assessment information.

Assessment information is returned to the LE using the normalized range mentioned above. This allows the AHS to inform the LE how the learner has performed in any assessments they have completed, but this is only a summative score for all assessments completed in the AHS. The IMS Question and Test specification was investigated as a candidate for richer communication of learner assessment results, but the uncertainty as to whether an individual assessment would be present in a personalized course meant the information for different learners might be inconsistent.

7. SUMMARY

This paper has described a mechanism for integrating Adaptive Hypermedia Services and Learning Environments and illustrated this approach with an implementation from the EASEL project. The mechanism described is based in current and emerging learning technology specifications and requires minimal modifications to LEs that utilize these specifications for their intended purposes.

By enabling AHSs to be successfully integrated into LEs this mechanism provides the potential for more learners to avail of the pedagogical benefits possible using customized adaptive content.

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9. REFERENCES

[1] Aviation Industry CBT Committee (AICC) Computer Managed Instruction (CMI) Guidelines for Interoperability, Revision 3.0.1, Release 24 November 1999.

[2] Busilovsky, P., and Miller, P., Course Delivery Systems for the Virtual University, Access to Knowledge: New Information Technologies and the Emergence of the Virtual University. Amsterdam: Elsevier Science and International Association of Universities, 2001, 167-206.

[3] Conlan, O., and Wade, P., Novel components for supporting adaptivity in education systems - model-based integration approach, ACM Multimedia 2000, November 2000.

[4] EASEL, Educator Access to Services in the Electronic Landscape, IST Project 10051.

[5] Fretwell-Downing Education, http://www.fdgroup.com/fde/company/home.html.

[6] Gachuhi, D., and B. Matiru, Active Learning, Distance Education-By Design, Symposium 87 Papers. Alberta Correspondence School, Alberta, Canada, pp. 1-21, 1987.

[7] IMS Content Management, Version 0.1, June 2000

[8] IMS Content Packaging, Public Draft, Version 1.1, December 2000.

[9] IMS Learner Information Package, Public Draft, Version 1.0, December 2000.

[10] Laurilard, D. "Rethinking University Teaching: A Framework for the Effective Use of Educational Technology", Routledge & Kegan Paul. , 1993.

[11] Microsoft Learning Resource Interchange (LRN), http://www.microsoft.com/elearn/support.asp.

[12] Public and Private Information (PAPI), Draft 6 Specification.

[13] Robson, R., Course Support Systems: The First Generation, International Journal of Telecommunications in Education 5(4), 271-282, 1999.

[14] Schaefermeyer, S., Standards for Instructional Computing Software Design and Development, Educational Technology, 1990.

[15] SCORM, Sharable Content Object Reference Model, Version 1.1, Advanced Distributed Learning (http://www.adlnet.org), January 2001.

[16] University for Industry, http://www.ufiltd.co.uk.

Humanities in the Cyber-Age

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Abstract: Contemporary humanities students tend to think that human expression occurs in a vacuum. They do not understand that human expression in any given time period is produced by, and remarks, the *zeitgeist* of that period while at the same time exhibiting characteristics of human nature that have existed since the beginning of human history. Humanities students need connection among disciplines, among cultural forces, with history, and to themselves. This paper illustrates how technology and Internet access can change the roles of instructor and learner alike, as well as improve the pattern of learning behaviors in a classroom. Through online resources students can gain a better sense of *zeitgeist* in a given culture at a given time; at the same time they can recognize the universality of the human experience. The Internet and Web page design tools also provide opportunities for students to conduct research themselves and to publish their research efforts in new and engaging ways.

Introduction

Because of movements toward specialization and compartmentalization in education through the course of the twentieth century, many of my students have a fragmented view of the world. To some extent, they have been taught art, literature, and music, but they do not understand any historic or contemporary connections among these disciplines, nor do they recognize relationships among these and science, technology, religion, politics, and mathematics. Thus, they tend to think that human expression occurs in a vacuum. They do not understand that human expression in any given time period is produced by, and remarks, the *zeitgeist* of that time period. Human expression, however, also exhibits those characteristics of human nature that have existed both before and since the beginning of recorded history. Students in the humanities really need connection among disciplines, among cultural forces, with history, and to themselves. With this rationale in mind, and after a brief overview of my evolving pedagogical method, I seek in this presentation to illustrate how technology and Internet access can change the roles of instructor and learner alike, as well as improve the pattern of learning behaviors in a classroom (Dalgarno, 2001). Technology can provide opportunities to interweave resources so that students can gain a better sense of *zeitgeist* in a given culture at a given time; at the same time they can recognize the universality of the human experience. The Internet and Web page design tools also provide opportunities for students to conduct research themselves and to publish their research efforts in new and engaging ways.

Pedagogical Methods

Before discussing interweaving strategies with an example text, I must comment on my changing method of teaching the course from which the example comes. The course is pre-modern world literature. I used to teach this course in a lecture and class discussion pattern, but in recent years I have come to recognize that students learn best when they are active collaborative learners (Anstendig, Meyer, & Driver, 1998; Barab, Thomas, & Merrill, 2001; Lu, Zhu, & Stokes, 2000; Scheurman, 1997) and that "[t]he internalization of capabilities that constitutes learning is . . . as much a social as an individual cognitive phenomenon" (Borthick, 2001). Therefore, I first modified the course by having my students do research and oral presentations on works during the course of the semester (Mintz, 1998). However, I realized that this alteration was not sufficient to change the learning patterns in the class and to engage and enable my students on the path to learning. Thus, I decided to have my students prepare for class by reading the assigned text and answering directed questions that I now place on the course calendar in WebCT. The questions relate to structure, themes, archetypes, metaphors, etc., of that text in relation to earlier works as well as to contemporary culture, and they build upon each other through the course of the semester. At the beginning of class, I give a daily quiz to ensure that students have read the work. Then students give their scheduled presentations on that day's text. After these presentations, students break up into groups, physically moving their chairs to face each other and thus altering the monolithic, instructor-centered structure of the classroom. They share their responses to the online questions and decide on the best answers to each question regarding the work. During this time I wander through the classroom, listening to group exchanges, asking more guided questions to help them "flesh out" their better responses, and expanding upon their insights by making reference to historical information or to past texts with which they are now familiar. Finally the class comes together to answer the questions, and, using Internet sources to supplement the discussion, I reinforce those answers with the information that I once imparted through lecture. Frequently, however, students end up telling me what I would have told them in a lecture. In other words, they discover and own the knowledge. Also, quieter students respond very positively to this format because it tends to give them voices; the quiet student learns that if I call on him or her to answer when the class is working together, then I have heard his or her answer and thought it a good one.

As an illustration of effective Internet use, in this presentation I will employ the medieval play, *Everyman*, as an example. To instill in my students an understanding of the medieval world view vis-à-vis the play, I provide links to sites in both WebCT as an accompaniment to the questions and on the online syllabus that is produced in FrontPage and linked from my home page. For religious, political, economic, and other reasons, the common medieval European was encouraged to think of his station in life as an act of God's will. In his relatively harsh world he was encouraged to focus on the afterlife and on the purgation of sin in this life in order to avoid the harsh judgment of God. To show that medieval architecture reflected this thinking by drawing the eye upward to heaven and to beauty at great heights, I furnish links to the cathedral at Chartres. To illustrate the fact that art production and the transcription of religious texts were considered by many as acts of spiritual devotion and thus were quite elaborate, I provide links to medieval art and to illuminated manuscripts. I also furnish links to audio sources of medieval music including Gregorian chants, as well as to sites that treat medieval quotidian life and demonstrate not only cultural *zeitgeist* but also how very human and like us the medieval Europeans were. My students view these sites on their own, but by the time we revisit them together in class, students can really begin to grasp how these different means of expression and cultural behaviors, as well as universal behaviors, are tied together. In addition, in order to help them to understand the dynamic quality of the English language especially during the rise of the printing press, I link to an early printing of *Everyman*, in which 'u' and 'v' were used each others' places when compared to modern usage. This recognition serves to alter students' misguided perspectives that English has historically been static.

Having witnessed the positive effects of Internet use in teaching this world literature course, I then decided to let my students use the Web to share some aspects of what they had learned. In lieu of the traditional research assignment, in recent semesters I have given my students the option of designing research Web sites. Since both traditional essays and research sites were assessed by Clayton College and State University's established writing criteria, those who chose traditional essays were by no means penalized for their choice. Because of difficulties with hypertext readability, the only difference in the assignment was that the traditional essays were to be five to seven pages in length, while online essays were to be approximately five pages in length. As examples provided during this conference presentation showed, students who made the research site choice found great benefits in publishing on the Web. Those benefits included learning to use established criteria for authoritative Web sites; reasoning out for themselves how interdisciplinary forces were at work in a culture by using visual, audio, and textual sources; linking directly to sources from their sites and even within the text of their essays; and using their own creativity in site design. There were also problem areas. Those included problems with coherence in the multimedia environment and with transference of text from one application to another. For example, many HTML editors do not permit or recognize indents, so proper paragraphs and MLA "Works Cited" lists cannot be composed in them nor pasted into them. Students also ran into problems with changing or alternative rules for citation of sources on the Internet. In addition, some students lacked Web design experience, and their sites verified this lack. However, a few of my novice designers produced the most remarkable sites with well-composed essays.

Conclusion

My methods in this course are still progressing toward a those that facilitate the best learning for the student, but the rate of student information retention is markedly higher, as is the positive awareness of learning among students; both superior anecdotal exam evidence and more positive student responses to questionnaires in my classes versus those in the traditionally taught courses indicate these improvements. Students utilize and recognize their knowledge and empowerment.

As I am discovering, from one semester to the next, authoritative sources for the humanities are appearing at an exponential rate on the Internet. Our use of these sources with innovative teaching strategies can serve to alter the roles of instructors and learners. This use can serve to enhance our students' grasp of a work within its cultural *zeitgeist*; it can also illustrate more clearly the universality of human characteristics from the beginning of recorded history. In short, these resources can reconnect our students to the world around them in encompassing and interdisciplinary ways. In addition, Web publishing offers new means for students both to synthesize research information and to compose innovative hypertext essays. The cyber-age is a breakthrough time for new media and new methods of teaching and learning in the humanities.

References

Anstendig, L. , Meyer, J. & Driver, M. (1998). Web research and hypermedia: tools for engaged learning. Journal on Excellence in College Teaching, 9(2), 69-91.

Barab, S., Thomas, M., & Merrill, H. (2001). Online learning: from information dissemination to fostering collaboration. Journal of Interactive Learning Research, 12, 105-143.

Borthick, A. F. (2001). Designing learning experiences for enabling collaborative discovery learning online. Selected Papers from the 12th International Conference on College Teaching and Learning. (pp. 25-33). Jacksonville: Florida Community College.

Dalgarno, B. (2001). Technologies supporting highly interactive learning resources on the Web. Journal of Interactive Learning Research, 12, 153-171.

Lu, A., Zhu, J., & Stokes, M. (2000). The use and effects of Web-based instruction: evidence from a single-source study. Journal of Interactive Learning Research, 11, 197-218.

Mintz, J. (1998). Involving students in their own learning: when the students become the teachers. Journal on Excellence in College Teaching, 9(1), 69-85.

Scheurman, G. (1997). Using Principles of Constructivism to Promote Reflective Judgment: A Model Lesson. Journal on Excellence in College Teaching, 8(2), 63-86.

Tutoring: A Different Background for the Same Role

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Abstract: In an online course the role of tutor is fundamental and the choice of people to hold this role is very important. In this speech I shall look in detail at the skills, requirements and criteria used to choose the three tutors for the Metodi 99 project (an online course in Methodology and Techniques of Social Research delivered in 1998/1999 by the Ctu of Milan University and Faculty of Political Science), how this choice was made, what strategies were adopted and what results were obtained.

Context

Metodi 99 was organised in two different environments: a Web site for the publication of teaching materials and communication (forum) among professor tutors and students and a First Class software where participants communicated with each other in five spaces (Technical Aid, Mailbox, Secretary, Student Area and a Project Area limited to the project team). Due to some problems relating to the financing of the project, the confirmation of the feasibility immediately preceded the production phase, making it necessary to find an urgent solution to several very important questions only a few days before the start of the course. All these considerations had great repercussions on the tutoring, first and foremost on the choice of people suitable for assuming this role and, second, on the preparation of an appropriate training programme.

Requirements and Role

In an online environment where there is no verbal and physical language to help the dialogue, interpersonal communication techniques are particularly important. As D. Rowntree says "Tutoring an online course is not an easy option. There is a lot to do". There are many potential roles for the tutor (pedagogical, social, managerial and technical) in different areas (organisational, stuctural, social and conceptual). In our course the tutor was halfway between professor and students. In the first place, the tutor had to be an "expert in the subject" to provide students with didactic and methodological support, to give advice on materials and clear up any doubts. Secondly, he or she had to possess good "interpersonal skills" to communicate with students in simple terms choosing a suitable register, and with the professor and project team. Lastly, a "reasonably good training in computer skills" was necessary in order to be at ease with the use of a computer, the network and the hardware and software necessary to follow the course.

The tutor's main task was to look after a group of about twenty students both from a didactic and an organizational point of view, explaining the activities to be carried out, allocating assignments, sending reminders of deadlines and assisting the professor in deciding grades. In terms of time, the role involved at least one hour online every day including weekends.

Choice and Training

Three young people were chosen: Francesca, Marco and Matteo. None of them had ever had experience of tutoring online but all of them were proficient in their subject. Their backgrounds were substantially different and this in tern had a strong influence on their attitude to their new role. Francesca was a political science student at the end of her university studies and working occasionally for her professor; Marco was a recent graduate hoping to do a doctorate but without didactic experience; Matteo (the oldest) had had several teaching and training experiences in the research methodology field. These different "life experiences" also resulted in a difference in the amount of time available for the course: Matteo's work kept him occupied, so that he was more distant, at times absent.

A brief training period was arranged to explain the role of the tutor with some documentation and examples of messages sent by the tutors of the previous courses; a session was also held with the course designer who clarified their role and responsibilities. Compensation for the curtailed training period was provided in the form of a tutor co-ordinator with previous experience as the "observer" of an online course and a good knowledge of the role, particularly from a communicative point of view. Together with the course designer, this figure was of vital importance in helping the three tutors to assume their role.

The experience

Before the start of the course, the tutor co-ordinator made contact through a series of messages of a theoretical nature, soliciting reflection on the role of the tutor. A firm but flexible attitude was advocated, in order to provide students with suggestions and encourage them to reflect on the content. In doing this, the students needed to bear in mind that the learning environment was not a traditional one but based on words, where written communication had a set of different rules, characteristics, advantages and limits compared with spoken communication and these could not be ignored (Ong, 1982). When the course started, the three tutors soon realized that theory was very different from practice and they were obliged to face up to a kind of role crisis, with doubts as to their identity as tutors. A theoretical knowledge of their tasks was insufficient and the standard support outlined in the documentation handed out at the start of the course broke down in practice.

All three tutors experienced the same sense of unease and inadequacy and regretted the lack of a longer training period of a more practical nature. Francesca felt the most disoriented: she was strongly tempted to place herself on a level with the students, as she still felt part of this category, rather than assuming more authority.

Reactions differed: whilst Francesca and Marco attempted to look for support in the project team, Matteo tended to remain outside, limiting himself to observing his own class. This did not imply lack of interest in what was going on but the urge to reflect on his role and question his decisions. Of the three tutors, he was, in fact, the one who revealed the greatest maturity from a professional point of view and best covered his role.

In this initial phase of general disorientation, the advice of the tutor co-ordinator proved to be a great help, since he helped solve specific practical problems, making suggestions as to the style of communication to be adopted.

The tutors' ways of relating to the students were different: Francesca was always more than ready to help, since she felt closer to them in terms of age and experience, and the style of her messages was very colloquial and informal. Marco gave the impression of being stricter and less willing to intervene by encouraging the students to participate and learn, being aware that at university each of them was responsible for his own learning route. In his view, the tutor should merely provide the tools and students decide whether to take advantage of them or not. Lastly, Matteo proved to be the most formal and detached; certainly the most thoughtful. From him came the most interesting observations on the difficulties encountered: "assuming your role is different from assuming responsibility," he told us; "it is essential to compare yourself with other people in order to learn how to behave". These comments were inspired by the difference between the role of the traditional university assistant and the role of the online tutor. In conclusion, Metodi 99 taught us a great deal about tutoring: it is not easy to find people for this role; a training course before the start of the course is essential; personal background can have a strong influence both on the way the role is approached and on the style of communication.

References

Berge, L.Z. (1995). Facilitating Computer Conferencing: Recommendations From the Field, *Educational Technology*, 35 (1) 22-30.

Metodi 99 Tutor's End-of-course reports and interviews.

Ong, W. (1982). *Orality and Literacy. The Technologizing of the World.* London and New York, Methuen.

Rowntree, D. (1995). Teaching and learning online. A correspondence education for the 21st century?, *British Journal of Educational Technology*, 26 (3), 205-215.

Salmon, G. (2000). *E-Moderating. The key to Teaching and Learning Online.* Kogan Page, London

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Does an agent matter?: The Effects of Animated Pedagogical Agents on Multimedia Environments

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Abstract: Data are presented on the effects of Animated Agents on multimedia learning environments with specific concerns of split attention and modality effects. The study was a 3 (agent properties: agent only, agent with gestures, no agent) x 3 (picture features: static picture, sudden onset, animation) factorial design with outcome measures of mental load rating scale, a persona rating scale, multiple-choice questions, a matching test, a retention test, and transfer tests involving creative solutions. Overall, there were no split attention or modality effects found with integrating the agent into the display.

KEYWORDS: **animated pedagogical agents, multimedia learning, split attention effects, attentional control**

Interest in the use of animated pedagogical agents in instructional design involving multimedia in virtual learning environments has increased recently, as new technologies have made them more accessible (Craig, Hu, Marks, & Graesser, 1999; Johnson, Rickel, & Lester, 2000). An animated pedagogical agent is a computerized character (either humanlike or otherwise) that can interact with a user in order to impart some type of information. Because these agents are relatively new, there has been little research into their proper construction, capabilities, use, or limitations.

Animated agents can be seen as logical extensions of the development and customization of new learning interfaces. A line of research conducted by Byron Reeves and Clifford Nass (1996) provides a context for exploring these interfaces. They put forth the basic principles of what they call the "Media equation theory." This model holds that people naturally interact with various forms of media in the same ways they interact with other people. In this context, media can include anything from written text to television to computer programs.

If people tend to anthropomorphize media such as computers and the programs that run on them, there may be real advantages to implementing pedagogical agents in computer interfaces. First, agents increase the bandwidth of communication by the addition of a direct conversational partner, a partner who is potentially capable of showing varied emotional states and patterns of deixis. Second, agents may increase the computer's ability to engage learners and motivate them. Furthermore, appropriate lifelike behaviors make agents appear knowledgeable, attentive to the learner, and helpful (Johnson et al., 2000).

Animated pedagogical agents would seem to provide a challenge to multimedia environments, given the precepts of the cognitive theory of multimedia learning (Moreno & Mayer, 1999). If the agents are integrated as a part of an illustration or animation, their presence could cause split-attention effects (Sweller & Chandler, 1994), or modality effects (Moreno & Mayer, 1999). Modality effects could result from both the agent and learning materials being presented in the visual modality. Such effects might not be overcome entirely by the integration of spoken text with a picture or animation, because learners might concentrate on the agent and ignore the learning materials. What might be required is to direct attention away from the agent who provides the spoken text and toward the appropriate visual materials, for example gesturing by the agent (Johnson et al., 2000) or attention capture within the animation itself (Yantis & Hillstrom, 1994). There is currently evidence that animated pedagogical agents used in virtual learning environments can promote baseline problem solving skills (Johnson et al., 2000; Moreno, 2001; Moreno, Mayer, Spires, & Lester, 2001). However, it is not clear what role agents play in learning environments (Andre et al., 1999).

One of the first studies (Lester, Voerman et al., 1997; Lester, Towns, Fitzgerald, 1999) of animated agents led to what is called the "Persona effect." The claim is that the presence of a lifelike character in the environment has a positive impact on the learner's interactive experience. The study also revealed that more expressive agents are given higher ratings on clarity and utility than the less expressive. Herman the bug was the agent in the study. Participants gave ratings on how helpful Herman was as an aid to their learning experience. However, it is important to note that the Persona effect is silent on whether participants learn more when interacting with agents (Lester, Voerman et al., 1997). It only states that learners enjoy the experience more.

The present study was designed to investigate issues related to attention by manipulating agent properties and features of the pictorial information. Two possibilities present themselves in this context. First, consider the agent, deictic gesture can be used to direct the learner's attention while integrating the animated agent with a picture or animation. Pointing and gesturing are a natural way in which both adults and children attempt to direct attention (Alibali & DiRusso, 1999; Krauss, 1998). Gestures should occur simultaneously or prior to the onset of the speech act that they signify (Morrel, & Krauss, 1992). A second option is to capture attention by using parts of a picture or animation itself. According to attention research, an excellent way capture attention is by an abrupt onset and motion (Jonides & Yantis, 1988; Yantis & Hillstrom, 1994).

The design was a 3 (agent properties: agent only, agent with gestures, no agent) x 3 (picture features: static picture, sudden onset, animation) factorial. If the use of an agent leads to split attention effects and if these effects are reduced by agent gesture, then we would expect to see the no agent condition > the agent condition < agent with gesture condition. If there were no split attention effect, then no differences would be seen between agent properties. The cognitive theory of multimedia learning would predict that within the picture features animation > static picture. Also, within the picture features sudden onset > static picture if attention capture is sufficient for learning.

Methods

Participants

Participants in this experiment were 135 students drawn from an undergraduate psychology students at the University of Memphis who volunteered from a pool of participants. This pool consisted of all students taking either of two levels of introductory psychology courses.

Materials

The materials for the experiment were of two kinds: computerized materials and pencil and paper. The computerized materials consisted of the visual and narrative information presentation (training section). The pencil and paper materials consisted of a questionnaire for domain knowledge, a test of spatial ability, a mental load rating scale, a persona rating scale, multiple-choice questions, a matching test, a retention test, and transfer tests involving creative solutions.

The computerized materials were created using three different computer application packages. The agent and voice were created using the Microsoft Agent software package (Microsoft, 1998). The multimedia animations were created using Macromedia Flash 3.0 (Macromedia, 1998). These packages were integrated using a Program called Xtrain (Hu, 1998; Hu & Craig, 2000).

Likert-type scales were used for the Persona test and mental load rating. The persona test ranged from 1 to 6 with 1 being extremely enjoyable and 6 being extremely not enjoyable. The scale was similar to those that were described in previous research literature (Johnson et al., 2000; Lester et al., 1997). The mental load rating ranged from 1 to 6 with 1 being extremely easy and 6 being extremely difficult. This subjective rating has been used in previous research as a measure of the cognitive load of a task (Kalyuga, Chandler, & Sweller, 1999; Paas & Van Merrienboer, 1993, 1994).

Participants also received two pencil and paper tests at the outset of the experiment session. Both of these tests were brief and were given prior to the multimedia information presentation. The tests were for domain knowledge and spatial ability.

The test of domain knowledge was a standard screening test used in related research (Mayer & Moreno, 1998; Moreno & Mayer, 1999). This questionnaire consisted of a seven item activity checklist containing statements concerning weather knowledge, with one point added for each checked item and a five level-self assessment from less than average domain knowledge (1) to very much (5). The cut-off criterion adopted was six (out of a maximum 11) in order to be consistent with related research (Mayer, 1997; Mayer & Moreno, 1998; Moreno & Mayer, 1999). The test of spatial ability was a standard paper-folding task with scores used as a covariate. In the task, participants were simply given twelve minutes to correctly answer as many questions as they could (Bennet, Seashore, & Wesman, 1972).

The information presentation was concerned with the process of lightning formation. These materials have been shown to be effective for achieving learning gains in previous research (Mayer & Moreno, 1998; Moreno & Mayer, 1999). The scenario presented followed a causal path from how a storm front forms to the creation and display of lightning.

The three remaining tests have been used in previous research (Mayer & Moreno, 1998; Moreno & Mayer, 1999). These involved retention, matching, and transfer. The retention test consisted of one question, "Please write down an explanation of how lightning works" (See Appendix D for example). These tests were collected after five minutes. The matching test consisted of four frames with instructions that ask the participants to circle and label the cool moist air, warmer surface, updraft, freezing level, downdraft, gusts of cool wind, stepped leader, and the return stroke. These were collected after three minutes. The test for creative solutions consists of four questions presented one at a time for three minutes each.

In addition to the tests used by Mayer, participants were also presented with a series of six multiple-choice questions requiring a forced choice among four possibilities, one correct with three other foils. These six questions assessed three categories of knowledge (explicit shallow, explicit deep, and implicit deep). The explicit shallow questions focused on the shallow surface level information from the presentation (e.g., The upper portion of the cloud is made up of what?). The explicit deep questions focus on understanding of the concepts what were presented in the information delivery (e.g., When do downdrafts occur?). The Implicit deep questions focus on the application of the underlying concepts to problems that were not focused on in the information delivery (e.g., Why does it get colder right before it rains?).

Procedure

The basic procedure was as follows. When the participants first entered the laboratory, they were issued a packet of materials. This packet contained their informed consent, test of domain knowledge, and the test of spatial ability. After these were completed, those eligible for the study (those scoring under half on the domain knowledge test) received instructions for part two of the experiment. They were presented with the information delivery, which took about three minutes. Afterward, they were given the retention question (5 minutes), the Multiple-choice questions (2 minutes), the matching test (3 minutes), and 4 transfer questions (3 minutes each).

Results and Discussion

Persona effect

A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA was performed on the persona data. There was no evidence for a persona effect in this study. There could be several explanations for this. Participants were only exposed to one condition and thus, they had nothing to make a comparison with. If this is the case, a within subject design would be an accurate measure. Also, the agent was displayed for only 180 seconds and that might not have been long enough to produce an effect. Since the persona effect is based on the agent making the learning experience more enjoyable (Johnson et al., 2000), an agent interaction within the learning environment for 180 seconds was probably not enough to produce an effect.

Even though the persona effect (Andre et al., 1999; Lester, Convers et al., 1997) was not significant, a trend can be seen in the data. In the scale, a lower score indicated a more positive rating. The means ratings for the three groups were $\underline{M} = 3.44$ for no agent present, $\underline{M} = 3.42$ for agent present, and $\underline{M} = 3.07$ for agent with gestures with lower numbers indicating a more positive rating. A Cohen's f effect size was calculated for the persona data. These analyses yielded effect size score of .42 in the agent-with-gestures vs. no-agent comparison, and a score of .02 in the agent-only vs. no-agent comparison. This shows a supportive trend for the persona effect.

Cognitive Load

A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA was performed on the cognitive load data (Paas & Merrienboer, 1993). It yielded a significant effect between the picture features, ($\underline{F}(2,126) = 3.737$, $\underline{p} < .05$). A post hoc test performed on the three picture features groups yielded significant differences in perceived comprehension ratings between the picture condition ($M = 3.62$) and the motion condition ($M = 3.09$), ($p < .05$). This finding is in line the cognitive theory of multimedia learning. It predicts a decrease in the difficulty of comprehension for the motion condition over the picture condition when synchronization of the display is attained that ensures temporal and spatial contiguity (Moreno & Mayer 1999).

Matching

A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA was performed on the matching task data. It yielded a significant effect only for picture features, $F(2,133) = 12.434$, $p < .001$. Tukey contrasts revealed that both onset ($M = 4.42$) and motion ($M = 4.56$) conditions performed significantly better than the picture condition ($M = 3.13$, $p < .001$), but that the onset and motion conditions do not differ from each other.

Although these results differ from previous results that did not find differences in the matching data (Mayer, 1997; Moreno & Mayer, 1999), they support the cognitive theory of multimedia learning. According to this theory, in order for successful learning to occur, there must be an integration of the verbally based and the visually based models of the material (Mayer, 1984). This integration may be enhanced by the use of animations over pictures (Moreno & Mayer, 1999). Both the motion and the onset conditions provided the verbal and visual integration needed for matching in the present study. The difference was possibly due to the decreased presentation time that prevented the ceiling effects found in previous research by Moreno and Mayer (1999).

Retention

A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA was performed on the retention data. It yielded a significant effect only for Picture features, $F(2, 133) = 25.73$, $p < .001$. Tukey contrasts yielded a difference between the picture condition ($M = 1.93$) and both the onset ($M = 4.20$) and motion ($M = 5.07$) conditions. There was no difference between the latter two groups.

Transfer

The transfer task probed the extent to which participants applied the concepts they learned to other problems and exhibited creative solutions. A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA was performed on the transfer task data. This analysis yielded a significant effect of picture features only, $F(2,133) = 4.03$, $p < .05$. Tukey contrasts yielded a difference between the onset ($M = 2.13$) and picture ($M = 1.44$) conditions ($p < .05$). The motion condition ($M = 1.89$) was intermediate and did not differ from either of the other two groups.

The differences between the onset and picture conditions provides support for claim the that a sudden onset of a color singleton directs attention as needed to assist the construction of mental models that facilitate the implicit inferences necessary to construct creative solutions.

Multiple-Choice Questions

A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA was performed on the total score obtained from the multiple-choice questions. This yielded a significant difference only between picture features, $F(2,133) = 7.58, p < .001$. Both the onset ($M = 2.13$) and motion ($M = 1.89$) groups significantly outperformed the picture ($M = 1.44$) group ($p < .001$). There was no difference between onset and motion conditions.

Explicit Shallow. The multiple-choice questions attempted to evaluate three types of knowledge (explicit shallow, explicit deep, and implicit deep). A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA performed on the data from the questions that tapped explicit shallow knowledge yielded only a significant effect of picture features, $F(2, 133) = 3.08$, $p < .05$. Tukey contrasts showed that participants in the motion condition ($M = 1.64$) outperformed the picture condition ($M = 1.36$), ($p < .05$). This result is consistent with findings from the matching task, which tested for shallow knowledge.

Explicit Deep. A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA was performed on the data for the explicit deep questions. It yielded only a significant effect for the picture features, $F(2,133) = 7.93$, $p<.001$. Tukey contrasts revealed differences between both the onset condition ($M = .71$) and the motion condition ($M = .79$) when compared to the picture condition ($M = .29$). The participants in the motion condition outperformed those in the picture condition ($p < .001$). Similarly, those in the onset condition outperformed participants in the picture condition ($p < .01$). These findings suggest that by directing attention appropriately the onset of the color singleton (Yantis & Hillstrom, 1994) facilitated deeper learning of core concepts as effectively as an animation with motion in the present relatively brief presentation. This would seem to indicate that the onset provided the temporal contiguity that, according to Moreno and Mayer (1999), was required to get full integration of the verbal and visual representations.

Implicit Deep. The final multiple-choice questions were designed to tap implicit deep knowledge. A 3 (agent properties: no agent, agent, agent with gesture) x 3 (picture features: picture, onset, motion) ANOVA that was performed on the data yielded no significant effects, but picture features was marginally significant, $F(2,133) = 2.738$, $p = .068$. Furthermore, the means (picture $M = .96$, onset $M = 1.20$, motion $M = .91$) were in a somewhat similar direction as the transfer data, which attempted to tap the same pool of knowledge.

The means and standard deviations for all conditions and measures are presented in Table 1 below.

	Persona Test	Matching Test	Retention Question	Transfer Questions	Multiple Choice (Total)	Explicit Shallow	Explicit Deep	Implicit Deep
Agent Properties								
No agent	3.44	4.04	3.91	1.69	3.40	1.56	0.67	1.18
Agent Only	3.42	4.04	3.80	1.76	2.96	1.53	0.49	1.00
Agent w/ Gesture	3.07	4.02	3.49	2.02	3.02	1.52	0.59	0.89
Picture features								
Picture	3.62	3.13	1.93	1.44	2.60	1.36	0.29	0.96
Onset	3.24	4.42	4.20	2.13	3.47	1.56	0.71	1.20
Motion	3.09	4.56	5.07	1.89	3.31	1.64	0.79	0.91

Table 1. Table of Means and standard deviations

Summary and conclusions

The study revealed several findings. First, there were no differences due to agent properties and, thus, there was no evidence of split-attention effects. The presence of the agent in the learning environment was not detrimental to learning. It appears that agents can be safely integrated into brief multimedia presentations without fear of interference, as proposed by Johnson et al (2000). Second, most of the analyses revealed differences among the image-type conditions that supported the cognitive theory of multimedia learning (Moreno & Mayer, 1999). Close temporal synchronization of the narration with the animated display enhanced learning, presumably by establishing relationships between the visual and verbal representations. Third, the findings suggest stimulus onset is just as effective and in some cases more effective in directing attention to appropriate parts of the display as motion in a fully animated display.

References

Andre, E., Rist, T., & Muller, J. (1999). Employing AI methods to control the behavior of animated interface agents. Applied Artificial Intelligence, 13, 415-448.

Hu, X. (1998). Xtrain 1.0 [computer software]. The University of Memphis: Advanced Learning Technologies Laboratory.

Johnson, W. L., Rickel, J. W. & Lester, L. (2000). Animated pedagogical agents: Face-to-face interaction in interactive learning environments. International Journal of Artificial Intelligence in Education, 11, 47-78.

Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia intsruction. Applied Cognitive Psychology, 13, 351-371.

Lester, J. C., Convers, S. A., Kahler, S. E., Barlow, S. T., Stone, B. A., & Bhogal, R. S. (1997). The persona effect: Affective impact of animated pedagogical agents. In Proceedings of CHI 97, 359-366.

Lester, J. C., Towns, S., & Fitzgerald (1999). Achieving Afective Impart: Visual Emotive Communication in Lifelike Pedagogical Agents. International Journal of Artificial Intelligence in Education, 10, 278-291.

Macromedia. (1998). Flash 3.0 [computer program]. San Francisco: Author.

Microsoft. (1998). Microsoft Agent 2.0 [computer program]. : Author

Mayer, R. E. (1984). Aids to prose comprehension. Educational Psychologist, 19, 30-42.

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? Educational Psychologist, 32, 1-19.

Mayer, R. E., & Moreno, R. (1998). A split attention effect in multimedia learning: Evidence for dual processing systems in working memory, Journal of Educational Psychology, 90, 312-320.

Moreno, R., & Mayer, R. E. (1999). Cognitve principles of multimedia learning: The role of modality and contiguicy. Journal of Educational Psychology, 91, 358-368.

Paas, F. G. W. C., & Van Merrienboer, J. J. G. (1993). The efficiency of instructional conditions: An approach to combine mental-effort and performance measures. Human Factors, 35, 737-743.

Paas, F. G. W. C., & Van Merrienboer, J. J. G. (1994). Variability of worked examples and transfer of geometrical problem solving skills: A cognitive load approach. Journal of Educational Psychology, 86, 112-133.

Reeves, B., & Nass, C. (1996). The media equation: How people treat computers, television and new media like real people and places. New York: CSLI.

Sweller, J., & Chandler, P. (1994). Why some material is difficult to learn. Cognition and Instruction, 4, 295-312.

Yantis, S., & Hillstrom, A. P. (1994). Stimulus-Driven Attentional Capture: Evidence From Equiluminant Visual Objects. Journal of Experimental Psychology: Human Perception and Performance, 20, 95-107.

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Putting the ACTION into INTERACTION: What instructors and students DO online

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Abstract

A common "mistake" made by lecturers teaching online is to do little more than put their notes online, and to support it with some sort of electronic mailing list. Many online learning environments such as WebCT and Blackboard are also designed to support this instructional model. This paper discusses alternative activities that have been used to put the ACTION into INTERACTION in an online teaching and learning environment. Activities discussed include virtual discussions, building virtual desks, and even a virtual student rag procession. The paper also shows which message acts are most likely to be engaged in by instructors, and what message acts are carried out by learners.

Introduction

The word "virtual" that has become associated with what is done over the Internet, always implies comparison "virtual reality" is like reality, "virtual teaching" is like actual teaching. An implied comparison of items is known as a metaphor (Aristotle, s.a.). Much of the World Wide Web takes the form of a metaphorical book with "web pages". Teaching on the web occurs in metaphorical "virtual classrooms". An extended metaphor is a model. The traditional contact lecture is the model for activities in a metaphorical classroom, by way of text-based lecture notes and e-mail and chat room-based questions and answers. Much of this unfortunately lacks creativity. The same boring stuff produced as lectures become boring web pages.

This paper explores the dynamics between the design of internet-based instruction and the response of learners to the activities that they are asked to carry out. Two questions are addressed: (1) To what extent can activity-based learning be conducted over the Internet; and (2) What message acts do lecturers and learners execute over the Internet?

Context

This on-going research has been taking place in a two-year tutored masters' degree in computer-based education at the University of Pretoria. Students range from 23 to 55, and all work full time. Reactions of both the enrolled students and alumni are reported. Teaching is constructivist rather than instructivist. Students meet once a month for three days and keep in contact via the Internet. One module, "Teaching on the Internet" is presented entirely over the Net.

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Literature survey

To what extent can activity-based learningbe conducted over the Internet?

Russel, (s.a.) shows that the medium of instruction causes no significant difference in student performance. Similarly, Clark (1994) advocates the separation of medium and methodology in research on educational technology, and feels that it is the method, rather than the medium that influences learning. Kozma (1994) on the other hand, argues that certain media attributes demand certain methods. Mabry (1997) describes models for "providing communication resource opportunities similar to those expected from face-to-face interaction".

Conversation

Email bulletin boards and chat rooms are the equivalent of classroom conversation, providing a " 'talk' metaphor, which compares on-line interaction to face-to-face conversation" (Baym, 1995). Moreover "An informal, everyday quality is created through the use of smileys, non-standard spelling reflective of vernacular pronunciation, punctuation to indicate pauses rather than speech clauses, special symbols borrowed from programming languages and an extensive special vocabulary" (Marvin, 1995).

Collaborative and co-operative learning

According to Garton (1997) "When a computer network connects people or organizations, it is a social network".Although Anderson and Kanuka (1997) point out that an online forum appears to hold little or no relative advantage compared to face-to-face forums with regard to socialization and ability to communicate, there are other advantages. Employees "would have minimal work time loss and no travel time loss". For Johnson and Johnson (1991) successful co-operative learning has three prerequisites, a mutual goal, individual responsibility and positive interdependence. From the literature then it would seem that the methods of contact teaching could be replicated since medium and method should be separated; but different media may be necessary to simulate different aspects.

What message acts do lecturers and learners do over the Internet?

Learners are likely to adapt their behaviour based on the that they are given because of material behaviour: "The impact of the relationship between material and interpersonal behavior is termed material behavior" (Jones, 1997), because "material acts as a non-verbal message-system with rules that provide some degree of predictability which manages human interaction". Bonnycastle (1997) sees a duality between our *signs* and ourselves "Depending on a variety of factors, we choose forms of representation that are both individually and culturally determined to facilitate that communication. In turn, that painting, book, idea become part of the environment and the cycle begins again".

Teaching and learning in a metaphorical classroom

The digital classroom in this article used the metaphor of a junior school classroom to teach "Internet-based learning" to adult learners. For Branscomb (1996) "Metaphors serve as a map for sorting out what is similar and what is different when confronting a new problem". I wanted to see how closely I could mimic the events of a real, physical classroom in a web-based environment. Because of this the

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visual similarity in my initial digital classroom had to be as strong as possible since the physical differences were enormous. The students never met face-to-face, and neither were they able to communicate face-to-face.

The classroom had two components: A website (representing the "physical" classroom) and an electronic mailing list that represented interpersonal (speaking) interaction that occurs in a classroom. Jones (1997) distinguishes between "a virtual community's cyber-place and the virtual community itself. A virtual community's cyber-place will be termed a virtual settlement". The classroom with its associated mailing list therefore formed the virtual settlement, and had the following characteristics as identified by Jones (1997): "Minimum Level of Interactivity, variety of communicators, a common-public-space where a significant portion of a community's interactive group-cmc occurs; and a minimum level of sustained membership" (Jones, 1997).

The website "classroom" can be viewed at <*http://hagar.up.ac.za/rbo/classrm.html*>. It had four sections. First there was the blackboard and notice boards. Clicking on these revealed timetables and tasks; the blackboard revealed comprehensive on-line study guides, as suggested by Van Brakel (1996). The chalkboard was a graphic that students could modify, producing graffiti as in a real classroom.

Second was the administrative area with the presenter's desk (linking to my own home page), resource cupboard (with links to subject matter and construction programs such as graphic and HTML editors) and alumni association (with links of a general nature, regarding computer-assisted education).

Third was the poster wall with links to projects by previous students, and links to the "posters" created by current students co-operatively as the course progressed.

Lastly came the learners' desks. Each student had a WWW directory linked to a desk. The student had to replace the generic picture of a desk with a personalized one, and then "fill the desk" with things typically found in a school desk: (1) Your ears (Mail to: ...), (2) Your utility bag (Links to handy utilities such as HTML editors, Search Engines, Clipart libraries, etc.), (3) Your textbooks (Links to useful sites), (4)Your work (Interesting work you have done in other M.Ed. modules), (5) Your hobbies (Links to sites of special interest to you), (6) Your class work (Your answers to all the objectives of the course); and (7)Your portfolio (A link to the portfolio of your examination project).

In this classroom learners did not only find information, but generated their own web pages. The students immediately took on the roles of learners in a schoolroom. They addressed me as "Sir" or "Teacher" in all their emails, tattled on one another, interrupted proceedings with jokes, and generally acted with an air of light heartedness. One student, Mari, went as far as "bunking" class. Instead of sticking to the "desk" metaphor that she had to create, she replaced it with a beach metaphor. She did not have a desk. She had a surf kit instead. Ari, did not show a picture of his desk, but of his two feet resting on it. These results show how the adult learners, when placed inside the metaphor of the schoolroom, exercised typical schoolroom "naughtiness". The other desks show and interesting blend of students' creativity or lack of it – much the same as one would find in a real classroom.

As a special challenge students were allowed to add graffiti to the chalkboard. This was a reasonably complicated task but they found the environment sufficiently motivating, and by the second week of the course, all had written on the board.

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We were able to reproduce:

- Posters: i.e. vignettes of information, examples of similar projects, and examples of the work of other students.
- Resource cupboards and toolboxes: i.e. repositories for additional reference information and imaging and website construction tools.
- Presence of other learners in the form of "desks", and
- Conversation by means of a dedicated mailing list.
- What we could not create at that stage was real-time interaction, and that made us miss the element of urgency thus created.

Humor figured strongly in the class, supporting Baym's (1995) contention that "...humorous performance can be used to create group solidarity, group identity, and individual identity in CMC". An analysis of the messages indicates that the most frequent actions of the instructor were to (1) make suggestions, (2) give encouragement, (3) explain how to do something; and (4) give directives. The main actions of the learners were to (a) give information, (b) ask questions, (c) present a problem, (d) initiate or contribute to the discussion; and (e) express amusement or joke. The message acts in the classroom were very similar to speech acts in a face-to-face classroom, showing that "Computer-mediated groups can create solidarity through developing interpretive consensus" (Baym, 1995).

A virtual rag procession

Building on the success with humour in the classroom I wanted to extend the virtual community to masters' students in the first and second and course alumni. According to Baym, (1995)"analysis of humor is important because CMC research has been slow to address the formation of group identity and solidarity, though such phenomena occur in on-line groups and are negotiated, in part, through humor". The model I was the University rag, a carnival, culminating in parade through Pretoria. Although graduate students never take part, my rag was exclusive to my graduate students and alumni The url is <*http://hagar.up.ac.za/catts/jool/jool.html*>. Unlike my students' other work this was not for marks, but the model was a competition. The first prize was *Microsoft Front Page* sponsored by *Microsoft South Africa.* It was not aimed at building new skills but at community building. Kozar (1995) says that "Not only does this kind of communication allow people to renew and strengthen friendships, but it also provides them with an interface for play, and through play for the creation of new patterns for the performance of tradition".

When the students recognised the metaphor, they were able to expand it. They found corporate sponsors whose pages were linked to the 'floats' and credit was given as would have been done on a physical float. Students asserted their right to express their own opinions. Although the theme 'Coin the barrel' was intended as and anti-gun-ownership campaign, Dolf, sponsored by the ***Magnum*** gun-collectors magazine, constructed a float giving "Good reasons why you should spend coins on barrels". This supports Baym's (1995) contention that "Humor also serves as a means of creating individuality when the cues we use to define ourselves in face-to-face groups are unavailable".

Mignon, took revenge on the sexist idea of having a "Rag Queen" beauty pageant, and constructed her own "Rag Man" float. She invited her fellow students to enter her competition and put their pictures on her site as additional floats. In this way she demonstrated that "humor is a joint production, which the audience not only understands but helps create. This joint authorship enhances group identity and solidarity" (Baym, 1995). She put my picture at the top of the float – an act reminiscent of the manipulation of teachers' pictures so prevalent inschools. The school metaphor created in the initial classroom, therefore, had survived even beyond the duration of the module.

Marí crept into the hearts of the virtual community with a very touching float, depicting the first sonar scan of her unborn baby, together with a poem explaining why, for the sake of the unborn child, we should 'Coin the barrel'. She demonstrated that "it is in part through humorous performance that particular posters overcome the seeming anonymity of the computer medium to develop their own voices" (Baym, 1995).

Conclusion

This section will briefly state the conclusions reached and lessons learnt in answer to the two original questions.

To what extent can activity-based learning be conducted over the Internet?

The physical attributes of an actual classroom, i.e. chalkboard, resource cupboard, teacher's workstation, learners' workstations, posters and portfolios can easily be metaphorically recreated in cyberspace. Learners' reactions to these creations are similar to those of learners in a physical environment. Group cohesion can be created through humorous interchange, large amounts of information can be sent across by e-mail based "virtual lectures". Student and teacher activities in metaphorical classrooms correspond closely with their activities in face-to-face classrooms.

What message acts do lecturers and learners do over the Internet?

Learner response to the metaphor was to "down age" and engage in the role-play of being in a school classroom. This spontaneous role-play activity assisted greatly developing a team spirit in the class, but while they engaged in the role-play exercises, nevertheless remained adult in their decision-making.

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References

Aristotle (s.a.) *Poetics* tr. S.H. Butcher. The Internet Classics Archive. [On-line], Available: http://classics.mit.edu//Aristotle/poetics.html

Anderson, T, & Kanuka, H. (1997). On-Line forums: New platforms for professional development and group collaboration. *Journal of Computer-Mediated Communication*, [On-line], 3 (3). Available: http://jcmc.huji.ac.il/vol3/issue3/anderson.html

Baym, N. (1995). The performance of humor in computer-mediated communication. *Journal of Computer-Mediated Communication*. [On-line], 1 (2). Available: http://jcmc.huji.ac.il/vol1/issue2/baym.html

Bonnycastle, D. (1997) *If only I could dance this - Semiotics and Instructional Design.* [On-line], Available: http://www.usask.ca/education/coursework/802papers/Bonnycastle/Bonnycastle.HTM

Branscomb, A.W. (1996). Cyberspaces: Familiar territory or lawless frontiers. *Journal of Computer Mediated-Communication* [On-line], 2 (1). Available: http://jcmc.huji.ac.il/vol2/issue1/introl.html

Clarke, R.E. (1994) Media will never influence learning. *Educational Technology Research and Development 42*(2) 21-30.

Cunningham, (1992) D. *A brief history of semiotics.* [On-line], Available: http://www.coe.usouthal.edu/semed/brehist.html

Garton, L., Haythornthwaite, C., & Wellman, B. (1997). Studying online social networks. *Journal of Computer Mediated-Communication* [On-line], 3 (1). Available: http://jcmc.huji.ac.il/vol3/issue1/garton.html

Jih, H.J. & Reeves, T.C., (1992) Mental models: A research focus fir interactive learning systems. *Educational Technology Research and Development. 40*(3), 39 - 53.

Johnson, D.W. & Johnson, R.T. 1991. *Learning Together and Alone.* New Jersey: Prentice Hall.

Jones, Q. (1997). Virtual-communities, virtual settlements & cyber-archaeology: A theoretical outline. *Journal of Computer-Mediated Communication* [On-line], 3 (3). Available: http://jcmc.huji.ac.il/vol3/issue3/jones.html

Kies, D. (1998) *Implementing online pedagogy.* http://www.cod.edu/dept/KiesDan/UWS/

Kozar, S. (1995). Enduring traditions, ethereal transmissions: Recreating Chinese New Year celebrations on the Internet. *Journal of Computer-Mediated Communication* [On-line], 1 (2). http://jcmc.huji.ac.il/vol1/issue2/kozar.html

Kozma, R.B. (1994). *Will* Media Influence Learning? Reframing the Debate. *Educational Technology Research and Development, (42)* 2, 7-20.

Mabry, E. (1997). Framing flames: The structure of argumentative messages on the net. *Journal of Computer-Mediated Communication* [On-line], 2 (4). http://jcmc.huji.ac.il/vol2/issue4/mabry.html

Marvin, L.E. (1995). Spoof, spam, lurk and lag: The aesthetics of text-based virtual realities. *Journal of Computer-Mediated Communication* [On-line], 1 (2).http://jcmc.huji.ac.il/vol1/issue2/marvin.html

Pacagnella, L. (1997). Getting the seat of your pants dirty: Strategies for ethnographic research on virtual communities. *Journal of Computer Mediated-Communication* [On-line], 3 (1). Available: http://jcmc.huji.ac.il/vol3/issue1/paccagnella.html

Rieber, L.P. & Noah, D. (1997) *Effect of gaming and visual metaphors on reflective cognition within computer-based simulations.* http://itech1.coe.uga.edu/faculty/lprieber/aera1997/aera1997.html

Russell, T.R. (s.a.) *The no significant difference phenomenon.* http://cuda.teleeducation.nb.ca/nosignificantdifference/

Van Brakel, P.A. (1996) Implementing Study guides via Internet's *World-Wide Web.* Proceedings of Conference on Information Technology in Tertiary Education, 1996.

Vitae

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Critical Evaluation Skills for Web-Based Information: "Lies, Damned Lies" and Web-Based Information[1]

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Critical evaluation skills are central to education as reliance on Web-based information increases. This is particularly true now that the editorial and peer review processes are implicitly removed from experts and textbook authors and placed into the hands of students searching the Web for material related to research projects. Since it is increasingly difficult for Web sites to attract readers' attention, the Web site designers increasingly resort to exaggerations, encouraged by the anonymity afforded by this technology. In the sciences, for example, students must sift through false or exaggerated claims, non-refereed research, and various forms of misinformation. These critical evaluation skills are no less important in other fields where students cite non-refereed research or quote papers posted on the Web. In response to this need, a number of authors have posted criteria for evaluating Web sites, although little research has been done regarding this process. Furthermore, teachers frequently assume it was the responsibility of other teachers (e.g., the English teacher) to have covered this topic (Iding, Landsman, & Nguyen, 2001). The strong need for both research and the development of effective instructional interventions in this area provides the impetus for this paper, which examines aspects of Web-site evaluation among high school biology students, university-level pre-service teachers and computer science students. We represent the perspectives of faculty working in different disciplines. By addressing these topics in an interdisciplinary forum, we hope to engage educators and researchers from other disciplines in constructive dialogue in which we co-develop instructional goals and research agendas to increase the critical evaluation skills of ourselves and the teachers and students with whom we work.

The emergence of powerful Web searching tools enables K-12 teachers and their students to locate a plethora of *potential* resources for teaching and learning, but the operative term is "potential", especially when considering possibilities for these resources in teaching and learning environments. As an initial step in addressing these needs, we first discuss research relevant to teaching critical evaluation skills, first by examining the credibility ratings of information sources by pre-service teachers, and secondly, by describing an instructional intervention carried out with high school biology students who were taught to evaluate Web-sites. For example, Klemm, Iding & Speitel (2001) compared pre-service teachers' and scientists' evaluations of the credibility of 31 information sources for science information. They found some noteworthy discrepancies. For example, elementary pre-service teachers rated material from weekly investigative television newsmagazines like 20/20 as among the highest in credibility, while scientists rated them among the lowest. In general, pre-service teachers tended to rate information sources as being more credible than did scientists. These discrepancies clearly demonstrate the need for critical evaluation skills among the general public and educators in particular. In another study, Iding, Landsman, & Nguyen (2001) carried out an instructional intervention with high school biology students, rather than teachers. Students received instruction in critical Web-site evaluation and developed their own criteria for evaluating science Web-sites generally and the science information contained in them, more specifically. Results indicated that students' lists of criteria were more extensive after instruction. They reported that they would devote more time to evaluating Web-material in the future and that their confidence in their ability to evaluate Web-based scientific information had increased

Next, we will mention instructional and research-related issues that emerge from these studies and other work (Lynn, Bell, & Hsi, 1998). For example, what factors should be provided in order to facilitate the development of critical evaluation skills? Suggestions include providing an orientation to some basic categories for their evaluation (e.g., validity, credibility), or providing computer-based scaffolding or tutorials, working collaboratively to discuss and/or create actual criteria for evaluating Web sites, and finally, gaining sufficient skills evaluating real Web sites, both individually and collaboratively. Other basic research questions include the need to elucidate the professional needs of teachers and the adequacy of tools for preparing and supporting teachers in selecting and teaching about selecting valid, credible, and useful Web-based resources. Secondly, in addition to addressing the needs of the teachers and students, research needs to address design and credibility aspects of Web-sites and how these factors affect teachers' and students' judgments about information and information sources. For example, questions driving this research could include the following: Do design aspects outweigh actual information content in influencing credibility judgments? What aspects of Web-based information affect users' judgments? How confident are students and teachers about their ability to make judgments about information in different content areas? In the next section, we describe some of the issues around Web-based information and Web-site evaluation that are pervasive among university-level computer science students.

Computer Science faculty find their students struggling with information on the Web. Students in courses spanning lower-division general education critical thinking to graduate research technique are frustrated and mislead. Students in critical thinking courses can be overwhelmed with the abstract notions of logic and argument, as well as the detailed activities of gleaning Web material and thinking logically about it. We believe that teaching critical thinking in the context of introductory computer science courses complements "information competence" training provided by many university libraries. For example, The California State University Information Literacy Fact Sheet describes several ways to incorporate information competency into university curriculums: freshman orientation courses, general education courses, cornerstone classes in major areas, and competency-based mastery. We also observe that graduate students are unable to determine the trustworthiness of materials found on the Web. We speculate that although the students have an abstract understanding of peer review and the scientific publication cycle, the students miss cues to correctly determine the trustworthiness of researchers' Web pages, technical reports, industry publications, and peer-reviewed on-line conference proceedings, magazines, and journals.

We also believe that recent research on Web usage provides insights into teaching information competence. For example, Morrison, Pirolli, and Card (2001) surveyed thousands of Web users about why they use the Web (*purpose*), how they use the Web (*method*) and what they are looking for (*content*). *Purpose* was broken down into "finding information" (25 percent), "compare/choose" (51 percent), "understand" (24 percent). Users' *methods* were "explore" (two percent), "monitor" (two percent), goal directed "find" (25 percent), and goal directed "collect" (71 percent). Note that 96 percent of user activities were goal-directed. Nielsen (2001) summarizes this research: "Users' most important Web tasks involve collecting and comparing multiple pieces of information, usually so they can make a choice." That is, Web users generally do tasks similar to what students are asked to do in the classroom. We speculate that this general usability research may provide insights into teaching skills for critical Web use. Future directions for research include collecting more data of how students use material obtained from the Web and analyzing the information derived from studies both qualitatively and quantitatively. However, many questions still remain on how and what to measure in order to collect meaningful information. Students must be trained to evaluate Web-based information critically and we want to develop software tools or metrics that can facilitate this training. We also must have a better understanding of how humans decide if information is valid. In order for this to happen, however, we need to discover what dimensions form a basis for value judgments of veracity. We expect that results from this research will be able to provide some insights into students' beliefs and attitudes about the veracity of information found on the Web. In addition, we hope this research can address how those beliefs and attitudes are related to task performance.

[1] Lies, damned lies and Web-based information is a play on the famous quote "lies, damned lies and statistics" that is typically attributed to Benjamin Disraeli. (See the autobiography of Mark Twain by Samuel Clemens)

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References

Iding, M., Landsman, R., & Nguyen, T. (2001)Critical evaluation of scientific Web-sites by high school students. *WCCE (World Conference on Computers in Education Proceedings.* The Netherlands: Kluwer Academic Publishers.

Klemm, E. B., Iding, M., & Speitel, T. (2001). Do scientists and teachers agree on the credibility of media information sources? *International Journal of Instructional Media 28(1),* 83-91.

Lynn, M. C., Bell, P., & Hsi, S. (1998). Using the Internet to enhance student understanding of science: The knowledge integration environment. Interactive Learning Environments, 6(1-2), 4-38.

Morrison, J.B, Pirolli, P., and Card, S.K. A taxonomic analysis of what World Wide Web activities significantly impact people's decisions and actions. Interactive poster presented at the ACM Conference on Human Factors in Computing Systems, Seattle. 2001. http://www.parc.xerox.com/istl/projects/uir/pubs/pdf/UIR-R-2000-17-Morrison-CHI2001-WebTaxonomy.pdf

Nielsen, J.K. the 3Cs of critical Web use: Collect, Compare, Choose. Alertbox column, 15 April 2001. http://www.useit.com/alertbox/20010415.html (Accessed 29 July 2001).

Getting Stuck in the World Wide Web: The Impact of Design on Navigation

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Abstract: Getting lost is a common phenomenon for anyone who has ever navigated through a confusing Web site. What makes a Web site confusing? Why do people get stuck in the World Wide Web? In this study we looked at how people reacted when presented with Web sites that differed in level of familiarity. We found that when people viewed Web sites with an unfamiliar structure, they became confused and they tended to take more time when navigating. Future research will examine what factors are involved in successfully extricating oneself from the World Wide Web.

Introduction

One highly documented phenomenon, which exemplifies a potential pitfall of allowing users to control their own navigation, is getting stuck or lost in hyperspace (Boechler 2001). No one really knows for sure why people seem so prone to this problem. One possible reason that people get lost is that they rely on some preformed concept of how to find their way through hyperspace. For example, many users seem to navigate from top to bottom, left to right, page to page (Eveland & Dunwoody 1998; Niederhauser, Reynolds, Salmen, & Skolmoski 2000). Another possibility is that the cues as to relevance and temporal precedence are not the same for a Web page as they are for books or other print-based media (Sundar, Narayan, Obregon, & Uppal 1999; Tewksbury & Althaus 2000). It is left up to the user to select which information is important to attend to without the benefit of familiar cues. A user who is not familiar with the structure of a particular Web site may not recognize the significance or relevance of the cues, and may instead look for cues that they have seen and used before.

We are initiating a program of research to begin to determine how it is that people navigate through hyperspace and why this process breaks down so frequently. The first study, which is reported here, examines what impact level of familiarity has on navigation. We compared two Web sites with different levels of familiarity classified as *text*-based and *metaphor*-based respectively. The *metaphor*-based Web site was designed to represent links metaphorically with pictures. The *text*-based site represented links with text.

We hypothesized that participants would spend different amounts of time navigating through the Web site based on their familiarity with the structure of the Web site that they viewed because the cues that they expected would not be there. We believed that people would spend more time navigating the unfamiliar site. We also believed that there would be differences in the amount of information recalled based on the type of Web site that they were viewing, because getting stuck and being confused by the Web site might actually compel users to internalize the structure of the unfamiliar Web site and thus lead to an increase in the amount of information recalled.

Method

Participants and Materials

Participants were 93 undergraduate psychology students from the University of Alberta. They received course credit for their participation. The majority of participants (85%) were 18 to 20 years of age, 6% were younger than 18, and 9% were older than 20. Of the 93 participants, 62% were female and

38% were male. The majority of participants, 66%, were in their first year of study, 22% of participants were in their second year of study and the other 12% where either in their third or fourth year of study. There were 45 participants in the *metaphor*-based condition and 48 in the *text*-based condition. The materials were two Web sites, an online questionnaire, and a free recall task.

Procedure

Participants were randomly assigned to view either one type of Web site or the other and were asked to evaluate the Web site. They were given a questionnaire to fill out after they were finished looking at the Web site The participants were then were asked to complete a free recall task, about which they had no prior knowledge. There was no time limit given for any of the tasks, and the participants were not told of the hypotheses of the study.

Results and Discussion

Participants viewing the *metaphor*-based site rated the Web site significantly more confusing and less understandable than participants viewing the *text*-based site. Participants also spent more time on the less familiar site. The lack of a familiar structure seemed to be a hindrance for the participants in the *metaphor*-based condition. Although participants in the *text*-based condition often reported that the site they were viewing was boring, and rated their site as less interesting than participants in the *text*-based condition, they were able to navigate more quickly through the site than participants in the *metaphor*-based condition. This suggests that even though the familiar structure may not have been as visually appealing as the less familiar one, the cues were transparent and participants did not have to have to discover the meaning of the cues.

While lack of a familiar structure did seem to be a problem for navigation, it did not impact participants' abilities to recall information implying, perhaps, that participants did not internalize the structure of the Web site. There was no difference in the amount of information participants were able to recall, either about the structure of the Web sites or the specific content that was located on the Web sites.

People come to Web sites with preconceived notions as to what Web sites should look like and the conventions that should be used. When these preconceived notions are not upheld, it can lead to an increased level of confusion and frustration when navigating online. When we are driving, or otherwise navigating through a physical environment we rely on conventional cues such as street signs or traffic signals to aid us in arriving at our desired destination. Similarly, when navigating through Web sites, we have expectations about how navigational cues should be implemented. In unfamiliar environments people have a hard time recognizing the significance of navigational cues. We plan to extend our research to examine what factors are the most important for successful navigation and to gather further evidence as to why people get stuck in the World Wide Web.

References

Boechler, P. M. (2001). How spatial is hyperspace? Interacting with hypertext documents: cognitive processes and concepts. *CyberPsychology & Behavior, 4,* 23-46.

Eveland, W. P. & Dunwoody, S. (1998). Users and navigation patterns of a science World Wide Web site for the public. *Public Understanding of Science, 7,* 285-311.

Niederhauser, D. S., Reynolds, R. E., Salmen, D. J., & Skolmoski, P. (2000). The influence of cognitive load on learning from hypertext. *Journal of Educational Computing Research, 23,* 237-255.

Sundar, S. S., Narayan, S., Obregon, & Uppal, C. (1999). Does Web advertising work? Memory for print vs. online media. *Journalism & Mass Communication Quarterly, 75,* 822-835.

Tewksbury, D. & Althaus, S. L. (2000). Differences in knowledge acquisition among readers of the paper and online versions of a national newspaper. *Journalism and Mass Communication, 77,* 457-479.

A Project-Based Approach: Training Teachers in Classroom Computer Applications

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Abstract: In order to teach K-12 inservice and preservice teachers to use computers and instructional technology to augment their instruction, Internet use was integrated into a face-to-face master's level education class at St. John's University. After setting course outcomes, a curriculum was developed working backward to create an ordered series of instructional tasks to achieve those outcomes. The procedures didn't require sophisticated software and can be replicated in the classroom using a word processor.

Introduction

Are today's teachers ready to integrate technology into their classrooms? According to the International Society for Technology in Education, ISTE (2000) a major problem in achieving this goal is the lack of teacher expertise. According to Jayroe, Ball and Novinski (2001) the difficulty faced by many educators is how to introduce technology into the curriculum in a meaningful and constructive manner. Inservice teachers need to be able to understand the usefulness of how technology can be effectively used in the classroom (Franklin, Turner, Kariuki & Duran, 2001).

Discussion

Many new teachers leave undergraduate schools with limited knowledge of how to use technology in the classroom, and in some cases the university faculty are "neither modeling the use of technology, nor requiring students to use technology" (O'Bannon, Matthew & Thomas, 1998). Before teachers enter a classroom they must be technologically literate. Professors must be proficient in the use of technology, and integrate technology into their existing courses (Kahn, 1997). There are schools of higher education that presently do not adequately integrate technology into their teaching (Rosenthal, 1999). Inservice teachers use the methodology that they feel comfortable with, when presenting a lesson. When a prospective teacher is taught with technology, this becomes embedded in their schema, and makes it easier to use when they teach (Plotnick, 1995). Technology is not central to teacher preparation experience, and most technology instruction is teaching about technology, not teaching with technology across the curriculum (Beck & Wynn, 1998). Albion and Gibson (2000) observed that if teachers are to become successful at adapting technology into their curriculum, they require an understanding beyond that of being confident in using computers in their daily lives.

Implementation

It was important to engage learners in meaningful hands on projects from the onset of classes. Through the use of project-based building block constructivist methodology a course was designed that gave learners new ideas on ways to infuse technology into their curriculum while learning about instructional technology. The course of study was divided into projects. Each project required mastery before attempting the ensuing project. Projects included; e-mailing a graphic attachment in a word processing document, locating and evaluating five curriculumbased Web sites, creating classroom/teacher material using Microsoft Word, presenting subject matter using PowerPoint and creating a Project-Based thematic unit using Inquiry-Based Learning. A rubric was given to each student delineating what was required for each project. Grades were posted to the class Blackboard Web site. This required the learners to monitor Blackboard where relevant announcements and projects were posted.

Conclusions

It is important in any course of study where instructional technology is used to have students become engaged in meaningful hands on projects. Summers, Lohr and O'Neil (2002) discuss the importance of a learner being able to transfer what they have learned in the classroom to real life situations. Through connecting technology with active involvement in learning Kommers and Mizzoguchi (2000) believe that teachers create a knowledge base that is described as a key issue by constructivists. Lloyd, Merkley and Dennenbring (2001) contend that learners must feel comfortable and understand the relevance of using various technologies upon graduation in order for it to become part of the educational process. Technology has an important role in teaching. Technology should not be taught in isolation but used to augment traditional teaching methodologies by providing alternative means of obtaining information.

References

Albion, P.R. & Gibson, I.W. (2000). Problem-based learning as a multimedia design framework in teacher education. *Journal of Technology and Teacher Education,* 8 (4), 315-326.

Beck, J.A. & Wynn, H.C. (1998). Technology in teacher education: progress along the continuum. Retrieved February 14. 1998, from http://www.ed.gov/databases/ERIC_Digests/ED424212

Blackboard (2000). http://www.blackboard.com/courses/EDU3280SJU. Enter as guest.

Franklin, T., Turner, S., Kariuki, M. & Duran, M. (2001). Mentoring overcomes barriers to technology integration. *Journal of Computing in Teacher Education,* 18 (1), 26-33.

ISTE (2000). National educational technology standards for teachers. Eugene, OR: ISTE.

Jayroe, T.B., Ball, K.C. & Novinski, M.R. (2001). Professional development partnerships integrating educational technology. *Journal of Computing in Teacher Education,* 18 (1), 12-18.

Kahn, J. (1997). Technology -rich teacher education: meeting the NCATE challenge. *Journal of Computing in Teacher Education,* 13 (2), 24-29.

Kommers, P. & Mizzoguchi, R. (2000). Intelligent systems/tools in training and lifelong learning. *Journal of Interactive Learning Research,* 11 (3/4), 259-264.

Lloyd, T., Merkley, D. & Dannengring, G. (2001). Distance education technologies in preservice methods courses. *Journal of Technology and Teacher Education*, 9 (4), 551-566.

O'Bannon, B., Matthew, K.I. & Thomas, L. (1998). Faculty development: key to the integration of technology in teacher education. *Journal of Computing in Teacher Education,* 14 (4), 7-11.

Plotnick, E. (1995). Trends in educational technology. Retrieved April 17, 1999, http://www.ed.gov/databases/ERIC_Digests/ED398861.

Rosenthal, I. (1999). New teachers and technology. *Technology & Learning,* 19 (4), 22-28.

Summers, L., Lohr, L. & O'Neil, C. (2002). Building instructional design credibility through communication competency. *Techtrends*, 46 (1), 26-32.

Accessibility and Transparency in Tamid's Civics Teachers On-Line Community

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Abstract: This paper is a report of the early findings of a study conducted within Tamid's Civics Teachers On-Line Community, operating at the Open University of Israel. At "Tamid", we aim to improve the standards of civics teaching in High schools by developing a specific environment that enhances democratic values among in-service teachers for the benefits of their students. Democracy is dynamic and evolves and improves according to social, cultural and technological changes. Accessibility and transparency are two qualities of the World Wide Web that may deeply influence tomorrow's democracy. At Tamid, the interactions between the teachers are examined from the pedagogical content knowledge building perspective. Early findings show that On-Line relevant resources and assignments encouraged some teachers to relate to their peers' work, to share their own resources and to use them with their students; others witnessed they used resources and enjoyed discussions in a passive mode.

Introduction

Israel's internal cleavages are deepening and the teaching of civics became a very important challenge for Israel's education system. A new civics curriculum that is for the first time aimed at the Secular, Religious and Arab young Israeli citizens was introduced in 2000. This new curriculum sees democracy as a way of life rooted in values and principles and not only as formal set of institutions and processes. This was our opportunity to meet the teachers' needs and provide them a specific on-line educational environment in order for them to cope with these heavy conceptual changes. The debate on the democratization influence of the web convinced us to examine civics teachers on-line learning patterns. Accessibility and transparency are tools that enable the implementation of democratic values, it was interesting to check if a widely open and accessible on-line environment could enhance a meaningful and practically democratic process of learning: pluralistic debate, freedom of expression, respectful interactions etc....

Our project started with 20 Civics teachers in spring 2000 as a new branch of the Tamid environment for Science Teachers. Since October 2001, we train 120 teachers in 5 geographical groups by way of an on-line course. Apart from the on-line course, the teachers enjoy valuable resources both at the knowledge and pedagogical levels. Tamid's site is wide open to all with no need for password as part of our genuine desire to provide a design, accessible and transparent, to all Civics Teachers. We were interested to check if the on-line wide-open Tamid environment was motivating teachers to share their resources/knowledge with their peers and engage reflective dialogue around specific and general teaching problems/dilemmas. Was there a correlation between the fact that our environment was accessible and transparent to all civics teachers and the quality of the interactions between teachers and moderators and among peers teachers?

The Study: Building together practical disciplinary knowledge

"There may be some new form of community developing among the myriad solitaries perched in front of their screens and connected only by their fingertips to the new web defined by the internet. But the politics of that "community" has to be invented.." Benjamin Barber, 1997.

Inventing the "politics" of our civics teachers' community was not an easy job since we had to create a climate of mutual trust as a condition for a meaningful learning process. Coordinating the aspirations of each one of different participants, thinking over what is a meaningful feed-back, discussing the advantages and the risks of a transparent environment in which everyone's assignment is subject to the group's criticism or praise, dealing with others' opinions and experience the suffering that may imply tolerance. These are only a tiny part of the on-going questioning which the developing team and the teachers are experiencing day after day at Tamid.

Our research is based on one On-Line course that has been running in five geographical groups from October 2001 to April 2002. 120 in-service teachers attended the course. Electronic discourse was taking place in both a "national" discussion group - where actuality issues where discussed from the point of view of practitioners that needed to use up to date material for explaining curricular concepts - and local groups - where assignments were mainly oriented toward analysis of students' texts and knowledge building trough academic articles and their "translation" into didactical practice.

As part of the learning process the teachers had to develop their own sense of responsibility and autonomy since there was no external due-date for the diverse assignments. Still, all of the assignments implied interaction and discussion. Each teacher had to lead the discussion one academic article within an on-line discussion group. This dialogue was a very fascinating alchemy since it was an occasion to enhance the connection between the subject matter and its didactics besides inducing reflective thinking among the teachers. Who started the discussion? Who reacted? How many "reactions" to a topic? What made a topic turning into a highly reflective learning process? To which extent did "passive" teachers witnessed the use they made of materials or arguments that came up during the discussion? Which patterns of participation: pedagogical issues or ideological views, passive versus active behaviors, consumer or contributor etc..

Early Findings

The building of an on-line teachers community is a process. But our early findings (evaluations, questionnaires, interviews and discussion groups analysis) show that for most of the teachers, Tamid site became a professional meeting place: to submit a test to peers and moderators appreciation, to view links to up-to-date articles on relevant issues, to ask specific questions that came up at school, to take part on discussions on political discussions and to think together with peers of new strategies to teach highly controversial topics, to inform peers of the use that was made with students of material or arguments.. These occur in a highly respectful climate, accessibility to all but still no curses and no anonymous participants. Thanks to Tamid's web environment, teachers from the periphery could enjoy the same high quality resources, experts and facilitators as teachers from the center of the country but this is still a theoretical access since most of these teachers usually lack the technological tools to make their participation in the on-line learning process meaningful.

Teachers are practitioners that need to update, confront and articulate their subject matter knowledge and their teaching skills. Therefore, building practical knowledge (from home) through an easily accessible site designed to meet their needs is highly motivating for in-service training teachers.

References

Barber B.R. (1997), "The new communications technology: endless frontier or the end of democracy?" *Constellations*, vol.4 , No 2, Blackwell Publishers, UK, USA, 208-231.

Schon, D. A. (1987). Coaching reflective teaching. In:P.P. Grimmett and G.L. Erickson, (eds.), *Reflection in Teacher Education (*pp.19-30) . New York: Teachers College Press.

Shulman L.S. (1997). *Communities of learners and Teachers' communities* (in Hebrew), Mandel Institute, Jerusalem.

The Role of Civic Education: A report Of the Task Force on Civic Education (1995) *prepared by the Center for Civic Education*, Washington D.C.

Assessing Information and Communication Technology Literacy of Education Undergraduates: Instrument Development

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Abstract: In recent years, the view that Information and Communication Technology (ICT) is vital in K-12 education has become widespread. ICT use in schools has increased and various professional bodies have set ICT standards for students and teachers. Schools of education are under pressure to produce teachers who are able to effectively integrate technology into their teaching. However, most teacher preparation programs do not adequately prepare teachers in ICT, nor assess candidates relative to ICT standards. This paper discusses the development of a computerized system to assess ICT declarative and procedural knowledge and to provide a profile to the participant.

Introduction

In recent years, governments, education organizations, and researchers have increasingly supported the view that incorporating ICT into learning and teaching is an important aspect of keeping the curriculum relevant and preparing students for their future in a complex knowledge-based world (Alberta Education, 1999b; CEO Forum on Education and Technology, 1997; Jonassen, 1995; Logan, 1995; Milken Exchange on Educational Technology, 1999; Thornburg, 1991). Data that provide insight into the computer literacy level of incoming undergraduate education students would be helpful to faculty designing appropriate curriculum. However, there is currently no assessment tool that establishes the ICT literacy level of current or prospective students. The predictive validity of a high school transcript or grade 12 English or mathematics marks is insufficient. How do the ICT skills of recent undergraduate students compare with the skills indicated at the Grade 12 level of the Provincial technology outcomes? Although the Best Practices in Technology documents (Alberta Education, 1999a) indicate that much ICT-related activity is occurring in schools, and an optional ICT K-12 curriculum has been available since June 1998, there are currently a few students entering educational technology courses at this university who have literally never turned on a computer (based on an informal "hands-up" survey of students in September 1999), while some students are familiar with some aspects of ICT, and a few are quite adept. This paper, part of a larger study (Davies, 2002) discusses the development of several Web-based instruments (Research Consent Form, Attitude Survey, Background Survey, Knowledge and Performance Tests) which assess the computer literacy level of incoming undergraduate education students.

Development of the Instruments

The Background Survey and Knowledge Test were implemented using ASPs written in the VBScript (Microsoft Corporation, 2000b) programming language. The ASP dynamically generated a Web page containing an HTML form with question and response data stored in a Microsoft Access 2000 relational database on a Windows server. The Background Survey included a variety of form field types that enabled implementation of different question types: radio button (multiple-choice/single response), drop-down list (multiple-choice/single response with a large set of possible answers), check box (multiple-choice/multiple response), and text box (short answer). The Knowledge Test was composed entirely of multiple-choice questions with five possible radio button answers.

The ASP also inserted client-side JavaScript (Netscape Communications Corporation, 2000) code into these HTML pages for the purpose of quick data validation. When the participant clicked on the form "Submit" button, the JavaScript local editing procedure was invoked. If unacceptable data were found, an error message window was displayed on the screen and the form was not submitted. For example, the Background Survey asked for the year of high school graduation. Acceptable responses had to be a four-digit year not greater than the current year. Upon acknowledgment of the error message, the participants' display was automatically scrolled to the question where the error was found. The JavaScript procedure also checked to see whether all applicable questions had been answered. If missing responses were found, a warning message window was displayed on the screen. Since it was unethical to demand that the participant answer all questions, the participant was then given the choice to return to the first missing response or to submit the data. The Knowledge Test responses were immediately scored by comparing with the correct response stored in the database for each item.

Observations of participants filling in the Web-based forms indicated that the JavaScript validation routines contributed to the completeness and accuracy of the data collected. For example, one participant was observed to receive the warning message stating that not all questions were answered. The individual read the warning message, returned to the form, stated "Oops, I missed that question," clicked on a response, and proceeded to submit the form with all questions completed. In all of the Background Survey data collected during the pre-course pilot test (34 participants x 35 questions each for a total of 1190 items) only 1 missing response and no invalid responses occurred. It would have been extremely time-consuming to ensure this level of data completeness and accuracy with paper-based forms. In the corresponding Knowledge Test data (952 items), there were 45 unanswered items. These were treated as incorrect responses when computing the overall test score. The vast majority of the missing responses (39) occurred because two participants attempted the first few questions and then submitted the form without checking responses for the remaining questions. Some additional messages were added to the Knowledge Test to ensure that students would be aware that there was no penalty for guessing.

The Performance Test was a much more technically complex instrument than the Knowledge Test since it required automating the analysis of files that participants manipulated on their local computers. The actual applications tested were established based upon required ICT skills, but were delimited by criteria such as time constraints for the initial instrument development, minimizing problems in collecting data, and allowing students to take the Performance Test with varying versions of application software on either the Windows or Macintosh platform. The solution chosen was to create a Visual Basic for Applications (VBA) (Microsoft Corporation, 2000) procedure within the same Access database described earlier. Web-based (especially client-side) programming techniques were avoided because of variable client computer setup and security issues involved in attempting to examine files on a client computer over the Internet. This part of the system required exchanging a set of files (compressed into a single archive) between each participant's computer and the database server.

During the Performance Test, the VBA procedure was continually running, monitoring a certain file directory every 60 seconds for arriving submissions and executing an automated scoring routine. The VBA scoring procedure implemented programming techniques (e.g., use of Microsoft Automation objects, methods and properties) which enabled automated execution of file system commands (e.g., file searches and directory listings), reading of text stream files, interfacing with external applications (e.g., Microsoft Word and Excel), opening files in these programs, and examining their object hierarchy.

The automated scoring routines were subjected to several iterations of testing and refining. The first author created about a dozen test cases - sets of computer files representing completed student practical tests - with a mixture of completely correct, partially correct and completely incorrect solutions for each task, completed using different software versions on different computer platforms. These were subjected to the automated routines and the scores for each item of each test case were manually checked for accuracy. This was repeated until all of the test cases were being properly scored. These same processes were repeated with files created by various expert reviewers as well as the entire group of student files resulting from the performance pilot test. Programming efficiency was also examined and improved until the time required to score the performance test averaged less than a second per test case.

The procedure that scored the spreadsheet activity of the Performance Test highlights the flexibility in the software used by participants allowed by the programming solution chosen. Spreadsheet files created in Excel 5 and 98 for Macintosh and Excel 95, 97, and 2000 for Windows formats were all scored without technical problems. In addition, the procedure also worked for files created in other programs such as Apple/ClarisWorks or Corel Quattro Pro then saved in Excel format. Multi-format flexibility assumes that the spreadsheet activities chosen for the test are limited to common features available in the different spreadsheet file formats. Only common tasks such as basic text or number formatting, cell alignment, and formulas were used. This was adequate for the level of expertise being measured in the target population.

Pilot Test

The instruments were pilot-tested on a thirty-five volunteer undergraduate education students prior to the main data-gathering period. These students were drawn from registrants in two Summer 2000 sections of the recommended educational computing option course. The students completed the Web-based forms and the Performance Test in a campus lab on Pentium 450 MHz computers with Microsoft Windows 98 and Office 2000 (Microsoft Corporation, 2000a) installed. No student chose the options of using a Macintosh computer, or to fill in paper-based copies of the online forms. The same group of students was later invited to participate in a Knowledge and Performance post-test, which was held on the second-last day of the term. After completing the test, the students were given a list of answers to the multiple-choice Knowledge Test, computer files providing correct solutions to the Performance Test, and personal help with any questions they had.

Instrument Validity

Content validity of the instruments was independently judged by three individuals who have expertise in educational technology: a faculty member, a PhD student, and a senior undergraduate student who had worked for a year as a marker in the educational technology undergraduate course. A number of modifications were made to the instruments based on the feedback from these initial reviewers. For example, some items that were deemed inappropriate were deleted from the instruments, the wording of some items was clarified, computer displays were improved, and new items suggested by the reviewers were added. These reviewers also served to verify that the system was operating without technical errors. Additional educational technology experts were called upon to similarly review the instruments after the pre-course pilot test. Improvements to the instruments were made as a result of this second round of validation activities.

Feedback on the instruments was obtained from the pilot-test students in a number of ways. First, during the pre-test, the researcher asked the students to raise their hand if at any time during the testing they found any information on the consent form or any question on the instruments to be unclear or inappropriate. A few such questions occurred and were discussed privately with the participant. These inquiries were noted on the researcher's printed copies of the instruments. Second, after reviewing the pre-test data, several students were contacted by email and asked for more information concerning their answers to certain items on the Background Survey. This resulted in some ideas for additional changes to the survey. Third, during the post-test, the students were asked to fill in a short feedback sheet. They were asked whether there were items that they felt were unclear or inappropriate on either the Knowledge or Performance Test, and whether they had any suggestions for additional items that could be included. All of these sources of student feedback were reviewed and resulted in modifications to the instruments.

Statistical correlations were computed as indicators of test validity (see Table 1). A high correlation ($r(33) = .460$, $p<.01$)[1] between the Knowledge pre-test and Performance pre-test scores provided evidence of concurrent criterion-related validity. That is, there was logically some commonality in the underlying constructs that these two tests measured. Strong correlations between the course midterm exam which occurred two weeks after pre-test and the pre-test Knowledge ($r(30) = .533$, $p<.01$) and Performance ($r(30) = .606$, $p<.001$) scores were evidence of predictive criterion-related validity.

Correlations between the course final exam and the post-tests (run 1 day before the exam) were: Knowledge post-test ($r(21) = .409$, $p = .059$) and Performance post-test ($r(23) = .673$, $p<.001$). The latter correlation was significant and offers strong evidence of concurrent criterion-related validity. The first correlation, while not quite statistically significant at the .05 level ($p=.059$), still offered some evidence of validity. It should be noted that the course exams during the Summer 2000 term were entirely performance-based, thus it was not surprising that the correlations between the course exams were stronger with the Performance Test than with the Knowledge Test. Also, it was easier to obtain some marks by sheer guessing on a multiple-choice test than it was on a performance-based test. Correlations between the course final exam and the pre-tests were: Knowledge Test ($r(28) = .522$, $p<.01$) and Performance Test ($r(28)= .688$, $p<.001$). All of these correlations were further evidence of predictive criterion-related validity.

	Know Pre	Perf Pre	Know Post	Perf Post	Course MExam	Course FExam	Course Assign	Course Total
Know Pre	1.000							
Perf Pre	.460**	1.000						
Know Post	.556**	.332	1.000					
Perf Post	.342	.678**	.220	1.000				
Course MExam	.533**	.606**	.211	.162	1.000			
Course FExam	.522**	.688**	.409	.673**	.627**	1.000		
Course Assign	.506**	.486**	.141	.427*	.579**	.592**	1.000	
Course Total	.592**	.707**	.341	.543**	.804**	.917**	.808**	1.000

** Correlation significant at the .01 level * Correlation significant at the .05 level

Table 1: Pilot Test Instrument Validity - Correlation Statistics

Instrument Reliability

The Background Survey was not constructed as a scale where all items contributed to an overall score. Rather than computing internal consistency statistics, reliability of this instrument was established by selective re-testing. Four of the students who had volunteered to participate in the initial instrument evaluation were re-tested using a different format for presenting the questions (as an interview rather than online written questions). No differences in the responses from the two forms were found, indicating high reliability (Fraenkel & Wallen, 1996) although these participants did offer a few suggestions for clarifying the wording of a few items. The consistency of responses was not surprising, since most of the questions on the survey would be considered objective (mainly factual information such as whether or not they own a home computer). Answers to questions like these are likely to be answered the same in a test-retest situation where there is little time between tests.

Cronbach's alpha coefficient was computed for the pre-test Attitude Survey (.63), the Knowledge Test (.79), and the Performance Test (.91). The Attitude Survey reliability was judged too low for meaningful data interpretation (a widely accepted lower limit for alpha is .7), the second was acceptable, and the latter was exceptionally high, being at the level of marketed achievement tests (Fraenkel & Wallen, 1996, p.163).

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[1] In this notation, r(33) means r(df), where df is the degrees of freedom (equal to n-1)

Improvements to the Attitude Survey were essential to establish solid reliability. Analysis of the inter-item correlation matrix identified three items that were poorly associated with the other items and thus did not contribute well to the overall test score; these items were modified. In addition, since the survey originally consisted of only 12 items, reliability could be easily raised by increasing the number of related items (Fraenkel & Wallen, 1996, p.163). A target of 20 items was established.

The alpha coefficients for the post-test Knowledge Test and Performance Test (run again at the end of term as a post-test) were not as high, .63 and .84 respectively. This was because the tests included some questions deemed by experts to be easy (equivalent to the stated prerequisites for the recommended educational computing course), yet which stumped many students in the pre-test, effectively screening individuals with very low knowledge or practical skills. Tests are not always equally effective in different situations (Murphy & Davidshofer, 1991); these tests were less effective as a post-test after completing a course which covers much of the content of the tests and provides remediation for missing prerequisite skills.

In the pre-course Knowledge Test, no questions (out of 28) were answered correctly by all students. In fact, the easiest question was answered correctly by 88% of students. By contrast, in the post Knowledge Test, there were 4 questions answered correctly by all students, and another 8 questions answered correctly by at least 75% of students. There was less overall variance in the post-test scores than in the pre-test scores. Also, items of zero variance (same score for all students) cannot be correlated with other test items and thus do not enter into the reliability calculations, which reduces the reliability coefficient (a measure of average inter-item correlation).

The course appears to have been effective in raising the student scores. The mean pre-to-post gain on the Knowledge Test was 17.52. A one-sample t-test on the gain scores (post – pre), comparing them to a test value of zero (equivalent to a dependent or paired samples t-test using the pre and post scores) found the difference statistically significant. On the Performance pre-test, no questions (out of 24) were answered correctly by all students, while on the post-test, 6 questions were answered correctly by all students. The mean pre-to-post gain on the Performance Test was 26.07; the one-sample t-test on the gain scores compared to zero found the difference statistically significant. It should, however, be noted that the difference in cases between the pre and post-tests must be considered; the students who didn't participate in both tests were not part of the gain analysis and may have differed from those that did.

The pre-to-post gains on these two tests affirmed the effectiveness of the instruction and were additional pieces of evidence for the validity of the tests. It demonstrated that participants who have had more training or practice with ICT tools (i.e., the students at post-test time) scored much higher than those with less (i.e., the students at pre-test time). This is logically consistent with what the tests purport to measure.

Time Required to Administer Instruments

The pilot pre-test also served to verify that the instruments could be completed within a reasonable timeframe on a single day. The actual time required for students to complete all of the forms and tests was approximately 1.5 hours, about 0.5 hour for all of the online forms (consent, attitudes, and knowledge) and 1 hour for the performance tasks. The start and end time for each participant's work on each online form was stored in the database, making it simple to calculate the average time required to complete a form. In the case of the Background Survey, the average time was about 8 minutes, and the maximum time was 12 minutes. The maximum time required for the 12 Attitude items was around 4 minutes. For the Knowledge Test, the minimum time required was 3 minutes, the maximum 25 minutes, and the average 13 minutes. For the Practical test the minimum time required was 12 minutes, the maximum 65 minutes, and the average 36 minutes.

Observations from the Pilot Test

A number of statistics were computed to provide a general picture of the pilot data. Histograms of the pre and post Knowledge and Performance test scores revealed that these distributions were approximately normal, with the post-tests having much higher means and lower variances than the corresponding pre-test. Overall, the achievement on the pre-course tests was quite low with the means of both tests being below 50%. Comparing the test questions against the recommended educational computing course curriculum and stated prerequisites, the researchers concluded that marginally acceptable course prerequisite skills and knowledge (basic computer operation, file management and word processing) would be indicated by a score of at least 50% on the pre-tests. On the Knowledge Test, 44% of students did not meet this standard and 59% did not meet it on the Performance Test, indicating that many students do not possess adequate course prerequisites. A more comfortable level of prerequisite skills would be indicated by scores of at least 60%. On the Knowledge Test, 77% of students did not reach the 60% level and 71% did not meet it on the Performance Test. At the other end of the spectrum, a few students performed well enough on the pre-test to be likely candidates for successfully challenging the course or taking courses that require skills equivalent to completing that course as a prerequisite. Obviously more testing and validity evaluation would be required to establish a standard for this, but in the authors' opinion, 80% seems like a level that would reasonably indicate mastery. If this were the case, 3% of students (1 individual in the pilot group) would have qualified. A summary report on the pilot test group performance on the pre-course tests was provided for informational purposes to the course instructors and senior teaching assistants.

Full Implementation of the Tests

The instruments were successfully incorporated into the regular offering of the course beginning in the Fall 2000 (approximately 1000 students). Validity and reliability tests gave similar results to the pilot test. In addition, the implementation of online testing substantially reduced the amount of time required to evaluate students, particularly in the Performance test. The data from these tests have established a baseline of data on the ICT skills and knowledge of students entering our Faculty of Education. We expect the average ICT skills and knowledge of education entrants to rise over the next few years. At some point a certain level of ICT Literacy could be an admission requirement. These automated instruments could be used as an efficient admission screening tool. The teacher education program could then focus more resources on improving teacher candidates' abilities to integrate technology into their teaching instead of development of basic ICT skills and knowledge.

REFERENCES

Alberta Education. (1999a). Best practices in technology. Retrieved March 27, 2000 from the World Wide Web: http://ednet.edc.gov.ab.ca/technology/bestpractices/bestpractices99.asp.

Alberta Education. (1999b). Learning technology in Alberta's schools: Information for parents. Retrieved March 27, 2000 from the World Wide Web: http://ednet.edc.gov.ab.ca/techoutcomes/.

CEO Forum on Education and Technology. (1997). From pillars to progress (School technology and readiness report - year one). Retrieved March 27, 2000 from the World Wide Web: http://www.ceoforum.org/downloads/97report.pdf.

Davies, J.E. (2002). Assessing and Predicting Information and Communication Technology Literacy in Education Undergraduates. Unpublished Doctoral Dissertation. Edmonton, Alberta: University of Alberta.

Fraenkel, J. R., & Wallen, N. E. (1996). *How to design and evaluate research in education* (3rd ed.). New York: McGraw-Hill.

Jonassen, D. H. (1995). Supporting communities of learners with technology: A vision for integrating technology with learning in schools. *Educational Technology, 35*(4), 60-63.

Logan, R. K. (1995). *The fifth language: Learning a living in the computer age*. Toronto, On: Stoddart.

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Microsoft Corporation. (2000). Microsoft Office 2000 [Productivity software suite]. Redmond, WA.

Milken Exchange on Educational Technology. (1999). Transforming learning through technology: Policy roadmaps for the nation's governors. Retrieved March 27, 2000 from the World Wide Web: http://www.milkenexchange.org/project/nga/ME266.pdf.

Murphy, K. R., & Davidshofer, C. O. (1991). *Psychological testing: Principles & applications* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Netscape Communications Corporation. (2000). JavaScript [Computer programming language]. Mountain View, CA.

Thornburg, D. D. (1991). *Education, technology, and paradigms of change for the 21st century*. Eugene, OR: Starsong Publications.

Best practices experiences: successful use of electronic learning environments

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Abstract: Two popular learning environments, TeleTOP and Blackboard, are implemented for specific educational contexts in many universities and other institutions. Goal is to increase the use of information and communication technology (ICT) in education, particularly network technology or Web-based systems. These electronic learning environments do not seem to differ a lot in functionalities and use. Also, the problems that instructors have to deal with are similar. Instructors must learn how to work with these new tools, and discover how they effect their education. Two similar *best practice days* successful experiences with functionalities offered and functionalities used by the instructors learn that instructors can make education as flexible (in time and place) for students, but should be aware of time consuming activities that cause dissatisfaction and frustration. The target should be that students should benefit from the added value of electronic learning environments, use functionalities that are useful for the students and the use is consistently.

Introduction

The inevitable expansion of the opportunities of technology and the growing awareness of the possibilities for using the technology in a specific educational context are causing many universities and other institutions to increase the use of information and communication technology (ICT) in education, particularly network technology or Web-based systems. In relation to this many organizations are using or starting to use electronic learning environments. Two of such learning environments, TeleTOP and Blackboard, are described here. After a brief overview of the general concept of an electronic learning environment the two environments will be described, considering the differences, but also the similarities between the two systems. Based on two similar *best practice days* the successful experiences with functionalities offered and functionalities used by the instructors will be described, concluded with some important outcomes.

Electronic learning environments

TeleTOP and Blackboard are two examples of tailor-made Web applications, also known as course management systems, virtual learning environments or electronic learning environments. Mirande, Riemersma and Veen (1997) give a very broad definition of an electronic learning environment. They describe it as a learning environment that uses technology. Jansen, Fisser, and Terlouw (2000) describe an electronic learning environment as an environment that supports and enriches the traditional environment by functionally using new forms of ICT. Droste (2000) defines e-learning platforms as the technical facilities that facilitate interaction in the learning process, communication, and organization. The three main characteristics of an e-learning platform in her analysis are that it contains a subject-matter section, a communication section and an organization section.

Electronic learning environment are thus comprehensive software packages that support some or all aspects of course preparation, delivery and interaction and are accessible via a network (Collis &

Moonen, 2001). Most electronic learning environments focus upon separate courses and do not collaborate with other systems such as the personnel database and a system for exams. It is believed that a system such as Blackboard or TeleTOP in combination with existing systems can offer a comprehensive electronic learning environment with one portal for instructors and students from which they can find all necessary information. However, this paper focuses on the electronic learning envrionment used in education. In the next sections TeleTOP and Blackboard are described as two examples of such an environment and a comparison between the two systems is made.

TeleTOP

TeleTOP is a course management system, developed at the Faculty of Educational Science and Technology of the University of Twente. Since 1997, the system has been developed and implemented. The implementation started at the faculty of Educational Technology and other departments soon followed (Collis & De Boer, 1999). At this moment TeleTOP is used throughout the University of Twente and is also in use in other Universities, companies and training settings. The core ideas to start building a Web-based environment were to support learning and make it more flexible. Furthermore the best of "old values of good teaching" and an attractive campus life with new didactics and advanced technologies were taken into account to optimize these new possibilities in learning.

The TeleTOP system was build upon a powerful database (Lotus Notes) and used by all staff members/teachers in the Faculty of Educational Science and Technology; it was made to be WWW-based (for both students as well as instructors) and it was made accessible through an ordinary Web-browser everywhere in the world. The TeleTOP system became a very easy to use system and it allowed to a certain extent fit with the instructional practices of an on-campus University and extent these to distance students as well. It also did engage change to new didactics. The starting-point was that WWW-based learning environments should not replace existing teaching and learning, but should add to them. As many systems TeleTOP is able to create and display all sorts of earning materials, as video, text, glossaries, web links, polls, quizzes, and so on. An important aspect of the environment is the Roster, a table-like environment in which study materials, assignment instructions, student submissions, and instructor feedback are integrated. This tool allows the instructor to model his course, create activities, relate assignments and study materials. It also helps instructors to think of effective ways to communicate with the students, and helps them to set-up the structural communication models.

Blackboard

Blackboard is the commercial electronic learning environment, developed by Blackboard Inc., which is used at the University of Amsterdam. Within Blackboard each course is delivered through a website. This website contains all the content and tools required to teach a course. Each course has an instructor who manages the course through the Instructor Control Panel.

For this article a description of the functionalities of and the experiences with CourseInfo v4.0 is given, the version of the electronic learning environment developed by Blackboard, which was used during the best practice day (**see last section**). The University of Amsterdam has been using this version since 1999, and is now migrating to Blackboard 5, Level Three, the software platform that delivers a course management system, with a customizable institution-wide portal and online communities and advanced integration tools and APIs to integrate Blackboard 5 with existing institutional systems.

Differences and similarities

Before taking a closer look at the actual use of two electronic learning environments, lets first look at some general characteristics. Table 1 shows the Differences and/or similarities of two of them: Blackboard and TeleTOP.

Table 1. Differences and/or similarities between Blackboard and TeleTOP.

Topic	**Blackboard**	**TeleTOP**	**Differences and/or similarities**
Instructors interface	Web-based, The instructor is able to place materials through a control panel. In the 'view' mode he is able to see how the students see the course.	web-based en based on the principle: what you see is what you get. An instructor is able to see how the student will see the site immediately.	Difference in that prospects that BB works with a control panel, TT with what you see is what you get.
Instructor Tools	All course administration is done through the Instructor Control Panel. This area is only available to users with one of the following defined roles as instructor, teaching assistant, grader and system administrator. It contains the following tools: User management; Communication center; Page editors to add text and files; Creating assessment materials, including quizzes; Managing the online gradebook; Online support and documentation and Site management	The instructor can choose his tools from the menu, per functionality (i.e. news, or roster) the forms will able the instructor to easily put materials in the environment. The tools are organized around the following themes: course organization; communication; group work and educational resources.	
Student interface	Web-based, the student is able to find materials using a Web browser.	Web-based, the student is able to find materials using a Web browser.	Similar.
Student Tools	Web-based, accessed through 'My Blackboard' (a listing of all the announcements, courses, and calendar items that are created or associated with it in a central location) or 'course gateway listing' (a listing of all courses in which the student is enrolled) and contains tools for Announcements , course information ,staff information , course documents, assignments, communication and external links. Furthermore student tools as a digital dropbox, edit home page and personal information, course calendar, check grade, manual, tasks, a resource center , a course map are available	Information tools (news, course info); Communication tools (mail; FAQ, discussion) and Resources (web-link, MM, quizzes, polls, etc) Special is the Roster: a schedule tool to combine al resources into web or face-to-face sessions. Here, the course activities are described, and the educational resources are connected to these activities. For example the assignments and feedback to these assignments. The student tools, and also the student interface is similar to that of the instructors. The student has fewer rights for adding materials, but instructors can modify these rights, so that students are able to for example add resources.	The Roster of TeleTOP is typical for the environment

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For a more detailed overview of differences and similarities between TeleTOP and Blackboard, as well as other systems, visit the site that Bruce Landon has set up: http://www.c2t2.ca/landonline/

Use of electronic learning environments in education, learning from experience.

In June 2001 a TeleTOP Best Practice day was organized at the University of Twente. A similar day was organized in September for Blackboard users at the University of Amsterdam. In both universities instructors were invited to present their experiences with the system in their education. There was a broad variety in instructors and courses, as instructors of different programs participated. In the presentations of the use of the electronic learning environments, instructors showed how the system was set-up, which functionalities were used, what goals were achieved and how this was experienced in the courses. The participants of both Best Practice days, all instructors also using the systems, were invited to nominate the presentation that they thought was the best example of good, useful and/or interesting use.

The best use of a TeleTOP site, selected by the instructors of the University of Twente, was a typical example of how electronic learning environments are used in the education at that university. Within the course the environment supports different students: students on campus and distance students who attend at face-to-face meetings every other Friday. Figure 1 shows a screen dump of the TeleTOP environment.

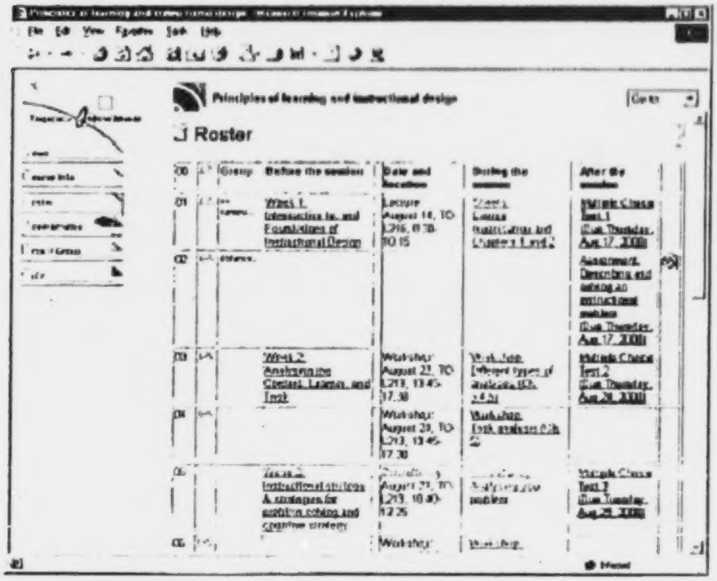

Figure 1. View of the Instructional Design course.

The instructor has used the environment to give a detailed overview of the schedule. A limited number of assignments were part of the course. The students could find these rights from the start of the course and were flexible in the submission of the assignments, though they needed it to submit for a fixed date. A part of these assignments were test in which the scoring and feedback was organized and given by he system. The instructors who liked this example, argued that the instructor managed to make use

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of ICT in his education to make in as much flexible for students to participate, but also cared for his time, so it would not get out of hand.

The Blackboard course that was evaluated as best practice at the University of Amsterdam was the course "Design of modern foreign languages", a course for students from the Graduate School of Teaching and Learning, in which the students have to make a design plan for a language course. Students participating in this course are regular on-campus students. Functionalities of the Blackboard learning environment that are used by the instructor to set up the course are Announcements, Course Information, Staff Information, Course Documents, Assignments, Communication and External Links. Students have their own tools as described in Table 1. This can be seen in Figure 2.

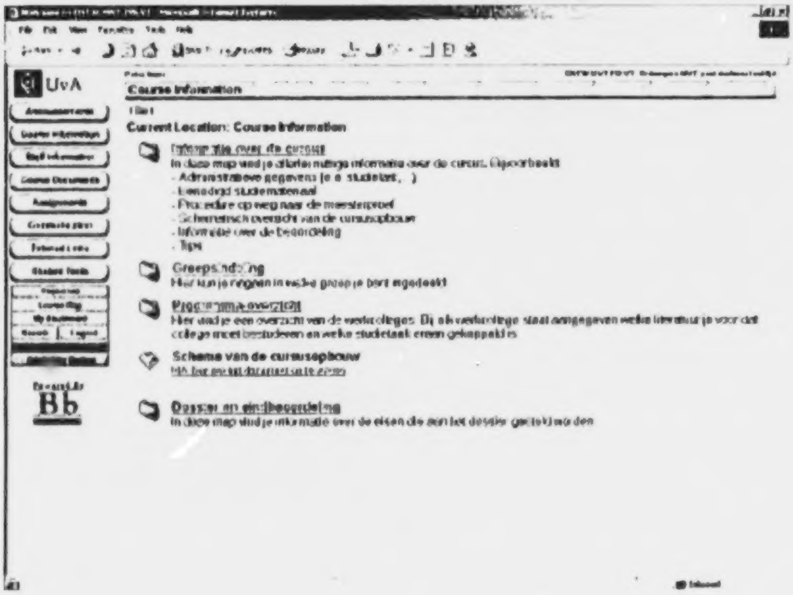
UvA
Course Information
Current Location: Course Information
Schema van de cursusopbouw
Bb

Figure 2. View of the Design of modern foreign languages course.

The options course information and assignments are the two options that are used most extensively. Students are informed about the course in general, including the goals, the schedule, and the way of assessing and grading the products of the student. The students have to do seven separate assignments. These assignments lead to a 'master test', the final assignment. In this assignment the students have to apply all knowledge and skills that they have used in the previous assignments.

The way the instructor designed the course and the way the functionalities were used were not evaluated as extremely original, but as very useful and consistent for the students. The instructor showed that by using the course in Blackboard next to the lectures students can benefit from an added value, especially related to time and place flexibility.

Conclusions

It is interesting to see what the institutions in the Netherlands that have decided to start working with electronic learning environments experience working with these systems. On one hand institutions

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decide to organise a full institution-wide implementation of these systems. On the other had we see that instructors are still struggling with the question how they should use these new flexible tools and how this will change their teaching. They are concerned with how they can use the opportunities and functionalities that will make their teaching and their students' learning more flexible, efficient and enriched. In those institutions were a clear innovation goal has been set, these questions are more easier to answer than when the instructors have to deal with this question themselves. However, despite of the differences in electronic learning environments we see that instructors are creative, eager to learn how to use the tools and like the new possibilities. It looks like that best practice days as we have described in this paper are very fruitful opportunities for instructors to exchange ideas. Most important outcomes of the recent best practice days at the University of Twente and the University of Amsterdam are:

- Make education as flexible (in time and place) for students as possible, but be aware of time consuming activities that cause dissatisfaction and frustration.

- Let students benefit from the added value of an electronic learning environment, use functionalities that are useful for the students and use them consistently.

Further research should clarify if, and how, best practice days focussed on the exchange of experiences with an electronic learning environment have effect on the positive use of electronic learning environments in current and future education.

References

Collis, B., & Boer, W. de. (1999). Scaling up from the pioneers: The TeleTOP Method at the University of Twente. *Interactive Learning Environments*, 7 (2/3), 93 - 112. ISSN 1049-4820

Collis, B., & Moonen, J. (2001). *Flexible learning in a digital world: Experiences and expectations.* London: Kogan Page.

Droste, J. (2000). Advies Keuze Teleleerplatform 2000. Surf Educatief, Cinop. ISBN: 90-74256-11-Z

Jansen, P.A., Fisser, P., & Terlouw, C. (2000). Designing digital learning environments. In: H. Taylor, & P. Hogenbirk (Eds), The school of the future (pp. 259-270). Boston: Kluwer Academic Publishers.

Mioduser, D., & Nachmias, R. (2001). WWW in Education. In H. Adelsberger, B. Collis, & J. Pawlowski (Eds.), *Handbook of information technology for education and training.* (in press). Berlin: Springer Verlag.

Mirande, M., Riemersma, J., & Veen, W. (1997). *De digitale leeromgeving.* Groningen: Wolters Noordhoff.

A Multimedia Web-Supplement to a Course on Beethoven

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Abstract: www.beethoven.neu.edu is the result of a faculty initiative sponsored by Northeastern University's College of Arts & Sciences, with a goal of understanding better the implications of technology upon teaching. This website was featured in the "Learning" section of the Boston Globe on July 15, 2001, and may be used as a case study for faculty, staff, and administration interested in developing web-based supplements to their classes. This session describes the content and design of the Beethoven web-supplement, its use of e-learning technologies, and an evaluation and assessment of its effectiveness.

Issues with E-learning

The Beethoven web-supplement attempted to grapple with a number of current e-learning problems and issues, a few of which are stated below:

- How can we better understand the implications of technology upon teaching?
- Do pre- and post- surveys shed light on students computing habits? Their acceptance of online learning methods?
- Do online pre-assessment tests enhance a students understanding of course material?
- Does streaming audio of musical examples relieve the stress on our university media labs costs and resources?
- Does an online gradebook, and the ability for students to monitor their grade progress throughout a course, diminish their grade anxieties?
- How much do students really know about multimedia plug-ins and are they really interested in using the Internet as an educational learning environment?

Description

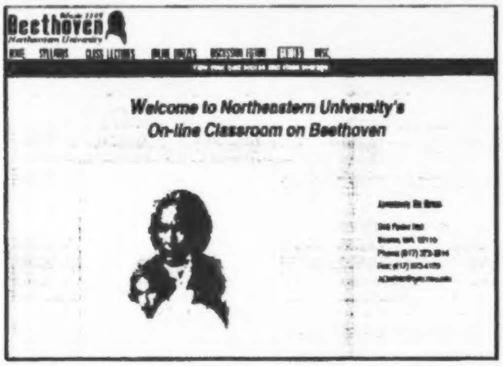
The web-supplement to MUS 1145: Beethoven, was the result of a collaborative effort between Professor Anthony De Ritis, his undergraduate assistant, Aris Amanatidis, the Northeastern University EdTech Center, and the College of Arts and Sciences and Northeastern University. Originally developed in 1999, this course has been offered at the university on three separate occasions. The College of Arts & Sciences offered faculty an opportunity to develop web-supplements through a Faculty Development Grant that included about $7,500 of funding. This included a one-course stipend, a laptop computer, a digital camera and scanner.

This Beethoven web-supplement was developed partly as an on-line companion to Maynard Solomon's book on Beethoven, the required text for the course. Each student purchased this text, and was expected to take on-line quizzes – one quiz per chapter (now often called "pre-assessment tests") – that required the student to read material for class discussions prior to attending class. At that time, through Web Course in a Box, all quizzes were automatically graded.

This website consists of:

- Pre- and post- surveys for evaluation and assessment
- Syllabus
- Lecture schedule
- Description of in-class lectures, including class business, topics to be covered, due dates for readings and assignments, and a glossary of important terms.
- Online readiness assessment quizzes
- An asynchronous discussion forum
- An online gradebook

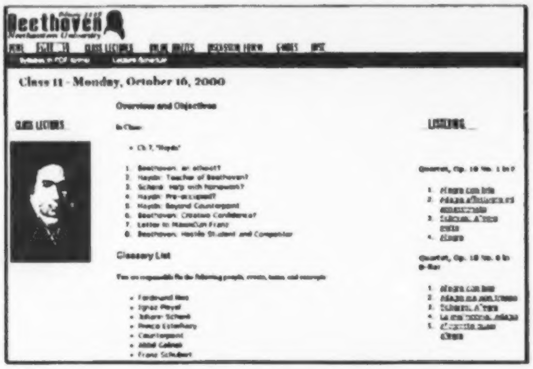
- Maps
- Required listening in both streaming and mp3 formats
- An index of Beethoven's music compositions



Beethoven

Welcome to Northeastern University's On-line Classroom on Beethoven

www.beethoven.neu.edu home



Beethoven

Class 11 - Monday, October 16, 2000

Overview and Objectives

Glossary List

Example lecture schedule

Outcome

This Beethoven web-supplement was featured in the "Learning" section of the Boston Globe in July 2001. This article, titled "The ELearning Road" chronicled how universities need to be aware of the "disruptive technology" of the Internet and the web in order keep their student "clientele".

Clearly, students felt a personal pressure to be prepared for class. Because their chapter quizzes, after they were automatically graded, also included a time-stamp that was e-mailed to me, I was able to monitor who was prepared for class, and who was not. I found that my class lectures were more interesting, in-depth and had participation from a larger portion of the student body (there are sixty students in each of the Beethoven classes offered with this web-supplement).

Survey data showed that over 80% of our average Northeastern students owned a computer with Internet access, and that some students actually upgraded their personal home computer systems during the course in order to take advantage of the web-based services. In particular, students were very please to be able to have access to all of the musical examples required for listening at their disposal 24/7 – instead of having to be held to the media library hours. In addition, I was able to customize an exact listening list that I felt important for each student (often these musical examples do not appear on a single CD purchase). Web-based streaming audio allows for the easy organization of supplementary musical examples, which saves time and money for both the student and faculty.

Relevance

www.beethoven.neu.edu is a case study that has be used for all university faculty, staff, and administration, for the impact of e-learning technologies on education. The success of this web-supplement has led the way for additional grant opportunities at Northeastern University up to $25,000, and has stimulated the development of hybrid-courses which consist of courses offered half "on-line" and half "in-class". In addition, Northeastern University has now examined a variety of possibilities of offering complete courses and degree programs online.

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There Is Still Hope for ICT in Flanders Fields.
ICT in Education: the Use, Benefits, Barriers and Expectations as Perceived by Educators at Flemish Universities.

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Abstract: In this paper we present the main research findings of a large scale investigation about the state of the art in ICT use for educational purposes in Belgium, and specifically the current situation in Flemish universities. The main focus is on user characteristics and the attitudes of educators. Questions asked include: How do educators use ICT in their teaching practices? How do they perceive the support given by faculties within the famework of overall university policy? Which problems and barriers do they encounter? By means of an online survey we collected opinions in order to unravel which factors play a role in the decision to adopt ICT. This investigation reveals how ICT is used in a non innovative way in Flemish universities.

Theoretical Background

Educators play a crucial role in the adoption and implementation of new technologies in universities. New means of transmitting knowledge are only used if they offer clear advantages with respect to the old familiar teaching methods and enhance flexibility, efficiency and effectiveness (Collis et al., 1999), means to cope with information sources (Veen et al., 1999), ways to develop individual learning paths (Gehl, 1996), better student-educator communication (Twigg, 1995) and responsiveness (Hatfield, 1997). Previous research indicates that teachers reveal a variety of attitudes towards the introduction of ICT:

Attitude	Short description
Neutralitarian	Usually users of ICT as a tool
Booster	Unconditional believers and pioneers
Oppositional	Technophobe, fearing encroaching on human values
Sceptic	Those waiting for clear results before engaging
Transformationalist	Those considering changes as necessary but studying ICT carefully before its implementation

Table 1: Categories of educators' attitudes (Source: Evans, 2000)

The fear of the unknown, the tendency to consider the existing situation as a good one, a feeling of solitude caused by a lack of support and knowledge, and a reluctance towards self reflection can influence these intermixed attitudes (Hagner, 2000). Collis et al. (1999) developed the 4E model to predict the chance an educator will adopt ICT, based on the following concepts: (1) environment, (2) (perceived) educational effectiveness, (3) ease of use and (4) (personal) engagement.

Evidently, institutional policy plays also an important role in the motivation of the educator. The university approach can be either top-down or bottom-up and based on different points of view (Collis et al., 1999). We quote (1) proactive (driven by image building and market share), (2) reactive (driven by response to demand), (3) transformative (student centred) and (4) speculative (driven by hope in improvement efficiency and/or effectiveness) professional contexts.

The barriers opposing the introduction of ICT in higher education were thoroughly investigated in The Netherlands. According to Veen et al. (1999) the most relevant ones, in order of importance, are: a lack of time, skills, adequate infrastructure, support and rewards.

Research objectives and methodology

Besides general computer use and training, the following themes were studied at six Flemish universities: the perception of university and faculty policy, educators' types of ICT use and attitudes towards ICT implementation, including perceived advantages and benefits. A self-administered questionnaire was delivered via a database driven website to all teachers in the humanities faculties (N= 2244). They belonged to the departments of arts, law, economy, applied economy, business, political and social sciences, communication, psychology, educational sciences and theology.

Results

Profile of the respondents

442 candidates completely filled in the questionnaire (approximately 20% response). Two thirds of the respondents are teaching assistants, one third lecturers. 61% of the respondents are male, 39% female. It is noteworthy that the male/female proportion is about fifty-fifty up to the age of forty. The age distribution is as follows: 20-30 51%, 30-40 21%, 40-50 15%, older than 50 13%. Female respondents are almost absent in the highest age category.

ICT skills and training

A very small fraction of the respondents is not able to handle computers, operation systems and gneral applications like word processing. Similarly, e-mail, digital information systems and internet applications are unknown to only a very small group (respectively 4.3%, 3.2% and 5%). The overwhelming success of the internet is not induced by educational puposes but used for research. CD Rom use is not frequent (as expected), except in situations where it is imposed by research. The consultation of electronic teaching media (databases, courseware, communication facilities, etc.) is not common. Merely 8.9% of the teachers use them daily, while 76% almost never or seldom get in touch with these media.

	Internet resources	CD Rom	Electronic teaching material
almost never	0.9%	28.0%	41.9%
from time to time	7.2%	44.9%	34.2%
weekly	20.6%	18.2%	14.7%
daily	71.3%	8.9%	8.9%

Table 2: Use of internet resources, CD-ROM and electronic teaching material

These ICT skills are mainly acquired via personal study and practical experience. Mainly younger educators had specific computer training at school or university. On encountering problems they tend to rely on colleagues.

Influence of university and faculty

Both the general use of computers and e-mail is heavily stimulated by the university or faculty (73,5% and 76%). On the other hand, educators do not report receiving much support when experimenting with ICT for educational goals. Significant differences between universities exist.

	General computer use	Use of e-mail	Use of ICT for educational goals
no	4.1%	1.4%	26.4%
some	9.3%	8.6%	35.4%
yes	73.5%	76.0%	36.6%
imposed	13.1%	14.0%	1.6%

Table 3: Stimulation by the university or faculty

ICT policy

Although all Flemish universities have official ICT policy plans and coordinators, only a part of the educators are well informed about these initiatives. Clearly, a lack of communication lies behind this.

Does the university or faculty have an ICT policy plan?		Is there an ICT coordinator or manager?	
yes	33.8%	yes	60.2%
no	5.4%	no	4.8%
don't know	60.8%	don't know	35.0%

Table 4: Policy plan and ICT coordinators

Educational use of ICT

One third of the educators use ICT for educational purposes. Table 5 shows the present use and objectives:

Use		Objectives	
not used	32.4%	eliminate shortcomings	11.0%
as an help tool	33.7%	extend exercises	29.7%
in the learning process	8.3%	substitution for exercises	10.7%
tool and learning process	23.1%	extend seminars	22.4%
don't know	2.5%	substitution for seminars	6.6%
		extend courses	26.2%
		substitution for courses	8.3%
		other	13.4%

Table 5: Present use and objectives

The left half of table 5 must be interpreted with caution because it appears that many respondents are not aware of the distinction between the use of ICT as an help tool and its capacity as a learning support.

Motivation

When considering the motivations teachers rate as important and very important for adopting ICT in teaching environments, they mainly want to increase the effectivity of their education. Secondly, they intend to promote autonomous study, enhance flexibility and create new educational contexts by means of ICT. Thirdly, they are motivated by enhancing the students' motivation and stimulating contacts between student and educator.

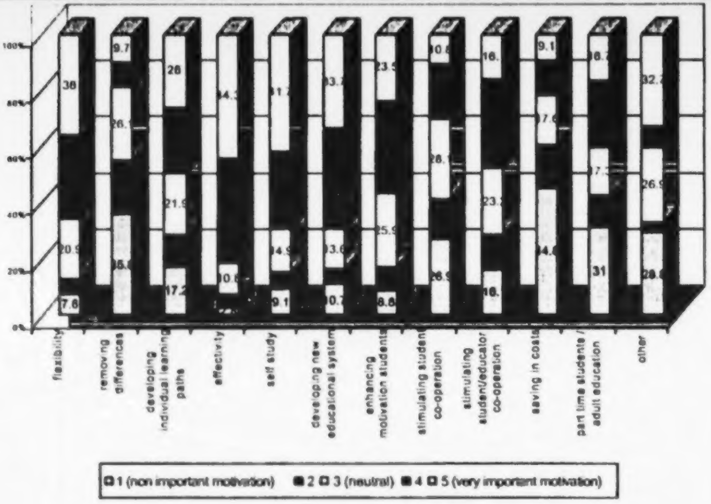

Figure 1: Motivation for ICT use

Desired use in the future

Substituting traditional classes is very unpopular. A clear majority of the respondents do not want to replace lectures, seminars and exercises by ICT supported activitities. They are more likely to use ICT to extend these teaching activities. As far as testing and remedying deficiencies are concerned it can be noted that about half the educators are not willing to apply ICT.

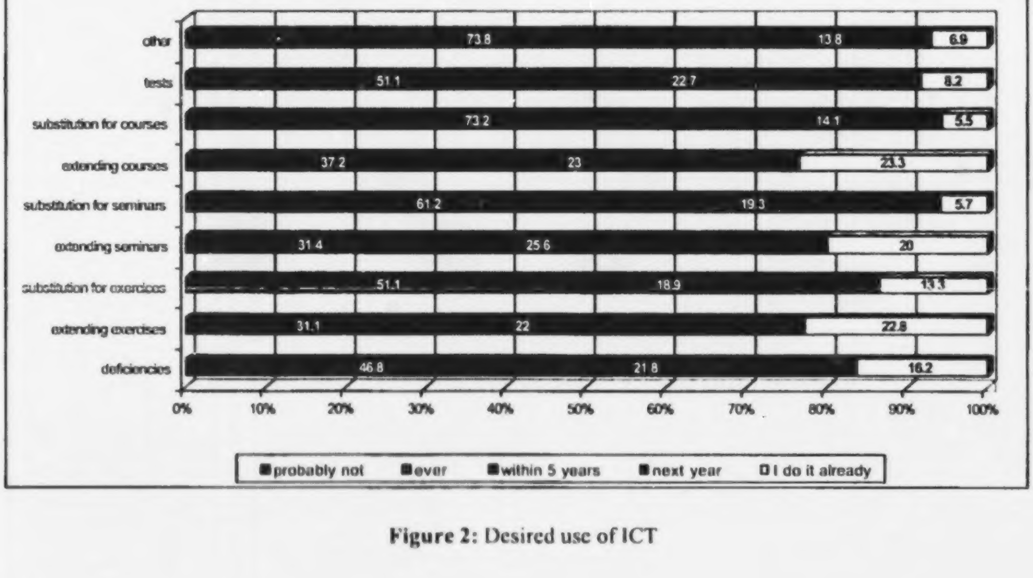

Figure 2: Desired use of ICT

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Barriers

When asked to point out the barriers for adopting ICT in teaching environments, the educators reported the following problems (in order of importance):

1. lack of time;
2. fear of loosing personal contacts with students (wich surprisingly appears not te be age related)
3. lack of skills, manpower support and adequate infrastructure;
4. problems caused by technical items and software;
5. lack of interest of students;
6. high costs;
7. introduction of ICT felt as a bad educational evolution
8. lack of university policy.

Only items (2), (5) and (7) refer to pedagogical aspects of computer supported education, the other are related to personal and materialistic factors.

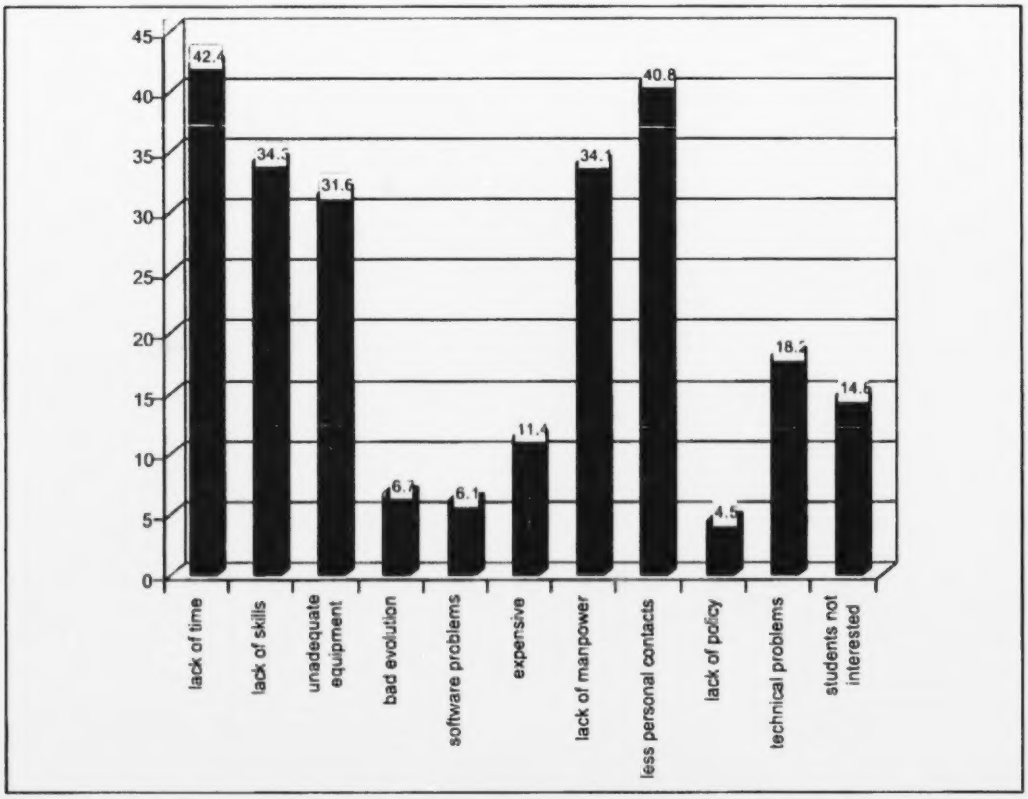

Figure 3: Perceived disadvantages of ICT (barriers)

Conclusions

This study shows that ICT is used in a rather non-innovative way in Flemish universities. The advantages of different technologies are well understood as far as communication, information gathering and distribution are concerned. But a vast majority of the educators surveyed do not grasp the rich possibilities ICT can offer in supporting or improving their teaching practices. Moreover, the teachers investigated perceive many practical and technical barriers for a succesful integration of ICT in educational settings. Universities should play a more important role in offering relevant information and stimulating educators, not only in a passive but in an active way. Possible "solutions" include: awareness raising, appropriate training and support - both technical and pedagogical – and new, strong policies with a long-term vision on educational renewal rather than a policy based on ad hoc decisions and actions.

There is still hope for Flanders Fields. Small groups of innovators are disseminating their knowledge and positive experiences to their colleagues and helping to influence university policymakers.

References

Collis, B.A. & Van der Wende, M. (eds.) (1999). *The Use of Information and Communication Technology in Higher Education. An International Orientation on Trends and Issues.* Cheps, Enschede. At URL: http://education2.edte.utwente.nl/ICTho.nsf.

Collis, B.A., Peters, O. & Pals, N. (1999). A Model for Predicting The Educational Use of Information and Communication Technologies. *Instructional Science*, 18 May 1999.

Evans, T. & Nation, D. (eds.) (2000). *Changing University Teaching. Reflections on Creating Educational Technologies.* London: Kogan Page.

Gehl, J. (1996). The Curriculum Has Run Its Course. *Educom Review*, 31 (6). At URL: www.educause.edu/pub/er/review/reviewArticles/31604.html.

Hagner, P.R. (2000). Faculty Engagement and Support in The New Learning Environment. *Educause Review*, sept/oct 2000, 27-37.

Hatfield, T.H. (1997). The Internet: Legitimate Educational Tool or Giant Electronic Sandbox? *Journal of Environmental Health*, 59 (8), 19-21.

Twigg, C.A. (1995). A Chicken-Egg Dilemma. *Educom Review*, 30 (3). At URL: http://www.educause.edu/pub/er/reviewArticles/30350.html.

Van Geloven, M. (ed.) (1999). *(On)Mogelijkheden en knelpunten van ICT in het Hoger Onderwijs. Een literatuuronderzoek.* At URL: http://www.ivlos.uu.nl/icth00906.doc.

Veen, W., Van Tartwijk, J., Van Geloven, M. et al. (1999). *Flexibel en open Hoger Onderwijs met ICT. Een inventarisatie van ICT gebruik; meningen en verwachtingen.* At URL: http://www.ivlos.uu.nl/ictadv.htm.

Integrating Technology Into Brain-Based Lesson Plans

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Abstract: Recent brain-based research has generated renewed interest in pedagogical practices of the classroom. This development has drawn attention to lesson plan development since the development of lesson plans guides the learning process of students. To address the "whole-brain" in the instructional process, technology application should be incorporated in lesson plan design since it can effectively activate attributes of both the left and right hemispheres of the brain. This paper will provide a brief review of brain-based research and link it to pedagogical practices in the classroom through the design and implementation of technology-integrated lesson plans to optimize learning. Following this discussion, the authors will discuss how the University of Houston-Clear Lake (UHCL) Preparing Tomorrow's Teachers to Use Technology (PT3) Project integrates technology-integrated lesson plans based on brain research into the UHCL teacher preparation program to provide quality learning.

Introduction

Brain-based theory indicates that learning is a process of active construction of meaningful ideas by the learner in an enriched environment (Lowery, 1998; Wolfe & Brandt, 1998). Dake (1977) asserts that traditional pedagogical avenues address functions in the left hemisphere of the brain (e.g., verbal reasoning, logic, analysis) and not the attributes of the right hemisphere (e.g., intuition and simultaneity). Lowery (1998) concurs, identifying teaching methods such as lecture, demonstration and textbook narrative as only minimally impacting the many avenues to the brain and learning. Teachers should use multiple methods of instruction to stimulate both brain hemispheres to optimize student learning. Technology applications have this capability. In an interview by Tell (2000), Healy warns that educators are dangerously close to limiting the use of technology on low-level content when research indicates that technology can drastically impact teaching and learning, especially in the development of higher-order thinking skills. An effective lesson design, which can incorporate technology usage, helps students to explore ideas, acquire and synthesize information, and frame and solve problems (Seamon, 1999).

Brain Based Research And Its Implications On Classroom Practice

Brain-based research on teaching and learning impacts not only teachers' delivery of instruction, but also the students' acquisition of knowledge and skills. Researchers (Caine & Caine, 1998; Wolfe & Brandt, 1998) caution educators not to use brain research as a template of prescriptive teaching strategies, but to use the general findings as guide to direct teaching and learning practices. Brain research provides educators with a framework for developing optimal situations for meaningful learning. This framework identifies general concepts about quality teaching and learning activities and situations to ensure student learning. Chief among the concepts is the notion of having an "enriched" environment. Enriched environments required learners to engage in a variety of inquiries within powerful content contexts, thereby increasing the probability that students will construct meaningful knowledge and thinking capabilities (Lowery, 1998). The environment in which a brain operates determines to a large degree the functioning ability of that brain (Wolfe & Brandt, 1998). Because the brain strives to "make meaning" from its surroundings, a classroom with many stimuli gives students several opportunities for comprehension of knowledge and skills at higher levels of understanding.

The notion that the brain changes physiologically through the learning process is supported by Wolfe and Brandt (1998), who argue that educators must develop an understanding of the brain and its processes to support meaningful teaching and learning, while disregarding the fads and ambiguous programs. To do this, educators need to stimulate different parts of the brain (Perry, 2000). Neural systems when exposed to only one form of stimuli fatigue quickly and need to rest. For example, after only a few minutes of lecture, the brain seeks other stimuli. When constructing knowledge, the brain requires data that can only be obtained through sensory perceptions. Show-and-tell teaching methods, such as lectures and textbook narratives, activate only a few of the many possible avenues to the brain (Lowery, 1998). The proper use of technology affords educators the opportunities to prescribe learning experiences in which students can experience multiple cultures, research planets in solar system, and converse with students on another continent, in a non-threatening way. The use of technology provides teachers with the ability to find and provide connections between new content and a variety of contexts, thereby giving meaning to material and concepts to be learned, since the brain does not effectively absorb meaningless data (Wolfe & Brandt, 1998).

Several studies (Carr & Harris, 2001; Haigh, 1981; Wolfe, 1998) indicate that quality lesson planning has a beneficial impact on the teaching and learning in the classroom. A lesson plan provides a sequential structure describing what and how specific information will be learned (Cruickshank, Bainer, & Metcalf, 1995). Educators should construct lesson plans that incorporate technology applications that can stimulate different parts of the learner's brain. Perry (2000) argues that optimal learning in a classroom occurs when teachers are able to activate the student's entire brain.

UHCL PT3 Project

The central focus of the UHCL PT3 Project, funded by the U.S. Department of Education, is to create an educational process in preparing teacher candidates to develop and deliver technology-integrated lesson plans so classroom students (Pre-Kindergarten to 12th grade) use technology in demonstrating mastery of lesson plan objectives. In its training methodology, the UHCL PT3 Project addresses brain-based researchers' recommendations of activating both brain hemispheres by using a two-pronged approach. First, the teacher candidates experience left and right brain stimulations through the training module activities. Teacher candidates work left-brained attributes in "pointing and clicking" the various links on the UHCL PT3 Website (http://pt3.cl.uh.edu); but engage in right brain development when evaluating lesson plans posted on the PT3 Website. The second 'prong' of the approach is helping teacher candidates identify software applications that can stimulate left and right brain attributes of classroom students. For example, software applications such as Inspiration and Kid Pix can encourage higher level thinking processes such as brainstorming, concept mapping, and webbing; but can also be used for math and spelling drill activities. After developing the technology-integrated lesson plans, teacher candidates deliver these lesson plans in their respective grade level classrooms during their internship assignments. These classroom instructions allow teacher candidates to experience first-hand the educational implications of brain based research, affecting the classroom students' learning as well as their own.

References

Caine, R. N., & Caine, G. (1998). How to think about the brain. *School Administrator, 55*(1) 12-16.

Carr, J. F., & Harris, D. E. (2001). *Succeeding with standards: Linking curriculum, assessment, and action planning*. Alexandria, VA: Association for Supervision and Curriculum Development.

Cruickshank, D. R., Bainer, D. L., & Metcalf, K. K. (1995). *The act of teaching*. New York: McGraw-Hill, Inc.

Dake, D. M. (1977). An education strategy for the right hemisphere of the brain. (ERIC Document Reproduction Service No. ED 154432)

Haigh, N. (1981). *Research on teacher thinking*. Paper presented at the National Conference of the New Zealand Association for Research in Education (3rd, New Zealand, December 4-6, 1981 (ERIC Document Reproduction Service No. ED 213657).

Hunter, M. (1991). Hunter lesson design helps achieve the goals of science instruction. *Educational Leadership, 48*(4), 79-81.

Lowery, L. (1998). How new science curriculums reflect brain research. *Educational Leadership*, *58*(3), 26-30.

Pappas, C. C., Kiefer, B. Z., & Levstik, L. S. (1990). *An integrated language perspective in the elementary school: Theory into action*. White Plains, NY: Longman.

Perry, B. (2000). How the brain learns best. *Instructor, 110*(4), 34-35.

Seamon, M. P. (1999). *Connecting learning & technology for effective lesson plan design*. Paper presented at the Association for Supervision and Curriculum Development Conference (54th, San Francisco, CA, March 6-8, 1999). (ERIC Document Reproduction Service No. ED 432982)

Tell, C. (2000). The I-generation–From toddlers to teenagers. A conversation with Jane M. Healy. *Educational Leadership, 58*(2), 8-13.

Wolfe, P. (1998, November). Revisiting effective teaching. *Educational Leadership, 56*(3), 61-64.

Wolfe, P., & Brandt, R. (1998). What do we know from brain research? *Educational Leadership, 58*(3), 8-13.

HDSL An e-education Hypertext Document Structuring Language

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Abstract

The development of a set of educational web pages is a complex task, because it involves multiple abilities: to be a good content author, a graphist, an ergonomist, following the advice of the webmaster. Moreover, this task has to be redone every time an author (or the academic site in which his pages are included) change the graphical or the navigational appearance. Last, you cannot use the advanced mechanisms of HTML (which can help in managing styles and content), since they are not fully supported by most frequently used web browsers. Our goal is to propose a language to be used by professors, helping them to structure the content of their hypertext pedagogical documents, and to free them from all the other aspects. The definition of a set of web pages is done by describing both a structural model (using our HDSL language), and a graphical model (using completely normal HTML). Using this pair of models, our HDSL engine will build automatically the XSL conversion sheets able to convert any of the documents built using the structural model into (for example) web pages using the most currently accepted HTML. HDSL also offers capabilities of inheritance between structural models, which allows a professor responsible of a whole pedagogical web site to define a look and feel for it, and derive it according to the needs of the various authors writing the hypertext supports of their courses. Moreover, the HDSL engine is able to accept presentation models in specific languages other than HTML, such as PDF, WML,...starting from the content of a single document.

Context

Developing a coherent set of web pages to produce a pedagogical document is a complex task, since the pages can usually be described using multiple approaches. One can, for example, organize them by dividing the main subject into sections (introduction, chapters, bibliography, index,...), or classifying them by kind of information (pictures, sounds, icons,...), by author. This list is not limited, and you have often to use many of these classification criteria simultaneously. This leads you to handle a great number of heavily interdependent documents, like a real software project manager. But the content of web pages has a much more dynamic structure than the source files of a software project: to be pertinent, the content of a pedagogical document has to be frequently updated.

Moreover, one has also to give a coherent look and feel to this complex set of documents. This aspect is of great importance in a pedagogical context, since it allows students not to be bothered by presentation or navigational considerations. Unfortunately, one has also to do with content authors who can either be HTML fluent, and these will take a lot of time to elaborate their own look and feel, or on the contrary they may be completely focused on the content of their document, and they will deliver them in various formats.

Another problem is the ability to describe the page content semantics for search tools, either your own, or commercial ones. The keywords HTML offers with its meta tags are also too simplistic, since they lack the ability to describe the context in which they are used, and are attached to the whole document, when we need a fine grain semantic description. A powerful and semantically-based search tool is a fundamental mechanism for helping students to browse your document, and find the definition or explanation they are looking for.

The cost of managing a huge set of HTML documents could be greatly reduced by the use of advanced tools available in HTML 4 (Ragget 1999). For example, CSS styles sheets can be used to insure a homogenous look, navigation toolbar and menus located in frames to standardize the interface presented to the internet reader. Unfortunately, most of these advanced tools are not universally supported by web browsers, or by other medium specific presentation languages (PDF, WML, restricted HTML).

The HDSL Project

Almost all these problems can be solved by using our Hypertext Document Structuring Language, HDSL, based on XML (Bray, 2000), that allows to describe the structure of families of hypertext documents, independently of their presentation and the medium on which they are displayed. That language allows also to add semantics to the items of the document, either on their content, or on their usage (navigation toolbar, menu,…). Separation of contents and presentation in HDSL give the ability to describe the look and feel of the pedagogical document which is different from mixing them with contents, as done with HTML.

To achieve this goal, we propose a mechanism based on pairs of documents. For every subset of the pedagogical document (course, chapter, section,…), which has its own look and feel, the content author will supply a model using HDSL, which describes its different parts (required or optional, describing the contents or the relations with other documents,…). According to this structural model, the graphist will supply a presentation model, which organizes the look and usage of theses parts. This presentation model can use various presentation languages, standard HTML, reduced HTML (for text-only browsers, low-bandwidth clients,…), WML, PDF, or others, according to the medium used to display the document. Our HDSL engine will take all these models, and generates automatically as many XSL stylesheets as needed to produce «displayable» forms of the concrete HDSL document written by content authors, for every needed medium. It allows to use a unique version of the document that defines the content, which is of a great importance to insure the coherence of the various displayable forms.

The solutions XML currently offers, such as pure XSL sheets (Clark 1999), has multiple drawbacks: you have to fully master XSL, to write a XSL sheet for every presentation medium, for every subset of your pedagogical document. Moreover, this XSL writing task must be redone every time you change the look and feel. And this way of producing web pages doesn't allow re-utilization or genericity which our tool includes, nor any possibility for handling interrelations between documents. It doesn't provide either any may to manage the versioning of the document the HDSL engine supports, and which is of great help in managing the production of many contents author.

Related Work

The WebML language (www.oasis-open.org/cover/webML.html) is a notation for specifying complex Web sites at the conceptual level. It allows the description of navigation and composition abstractions, which are assembled into pages and interconnected by links. WebML is devoted to the construction of web sites based on very dynamic information fetched from multiple databases, and linked by complex relationship, described using E/R model, ODMG object-oriented model in a structural model. The presentation model defines the appearance of pages, independently of the output devices and the rendition language, like HDSL, except for the data described in the structural model. The application domain of WebML is rather e-commerce oriented sites than educational or academic ones.

The Percussion's products (Rhythmyx Content Manager) (www.percussion.com) is a commercial set of tools, devoted to the management of web pages by the content authors, without asking them to mastering HTML, or even site rules and structures. It allows the same information to be presented in multiples pages, as HDLS does, and clearly allows the separation between content and presentation. But it is a relatively cumbersome tool, more dedicated to commercial sites than educational or academics ones. HDSL, on the contrary, is a rather straightforward tool, which pushes the versatility of XML in domains such as the expression of the content semantics. Percussion also develops a XML to HTML tool, Xsplit, but which presents only some of the capabilities of HDSL.

References

Bray T., Paoli J., Sperberg-McQueen C.M, Maler E.
XML: Extensible Markup Language
http://www.w3.org/TR/WD-xml-lang 2000

Clark J.
XSL Transformations (XSLT)
http://www.w3.org/TR/xslt 1999

Ragget D., Le Hors A., Jacobs I.
HTML 4.0.1 Specification1999
http://www.w3.org/TR/html4

Design Guidelines for Digital Learning Material for Food Chemistry Education

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Abstract

This paper describes the first stage of a four year research project on the design, development and use of web based digital learning material for food chemistry education. The paper discusses design guidelines, based on principles that were selected from theories on learning and instruction, and illustrates in detail how these guidelines were used for the design and implementation of digital learning objects (LO).

Six cases, a set of presentational LO and a dozen interactive exercises have been designed, developed, implemented, and imported in different learning environments. The design guidelines proved to be useful during the design process. The digital learning material has been evaluated positively by students and lecturers. The material forms now a set of inspiring examples for food chemistry in higher education.

Introduction

The Food and Biotechnology (FBT) programme is a research programme on design of digital learning material. The programme was initiated at Wageningen University in September 2000 and currently counts 5 large projects. The digital learning objects (LO) that are developed within the FBT programme should meet the following requirements. First, the quality of the learning material must be considered highly satisfactory by experts in the respective fields as well as by students. Second, it must be possible to manage the LO with the mainstream Learning (Content) Management Systems (LMS). Third, the LO must be useful in a wide range of different instructional settings in higher education. Finally, the development costs for one credit point (one weeks study) material should be within the 60.000 $ (US).

Within the FBT programme a four year research project on the design, development and use of web based digital learning material for food chemistry education is carried out. Food chemistry is a disciplinary science, which masters and generates knowledge and insight mainly related to a) components of food, b) (bio)chemical reactions occurring in food, c) effect of treatments on (bio)chemical reactions and d) quality characteristics of food. The challenge of the project is to select and experience with design guidelines, taken from different disciplines in order to design effective LO for food chemistry education.

Theories on learning and instruction offer important clues to design effective learning material, including digital learning material. In particular there are good textbooks on course design and instructional design (Posner 1997, Smith 1993, Merriënboer 1997). Furthermore, there is much research on effectiveness of computer assisted learning. This research is mostly conducted in a laboratory context where a number of practical constraints can be ignored. On the other hand, much literature describes the use of digital learning material in practice. Nevertheless, practical detailed guidelines for the design of LO within realistic budgetary limits, which also satisfy technical and organisational constraints, are missing. In fact, there is a strong need for paradigm examples for specific scientific disciplines such as food chemistry.

The work presented in this paper describes the design guidelines for digital learning material for the introductory course Food Chemistry, which is a 4 credit point course for second year food technology students at Wageningen University. Material has been developed to support two, for this course, important learning objectives: acquisition, construction and retention of (declarative) food chemistry knowledge and a quantitative understanding of the relative importance of the chemical reactions occurring during food processing and storage.

The next section presents which pedagogical principles were selected. Section 3 describes how a set of digital LO have been designed and developed according to guidelines based in the selected principles. Section 4 gives the evaluation of the use of the LO by students and lecturers.

Selected Design Principles

From theories on learning and instruction, five principles were selected as the basis for every LO. This selection was based on three selection criteria. First, the selected principles are relatively insensitive to changes of educational or instructional concepts. Second, the need to reduce cognitive load was especially considered relevant for food chemistry, where the amount of detail is initially overwhelming for many students. Finally, the selection focuses on the strong points of digital material as compared with lecture notes. The principles are not completely mutually independent. The principles are:

a. Aim at optimisation of cognitive load

Cognitive load is the demand placed upon a person's cognitive abilities when performing a task. Effective training should reduce the cognitive load, since learning is typically constrained by limited processing capacity (Merriënboer 1997). Ignoring this principle will reduce the students' confidence. Digital learning material provides more possibilities to reduce cognitive load than lecture notes.

b. Aim at motivation of students

Motivated students learn better, faster, and more and also remember better (Schmidt 1998). According to the ARCS model (Keller 1988) instruction should capture the **A**ttention of the student, should be perceived as **R**elevant by the student, and should induce **C**onfidence and **S**atisfaction, to motivate students. From this principle many guidelines for the design of learning material can be derived. Digital material provides new options for motivation (Malone 1987).

c. Present information Just In Time (JIT)

Providing information just prior to application is a form of Just-in-Time Education (JiTEd)(Hudspeth 1992). An advantage of JiTEd based learning material is that the cost of learning is directly turned into benefit. JIT-information is also an instrument to prevent cognitive load as well as to motivate students.

It is important to be aware that students who work with digital material *expect* JIT presentation, since they *know* that JIT presentation is one of the strong points of digital material.

d. Visualise whenever possible:

There is much evidence suggesting that retention of knowledge will be enhanced when images accompany words (Denis 1994). Additionally, images will often increase quick understanding and reduce cognitive load (Anderson 1995, Larkin 1987). Lecture notes seldom take advantage of presentational formalisms other than printed text and formulas. Visualisation in digital material is ultimately cheaper than in lecture notes.

e. Activate whenever possible:

Students should be activated to elaborate on recently acquired declarative knowledge. Evidence is found that practice or elaboration on a subject strengthens the retention and the retrieval of the subject (Anderson 1995) as well as understanding. Better retention reduces cognitive load in later stages (Merriënboer 1997). Clearly information and communication technology offers much more possibilities to activate students than lecture notes.

Applying Design Principles within Food Chemistry Education

Digital material is designed according to several criteria, for instance the intended learning objectives and the requirements of the FBT programme, which are all considered as important to design successful digital learning material. The above mentioned design principles are translated into design guidelines that match with the other criteria. The design guidelines are therefore different for different kinds of digital learning material.

Presentational Learning Objects and Interactive Exercises

Presentational learning objects (presentational LO) and interactive exercises have been designed to support the acquisition, construction and retention of (declarative) food chemistry knowledge.

A typical example of presentational LO or interactive exercises is shown in the figures 1 and 2, which display two parts of one interactive exercise (see Demo Site). In this exercise students first have to look at the molecule of anthocyanin (a natural colorant). By moving the mouse pointer over a specific part of this molecule an explanation of a specific property pops up. Figure 1 shows the situation where the mouse pointer points at a place that is known to make a complex with a multiple charged metal ion. When students have read the information they can go to the exercise. This part, which is shown in figure 2, is based on the game mah-jong. The student has to click two pieces that belong together and press the OK-button. If the two belong together the pieces disappear. The goal of the game is to get rid off all pieces. The information linked to the molecule in the first part is related to the words on the pieces in the mah-jong game.

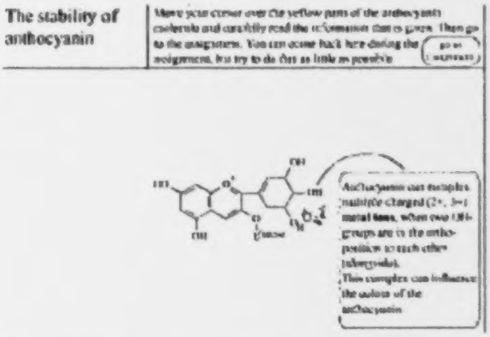

Figure 1: Information about properties that influence the stability of anthocyanin.

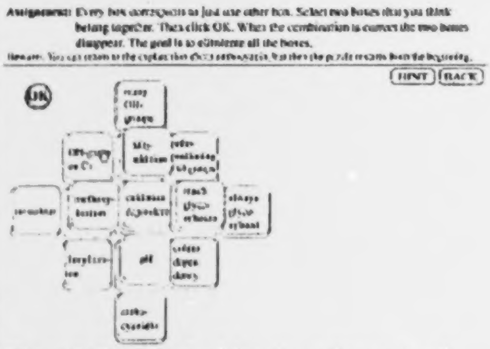

Figure 2: Exercise to elaborate on the previously acquired information.

The most important detailed design choices to design presentational LO and interactive questions, based on the guidelines listed in part 2, are listed in table 1.

Principles	Design guidelines
Minimisation of cognitive load	The LO and exercises should - Be small: it takes at most 30 minutes to go through the presented information. - Be independent: presented information is perfectly understandable on its own - Support acquisition or elaboration of one distinct knowledge structure - Use powerful key-symbols
Motivation of students	- Realise a large variation in the type of the LO - Incorporate games
JIT presentation	- Provide links to presentational LO in the interactive exercises - Present information which has to be used in actions in the same LO
Visualisation	- Consist of high impact visual components
Activation	- Induce active behaviour of the student

Table 1: Design guidelines specific for the design of presentational LO and interactive exercises

To minimise cognitive load the presentational LO and interactive exercises are small, complete and powerful. The LO are small since they are designed to take at most 30 minutes. In the case of the anthocyanin example, the whole exercise will approximately take 15 minutes. Second, the LO are independent and support the construction or the elaboration of a complete and distinct piece of knowledge. For instance, the example deals

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only with those properties of anthocyanin which are important for the stability of the molecule. The third way to minimise cognitive load is by using powerful key-symbols that explain the situation in a direct way. For instance, different parts in the molecule structure of anthocyanin (Fig. 1), the key-symbols, are highlighted (see Demo Site). Every student will understand that the information linked to a part belongs to that specific part of the molecule. This is essential to explain something without using words. The advantage of the natural relationship between (part of) an image and the meaning of that image is used in all LO and exercises.

To motivate the students, the range of different types of LO and exercises is large (see Demo Site). Different exercises are for example: a) choose the right option between two options, b) choose between several options, c) match propositions d) complete chemical reaction pathways by dragging molecules to the right place in the reaction, e) choose between different areas in a graph with different reaction rates, and f) complete the construction of a molecule by dragging the right component to each molecule. Examples of different presentational LO are: a) movies explaining or showing reactions, b) molecules that give information when clicking on it, and c) small, easy exercises providing additional information.

Another important tool to motivate students is by incorporating games (Malone 1987). The exercise in figure 1 and 2 is a typical example of a game. Several exercises have a game-like appearance.

JIT-presentation of information is mainly provided in two ways. First, the interactive exercises have links to corresponding presentational LO. In this way, students can easily look up information to answer a question or learn more about the subject. Second, like in the anthocyanin example, necessary information is presented within the LO.

Visualisation is an important part of the presentational LO and interactive exercises. Within these LO colour is used in a functional way, especially to highlight important elements. The visual LO vary from static pictures — for example a molecule or a photograph of a fruit — to animations and screen recordings — for example an animation of a chemical reaction in detail —. The use of text is minimised. Again the anthocyanin exercise is a good example.

The presentational LO and interactive exercises induce active behaviour. Both figures 1 and 2 show how students can be activated. In the first part of the exercise (Fig. 1) the student will only learn something about the molecule if (s)he points the mouse pointer at the molecule. The student is forced to pay attention to what (s)he sees and reads. In the second part of the exercise (Fig. 2) the student is activated to play a game and probably this activates the student to go back to the first part to study those parts (s)he didn't remember. In all presentational LO and exercises students are forced to do something: mouse-over actions, click the mouse, move objects, fill in numbers, answer short questions, play a game, etc.

Digital Cases

Digital cases have been designed to promote the transfer of knowledge of mathematics, reaction kinetics and reaction equilibrium, which students already acquired in previous courses, in order to be able to translate practical problems within Food Chemistry to arithmetical equations and to solve them. The intended learning outcome is a quantitative understanding of relative importance of reactions occurring during food processing and storage.

The digital cases are divided in a presenting and an activating part. The presenting part contains all necessary information about e.g. reaction kinetics and information about working with Excel. This information is structured in one place, which is denoted a library. The activating part exists of six different cases. Every case applies a certain concepts in the field of Food Chemistry, for example the hydrolyses of saccharose (sugar) in a fruit drink. On average, each case contains 10 guiding questions. The first questions (2 to 3) are introducing the subject, asking about basic knowledge necessary to understand the topic of the case. The following questions are mainly about making calculations or graphs, and they require for instance to fill in a (calculated) number or an interpretation of the calculation/graph. Calculations are assisted by the information in the library and by feedback and hints. The most important design guidelines for the digital cases, based on the principles in section 2, are listed in table 2.

The activating part within each case is built around a practical situation. For example, the student plays the role of a researcher who has the task to solve a problem in a company. The calculations on chemical reactions, kinetics, etc. are leading to a solution of the problem or a clarification of the situation, which shows the usefulness of the calculations.

Principles	**Design Guidelines**
Minimisation of Cognitive load	- Provide only necessary information - Minimise search for information
Motivation of students	- The student plays a role during the case - Show the usefulness of calculations - Give the student a feeling of independence
JIT presentation	- Provide hints/feedback/introductory questions - Provide movies on how to work with Excel

Table 2: Design guidelines specific for the design of the digital cases

The introductory questions have the objective to activate (make available) prior knowledge. The availability of much relevant prior knowledge improves the learning capacity (Schmidt 1998).

To minimise cognitive load, only necessary information that students need to calculate on reaction, like formulas, is provided in the library. Because students have to use some advanced tools of Excel, the library also contains information in the form of audio visual screen recordings. The students can put the information from the library immediately into practice, which is a form of JIT-presentation.

Cognitive load is also reduced by minimising the search for information, which is needed to solve a question within a case. Therefore, questions contain hyperlinks that point to specific information in the library. Also background information about food chemistry, for example, why a product turns brown during heating, is provided when needed. Especially the introductory questions refer to background information. Both the links and the background information are a form of JIT-presentation.

The information, the links to the information and the hints are applied in such a way that a student should be able to finish a case without the help of a teacher. The hints help students to work towards the solution. Students can ask for a hint themselves, but after submitting an incorrect answer a hint is given automatically. Also, after submitting an answer feedback on the answer is given. This will probably give the student the feeling that (s)he is able to solve the case by him or herself, which strengthens the student's self-confidence and satisfaction.

Evaluation of the Design Principles within Food Chemistry Education

The students used and judged the digital learning material during the time of the course. Table 3 gives some results from questionnaires students had to fill in after using the digital learning material. The results are categorised according to the principle they represent. Not all principles were evaluated, since some guidelines do not need to be judged by the students; these guidelines were just used by the designer.

It seems that the success of the digital cases is due to the JIT-presentation of information like hints, links to the theory, and feedback. Because of this information students seem to learn faster, to be more self-confident and to be more motivated to solve the questions.

The results of the questionnaires for presentational LO and exercises strengthen the belief that it is very well possible to provide knowledge by mainly using visuals accompanied by a minimum of textual parts, especially for explaining reactions or explaining intricate events in food chemistry. For food chemistry, visualisation of different aspects is a strong tool to help students understand and remember the sometimes intricate information.

For the designer, the guidelines, which are described according to theories on learning and instruction, supported the design of digital learning material based on theories rather than based on common sense. The guidelines keep the designer on the road during the project. Every piece of material that was designed and developed was judged to be parallel with the guidelines and principles. Although it is not easy to test if the principles are correctly implemented there has been no indication of the opposite.

The pedagogical principles seem to be translated successfully in guidelines that were used to design digital learning material. By this, a set guidelines based on general accepted principles are described that are useable in different educational settings within food chemistry and related settings.

Principle	**Presentational LO and exercises**
Cognitive load	- None of the objects give too much information at once - Time to finish each exercise ranged from 1 minute to 9 minutes (stdev = 60%) - The interactive exercises are clear: 95%
Motivation	- Exercises are useful: 86% - Students learned what was supposed: 86% - Students enjoyed the exercises: 86%
Visualisation	- Screen lay-out was judged positive - Objects that use more text than general are evaluated less positive by some students
Activation	- Activating parts, like clicking through an explanation of a chemical reaction or mouse-over effects, are judged useful
Principle	**Digital cases**
Cognitive load	- There is enough information provided: 100% - The links are useful: 100%
Motivation	- The difficulty of the cases was judged as good: 91% - Questions show the usefulness of the calculations: 91% - Questions give more insight in how to use the theory: 100% - Playing a role is motivational: 91% - Playing a role is useful: 100%
JIT presentation	- Introductory questions help to understand the cases: 100% - Movies about Excel are useful: 76% - Theory is useful: 95% - Hints are useful: 90% - Feedback was sufficient to carry out the cases: 86%

Table 3: Results from students' questionnaires.

Final Remarks

During the academic years 1999/2000 and 2000/2001 the digital LO were evaluated. Both students and lecturers judged the digital LO positive. The digital LO will now be used as an inspiration for faculty staff. Because of the independent character of the LO they can be imported in a range of different LMS such as Blackboard and Hyperwave ELS. The proof of the principle that it is possible to design and develop a rich body of LO for food chemistry, which satisfy the design criteria described in the introduction, is close at hand. Further research will be directed to articulation of design criteria for digital LO in food chemistry based on a match between intended learning outcomes of food chemistry courses and the possibilities and limitations of state of the art digital LO. This should be a first step towards a methodology of digital learning object design for food chemistry and to a handbook of best practices.

References

Anderson, J. R. (1995). *Learning and memory. An integrated approach.*, John Wiley & Sons, Inc.

Denis, M. (1994). *Image and cognition.* Paris, Presses Universitaires de France.

Hudspeth, D. R. (1992). Just-in-Time Education. *Educational technology.* 32 (6): 7-11.

Keller, J. M., Suzuki, K. (1988). Use of the ARCS motivation model in courseware design. *Instructional designs for microcomputer courseware*, D. H. Jonassen. Hillsdale, NJ, Lawrence Erlbaum.

Larkin, J., Simon, H.A. (1987). Why a Diagram is (Sometimes) Worth 10,000 Words. *Cognitive Science.* 11: 65-100.

Malone, T. W., Lepper, M.R. (1987). Making learning fun: a taxonomy of intrinsic motivations for learning. *Aptitude, learning, and instruction: conative and affective process analysis.* R. E. Snow, Farr, M.J. Hillsdale, Erlbaum: 223-253.

Merriënboer, J. J. G. v. (1997). *Training complex cognitive skills.* Englewood Cliffs, New Jersey, Educational Technology Publications.

Posner G.J., Rudnitsky A.N. (1997). *Course Design.* Fifth Edition. Longman Publishers USA New York

Schmidt, H. G. Moust, J.H.C. (1998). *Probleemgestuurd onderwijs. Praktijk en theorie.* Groningen, Wolters-Noordhoff.

Smith P.L.,Ragan T.J. (1993). *Instructional Design* MacMillan Publishing Company New York

Demo site: http://www.fbt.eitn.wau.nl/foodchemistry This site contains only a limited subset of all LO.

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MEDICAL EDUCATION: A MULTIMEDIA ENHANCED BLACKBOARD COURSE

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Abstract: The University of Nebraska Medical Center is a leader among the US Medical Schools with graduates who choose Primary Care Medicine. The ability to accurately diagnose an ear disease is an important skill of a Primary Care graduate. Prior to graduation all medical student receive didactic lectures covering ear disease. Upon inquiry the Department of Otolaryngology found that 30% of the students graduate with clinical "hands-on" experience of diagnosing ear disease. A Blackboard course was created to give the students an opportunity to experience diagnosing ear disease by offering a patient-based course with supporting visuals. The course creation, successes and failures will be discussed. A course demonstration will occur during the presentation. The instructional design and the demonstrated ability to create a course that is multimedia rich without a heavy commitment to programming with html are points of interest.

The University of Nebraska Medical Center, College of Medicine is a leader among the U.S. medical schools with graduates who choose to Primary Care medicine. A Primary Care physician should have the principal skills of ability to recognize, diagnose and treat common illnesses including acute, chronic, or emergent conditions in patients of all ages. The ability to accurately diagnose an ear disease is an important ability of a Primary Care graduate. Prior to graduation all medial students receive didactic lectures covering ear disease. Upon inquiry the Department of Otolaryngology – Head and Neck Surgery found that 30% of the students graduate with clinical "hands-in" experience of diagnosing ear disease.

A multimedia rich Blackboard course, based on patient-based model was created to give the students an opportunity to experience diagnosing ear disease. The course is also intended for third year medical students whom are engaged in the clinical experience and are in need of elaboration or just-in-time training.

The initiative was funded by the Department of Otolaryngology. A student worker managed the content research, multimedia capturing, and creation of the course. The student worker was employed for forty hours a week for three months. The department also purchased the necessary equipment to capture the supporting course multimedia (videos and still images).

Prior to the course creation and gathering of the multimedia a context analysis was completed. The first component of the analysis placed the online course within the third year of the College of Medicine curriculum. The curriculum for the first two years of medical school is predetermined for the medica student. The third year of the curriculum consists of six required clinical clerkships (Internal Medicine, Family Practice, Surgery, Pediatrics, OB/GYN, and Psychiatry). The fourth year of the curriculum consists of a required basic science elective and eight electives. Within the third or fourth year, with the input of an advisor, the student is required to select a primary area of interest. Upon the selection the students is required to choose five of eight electives from their primary area of interest (out of the 8 electives). These primary area electives have been determined to be appropriate for students entering that field. The remaining three electives can be chosen from any other primary interest area.

During the third year of the curriculum, traditionally only 30% of the medical students have selected Otolaryngology – Head and Neck Surgery during the Surgery clinical experience. During the second and third year of medical school a student attends a minimal number of hours of didactic instruction covering Otolaryngology – Head and Neck Surgery. This analysis was very helpful prior to researching and writing the content, acting as a barometer to set the level of content. The audience analysis highlighted the importance of closely simulating the traditional clinical experience.

Prior to being the course creation process, some instructional design aspects were identified. In effort to mimic the clinical setting a patient-based model was selected for the construct of the course. The course includes video of the ear examination, supporting still images, test results and the patient's history. The video examination is an essential piece of the instruction that exhibits the technique of using the examination instrument, orientation within the human anatomy, and the ability to show specific character tics to aid the process of ear disease diagnosis. The students will be instructed to participate in the course via the campus network or a high-speed Internet connection. An alternative option of writing the multimedia to CD-ROM and distributing the CD-ROM to off campus (non-networked/modem based) students is being assessed

Once these instructional design aspects where identified the faculty member began the research of content and capturing supportive multimedia as each the ear diseases were diagnosed and treated in the clinic. The faculty member obtained consent forms from patients, outlining the rights to summarize the patient's case and to capture necessary multimedia (digital images, video of examination, and test results).

Each level is supported with the multimedia, patient history and examination and the student is instructed to complete within a 15 to 20 minute interval. During the course creation process some message design issues addressed.

The overall structure of the course consists of eight levels of severity of the ear disease diagnosis based on physical findings. The students can work through the entire course or to jump to the desired content, offering the just-in-time training. Simple buttons and hyperlinks were constructed in Blackboard to create these two options. During the creation process, the message design was modified numerous times. The final design includes patient history, examination, still images, and a video ear examination.

Other elements of interest are prescriptive instructions, the importance of limiting the students' expectations, and the ability to create an online multimedia rich course without a heavy commitment to programming with .html (the language of the internet).

Following Faraday's steps at high school, using microcomputer based labs.

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Abstract

The new information technologies can create a more productive educational environment for physics teaching. In this paper we describe the use of microcomputer based labs (MBL) for the studying of electromagnetic induction. In MBL labs, the students —by participat ing in hands-on experiments— have the opportunity to measure, directly and simultaneously, the physical quantities that are involved in the induction phenomenon. The computer, equipped with an interface and sensors, serves as a measurement device. From the evaluation of the learning outcomes we can deduce that there is a major contribution to students' understanding of the physical concepts and laws.

Introduction

Today, more than any other period in the past, and due to the exponential growth of technological progress, people are greatly influenced by the development of scientific knowledge and the advancement of information and communication technologies[1]. The relationship between science-technology and education is far more complicated today than any other time in history[2]. Nowadays, there is a close relation between science and technology, where both fields share a constant feedback process. The expansion of scientific knowledge leads to new technological applications, while technology provides scientists with tools, techniques and devices that allow expansion of their capabilities and effectiveness, thus leading to a further development of science. Yet, as technology gets more and more complicated, there is no sharp boundary between science and technology since the area of their overlapping gets constantly wider[3].

Traditionally, the teaching of science and technology in schools focused mainly on providing the knowledge of theories and facts or the obtainment of technical skills. This mechanistic approach of teaching does not represent neither an effective nor an appropriate strategy towards science-literate and technology-literate pupils. So, there is a growing necessity to develop a new educational environment that will allow students to collect, visualize, analyze and model the experimental data so that they will be able —through their active involvement and participation— to understand the laws of physics and the present relationship between science and technology [4,5]. A new suggestion that will facilitae the obtainment of the proposed objectives is the use of microcomputer-based laboratories (MBL – labs) in education. In a MB-lab students do real experiments not simulated ones, using sensors connected to a computer via an interface.

Subject /Problem

The phenomenon of the electromagnetic induction holds a significant and central rank not only concerning its connection with the development of classical physics, but also with the technological utilization of a major physical discovery that led to the production of electric energy —a process that had a radical impact in modern civilization. Furthermore, it gives us the opportunity to understand the function of devices that transform mechanical energy into electric energy and vice versa, like electric generators, motors or transformers.

The traditional instructional approach to the phenomenon of electromagnetic induction is substantially limited in the repetition of the experiments conducted independently by Michael Faraday and Joseph Henry in the middle of the 19th century[6] —a practice which is followed by the sudden and inexplicably appearance of the Faraday's law of induction, that relates the induced emf with the rate of the magnetic flux change. But, naturally, the vast minority of children cannot follow Faraday's exemplary line of reasoning that led to the statement of the law of induction. So, they just memorize the law with no functional understanding of it and without having the opportunity to apply it at real-world situations or problems[7].

A laboratory approach, based on the new information technologies, could contribute to the improvement of the educational outcomes concerning the principles of electromagnetic induction and Faraday's law.

More specifically, the use of sensors for collecting voltage and magnetic field measurements and the real-time display of this data in graphs presented at the computer screen, permits:

- The direct measurement of the strength of the magnetic field —something especially difficult to be done with the use of traditional devices—, but without which, one cannot experimentally discover and verify Faraday's law.
- The comparison between the change of the strength of the magnetic field and the induced voltage.
- The focus of students' interest in the development of the phenomenon.
- The detection of students' preconceptions and the use of socratic dialogues between teacher and students throughout the experimental procedure.

Design and procedure

By utilizing the new information technologies we designed and applied an instructional intervention for the phenomenon of electromagnetic induction at the laboratory by connecting sensors through interface with the computer. The procedure involved the historical induction experiments of Faraday and Henry. Three high schools in Athens were selected to be school units of application, so that the sample would represent the average Greek high school student. 75 high school students of the 12th grade from 3 different school classes (of vocational-technical education), participated in our research. The students had already been recently taught about the induction phenomenon, through the traditional instructional method.

Two experimental activities were conducted. In the first one, we used a coil and a magnet that was moving relative to the coil, while in the second we used two coils wrapped around a soft iron core. With the use of a voltage and a magnetic field sensor— we obtained a real-time collection of the corresponding data and a graphical display of their change with time at the computer screen.

The first learning outcome was that students realized than an induced voltage in the coil occurs only during the movement of the magnet and that the polarity of the voltage depends on the direction of the magnet's movement, whereas, with the magnet inverted, the changes of the induced voltage with time vary accordingly. From all the above, students came to the conclusion that polarity is determined by the absolute value of the magnetic field change. Next, the students started wondering about the factors that determine the magnitude of the induced voltage V_{in} and concluded that V_{in} does not depend simply from the change of the strength of the magnetic field, but from its *rate* of change. By using printed-out diagrams, each student would calculate the slope of the curve that shows the voltage versus time; in other words, they would calculate the rate $\frac{dB}{dt}$ at the peak of the voltage waveform. Next, students determined the ratio $\frac{V_{in}}{\frac{dB}{dt}}$ and realized that this ratio remains constant or that the induced voltage is proportional to the rate of change of the magnetic field strength, i.e. with the rate of change of the magnetic flux. Finally, the fact that the induced voltage is proportional to the rate at which the magnetic field changes (i.e. to the rate of change of the magnetic flux), was

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also verified by the students through the software which allows the simultaneous screen display of how $\frac{dB}{dt}$ and V_{in} vary with time —a display that gives students the opportunity of a direct comparison between the two.

In the second experimental procedure we used three sensors at the same time. The first sensor was measuring the strength of the current, the second the strength of the magnetic field, and the third was taking measurements of the induced voltage in the second coil. The learning outcome was that the student understood (or realized) that an induced voltage is produced in the second coil when the strength of the electric current varies with time and that the voltage magnitude is proportional to the rate of change of the current in the first coil.

Results

Before the instruction, students were given a pre-test that consisted of several close-typed multiple-choice questions and they were asked to fill-in some sections of a diagram. Two weeks later, after the instruction, students were given a post-test, that consisted of similar style questions with that of the pre-test, but of higher difficulty level.

The results are shown on Table I. They show three basic elements of the electromagnetic induction phenomenon, namely the reasons for the production of emf, the polarity of the induced voltage, and Faraday's law. The table illustrates the percentage of successful students' answers concerning their conceptual understanding of these subjects.

Table I

	Pre-test	Post-test	Gain
Causes of electromagnetic induction	92	95	3
Polarity of the induced voltage	20	42	22
Faraday's law	20	51	31

Results of pre- and post-testing of students' conceptual understanding of electromagnetic induction

As we can see from the obtained results, the reasons for the production of emf are well-understood by the students even through the traditional instruction. But, with the use of MB-labs there is a substantial improvement on the results concerning the polarity of the induced voltage and the connection of its magnitude with the rate of change of the magnetic flux. Gain is observed mostly on those features that are illustrated more thoroughly through the graphical transformation of the data into time-varying diagrams (for example, the slope of the curve represents the rate of change of the corresponding physical quantity).

Furthermore, student course evaluation and comments by students show the MBL – labs have been very well received.

Discussion

In spite of the extensive implementation of MBL – programs in the teaching of Mechanics, the relevant literature about their application in the study of electromagnetic phenomena is very limited and it is characterized only by the indirect verification of Faraday's law of induction[8]. From the results of our research it is evident that MBL - labs, serves as an effective tool for the development of a good conceptual understanding of the electromagnetic induction. Our research supports the view that the utilization of MBL-labs assists students' ability to describe, understand and predict the development of physical phenomena. Similar conclusions have been reached from the implementation of MBL - labs for the teaching of other content areas in junior and high school students[5,9].

Our research team aims at the expansion of MBL - labs utilization into other phenomena included in the junior and high school science curricula. A wider and more general application of the microcomputer-based laboratories in various content areas and school grades, may be the key factor for the necessary reform that aims in boosting students' interest and improving the effectiveness of science teaching.

References

1. UNESCO (1999). The science agenda-framework for action.
2. Newton, D.P.(1988). *Making science education relevant.* London: Kogan Page Ltd.
3. American Association for the Advancement of Science (1990). *Science for all Americans.* NY: Oxford University Press.
4. Thorton R.K. *Using the results of research in Science education to improve science learning.* 1th International Conference on Research in Science education. Cyprus, January 1999.
5. P.Dimitriadis, L.Papatsimpa et al. *The study of Newtonian Mechanics in junior high school. A new technology – based learning environment* 12th Annual World Conference on Educational Multimedia, Hypermedia an Telecommunications. Montreal, Canada; June 26 – July 1, 2000.
6. Nickin R.F. "Faraday's law – Qualitative Experiments", Amer. Journal of Physics 54 (5) 1986
7. Arons B.A., *A guide to introductory physics teaching,* John Wiley and Sons, Inc. 1990
8. Trumper R., Gelbman M., *Investigating electromagnetic induction through a microcomputer-based laboratory*, Phys. Educ. 35, No 2, pp 90-95, March 2000.
9. P.Dimitriadis, L.Papatsimpa, G. Kalkanis, *Study of thermal phenomena in Junior high school. A new technology-based learning environment.* 13th Annual World Conference on Educational Multimedia, Hypermedia an Telecommunications. Tampere, Finland; June 25-30,2001.

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DESIGNING A MASTER OF SCIENCE ONLINE DEGREE PROGRAM

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Abstract: *This session will include critical information for administrators and faculty in higher education to develop and implement an on-line master's degree program in Technology/Human Resource Development. Students enrolling in the MS degree program can pursue the Master of Science in Technology/Human Resource Development degree or students can add Trade and Industrial Teacher certification to their degree plan or they may elect to complete only the T&I Teacher Certification portion of the program without pursuing the Master of Science degree. The degree program is offered through The University of Texas TeleCampus which provides a virtual university setting complete with library resources, student support, and tutorial help for participating students.*

Today's information technology and instructional telecommunications enable the U. T. System to extend its collective educational reach to students in Texas and beyond through the UT TeleCampus, an Internet-based central support unit for distance education. The UT TeleCampus was launched in May 1998 as a central support system for the online educational initiatives of the 15 component campuses and research facilities that comprise the U. T. System (UT TeleCampus).Extensive support services are provided by TeleCampus staff in the way of instructional design and course development, as well as faculty training in bringing courses from the lecture-based classroom to the Web-based classroom. Technological support, policy, marketing research and external communications are among the other essential support services provided to the campus from the UT TeleCampus (UT TeleCampus).

The goal of the TeleCampus in placing programs online was the creation of collaborative degrees, utilizing the best resources in faculty expertise from all campuses (UT TeleCampus). This was the model followed in developing the Master of Science Degree in Technology in Human Resource Development (HRD).

Overview

The Department of Technology, in support of the mission of The University, is a student-centered department committed to conducting multi-option programs targeted at preparing technical professionals, and educators. In developing this online degree program, the department is further supporting the mission of the institution that will "establish the university as a leader in the teaching and use of informational technology." Providing a Master of Science degree in Technology in the Human Resource Development (HRD) option in an online format so that it is accessible to all the citizens of Texas and beyond will achieve the mission of The University of Texas at Tyler and the Department of Technology. In the proposed third year of the phase-in program, additional courses will be developed to enhance the HRD option and complete the State Board of Educator Certification (SBEC) Trade and Industrial (T & I) certification to help address the critical shortage of teachers in this discipline.

Human Resource Development is a professional field of practice that focuses on education and training of adults in diverse settings. It is organized learning activities arranged within an organization in order to improve performance and/or personal growth for the purpose of improving the job, the individual, and/or the organization. HRD includes the areas of training and development, career development, organization development, adult literacy, and distance education.

The online Master of Science degree in Technology with the Human Resource Development option will utilize the resources of The University of Texas at Tyler, The University of Texas at Galveston (UTG), The University of Texas at Permian Basin (UTPB), The University of Texas at Arlington (UTA), and the UT TeleCampus. The Department of Technology will assume responsibility for developing six courses in the major of the degree option and will utilize existing component online TeleCampus courses to round out the degree requirements in the major and support areas. The degree offers access to higher education attainment by professionals in the field by flexible scheduling and asynchronous delivery. In the proposed optional 3^d year of the program, UTT will develop the three additional courses needed to complete the T& I certification program for Texas teachers in the trade and industrial discipline, and the courses will be utilized to strengthen the HRD degree option.

Benefits

1. A major benefit of this online degree is the meeting of the increased demand in business and industry for personnel trained and educated in the human resource area. By providing the access necessary for adult learners, the demand for a highly skilled workforce can be met.
2. Another benefit of the degree is to meet the unique needs of the adult learner, the nontraditional student, and the geographically bound student. The elimination of time, space, and boundaries allows The Department of Technology to meet its mission and the mission of the institution.
3. The cooperative nature of the degree program allows each component institution to leverage its strengths while at the same time minimize the inability to offer every course that is necessary in developing a quality degree option. The increased visibility of each component makes it a win-win for all participants
4. The online degree is now the standard vehicle for attracting and retaining the student population that today has more options for higher education selections than ever before.
5. The online degree will allow The Department of Technology to continue to serve students in remote locations who have been previously served by interactive television courses being phased out of the institution because of cost-cutting measures and increased line charges.
6. The online degree provides three of the six courses needed for trade and industrial teacher certification in public schools, an alternative certification program in a high demand area in the state.
7. In the third year of the grant program, the final three courses needed for trade and industrial certification will be developed helping meet the demand for teachers in this discipline.

Summary of Program

The Master of Science degree in Technology with the Human Resource Development (HRD) non-thesis option is a 36 semester credit hour degree program requiring two three semester credit hour core courses, *Research Techniques* and *History and Philosophy of Technology*, 18 semester hours in the area of concentration of HRD and 12 semester hours of support courses. During the last semester of the program, the candidate must successfully complete a written and/or oral comprehensive examination on the coursework of the degree plan.

The program is administered by The Department of Technology, The University of Texas at Tyler who will serve as the degree granting institution as authorized by the Texas Higher Education Coordinating Board. UTT personnel will develop 6 courses to be used in the major of the degree in a two-year period. Identified support courses will come from the components of UT Galveston, UTPB, UTA, and UTT and other online TeleCampus courses.

Students must meet the admission requirements of UTT graduate school as outlined in the current catalog that can be accessed at www.uttyler.edu.

Students completing the certification courses must meet the requirements of the State Board of Educator Certification for T&I teachers. Current guidelines for this program can be accessed at their web site of http://www.sbec.state.tx.us/certreq/certreq.htm or through the Texas Education Agency web site for Career and Technology at http://www.tea.state.tx.us/Cate/ti/index.html.

References

The University of Texas at Tyler, (2000-2001) Undergraduate /Graduate Catalog
[Online]. Available: http:// www.uttyler.edu
UT Telecampus, The University of Texas System [Online], Available:
http://www.telecampus.uttsystem.edu

Should Instructional Designers Be Project Managers?

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Abstract: Why do so many instructional design projects struggle? Perhaps one reason is that the projects are managed by instructional designers who have little project management experience. Experienced instructional designers frequently perform the role of project managers yet ID graduate programs rarely require project management courses. Even instructional designers who are not officially "project managers" need to manage projects, their own or those with other team members. Often, however, they have no training in project management.

Introduction

If an instructional designer does not have training and experience in project management, both the project and the instructional designer will suffer. Students enrolled in Master's of Business Administration (MBA) graduate programs spend months, perhaps years, studying project management yet instructional designers often have little experience in how to manage a project development schedule to insure that they are on schedule and on budget. Ironically, instructional designers are often offended when a subject matter expert is given the title "instructional designer." They argue that this person's area of expertise is the content, not instructional design. Similarly, an instructional designer is a subject matter expert on learning and the design of instruction. Why would anyone assume that a successful instructional designer will be a successful project manager if that person has no training in project management?

In other words, this is a very important topic for instructional designers as they will probably be required to perform some or many project management responsibilities. The goal of this paper is to reflect on our experiences as instructional designers and project managers and to provide practical suggestions for how to insure that successful instructional designers are also successful project managers.

Expert Opinions

There are three members of this panel plus a chair. Jackie Dobrovolny, Rod Sims, and Tim Spannaus are the panel members. Joe Lamos is the chair.

Jackie Dobrovolny

Jackie began her career in instructional design with no instructional design or project management experience or training. That was 25 years ago. Currently, she has a Ph.D. in instructional design, has taken several project management (MBA) courses and managed numerous projects. In 2001, she conducted an informal study of instructional designers and project managers at the annual conference of the International Society for Performance Improvement. In three separate round table discussions, she asked a total of 38 conference participants to sort 43 index cards, each of which contained a brief description of one knowledge or skill (see Table 1). The 43 cards were divided among participants at each round table and participants then sorted their cards into one of four stacks: instructional designer only, project manager only, both instructional designer and project manager, or neither instructional designer nor project manager. Each person at each of the three round tables received approximately four cards to sort. Once all 43 cards were sorted, the participants at each round table discussed and altered each of the four stacks of cards.

The results (see Table 1) indicated that of the 43 knowledge and skills, the participants at all three round tables labeled 22 of them in the same way. That is, they agreed that six knowledge and skills were unique to IDs, three were unique to project managers, and 13 were the responsibilities of both IDs and project managers.

ID Only Knowledge & Skills	PM Only Knowledge & Skills	Both ID & PM Knowledge & Skills
1. Apply current research and theory to the practice of instructional design	1. Develop and manage budgets	1. Conflict management skills
2. Apply principles of message design to page layout and screen design	2. Hiring, firing, and performance appraisal skills	2. Decision making skills
3. Create visuals that instruct, orient, or motivate.	3. Use project management software	3. Identify and resolve ethical and legal implications of instructional design in the work place
4. Develop effective tests and surveys		4. Knowledge of the political aspects of a project and/or organization
5. Knowledge of various learning theories.		5. Plan and conduct informative and efficient meetings
6. Knowledge of various instructional media, their advantages and disadvantages		6. Plan and conduct interviews
		7. Problem solving skills
		8. Time management skills
		9. Use active listening skills effectively
		10. Use project evaluation strategies
		11. Verbal communication skills
		12. Work with reviewers, e.g., subject matter experts, editors,

		managers to insure their input improves the product within the allocated time and budget
		13. Written communication skills

Table 1: Instructional Designer (ID) and/or Project Manager (PM) Knowledge and Skills

Interestingly, the three groups completely disagreed on two responsibilities. The three round table participants categorized "Manage revisions cycles…." as ID only, PM only, and both ID and PM. They categorized "Team building… as PM only, both ID and PM, and neither ID nor PM. They also disagreed on the following responsibilities: knowledge of effective motivation and/or reward strategies, knowledge of individual differences research and diversity literature, knowledge of various instructional design models and theories, and use of return on investment formulas and strategies to evaluate a project. This data suggest that there is significant disagreement on the responsibilities of a project manager. Instructional designers need to discuss this disagreement and at least clarify the overlap.

Rod Sims

Rod has been an instructional designer for several different organizations and wrote *Authorware With Style*. Recently, he took a position at Deakin University as manager of technology-based instruction. His team develops both e-learning courses and degree programs and his responsibilities include hiring and evaluation, staff training, budgeting, and internal marketing. He rarely exercises his instructional design skills and he finds that he misses that activity. While his management position is challenging and fulfilling, he longs to exercise his creativity designing instruction.

Perhaps it is possible to be effective at and enjoy both project management and instructional design. The creativity that fuels a good instructional designer is, however, neglected in project management and thus, we need to consider the possibility that good (creative) instructional designers should only be promoted to project manager when their creativity needs a rest.

Tim Spannaus

Tim is President of ibstpi (International Board of Standards for Training, Performance and Instruction) and contributing author of *Instructional Design Competencies: The Standards* (ERIC/IT, 2001). The Competency book resulted from a study over several years of the required competencies of instructional designers. By broad agreement among the respondents to the validation study, management skills were rated as highly critical to the success of a designer. Most of the management skills were regarded as advanced skills, in recognition that novice designers were likely to work as members rather than as leaders of teams.

In a separate, not yet published study of training manager competencies, it has been found that managers need to have some instructional design competencies. This finding confirms the idea that in an ideal world, the competencies of training managers and instructional designers overlap.

Tim is Senior Lecturer and Research Fellow at Wayne State University (USA) and Chairman and Chief Learning Architect of The Emdicium Group, Inc.

Joe Lamos

Joe has been in the field of instructional design and development for 32 years. For more than 20 years he has managed instructional design projects and teams of instructional designers and developers. Joe holds a

Ph.D. in Educational and Psychological Studies from the University of Colorado. He is currently Acting Director of the Cooperative Program for Operational Meteorology, Education and Training (COMET), a division of the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado.

Most worthy education or training efforts today require a team to accomplish. If the project is to provide an instructional solution to a performance problem, because that is what is needed, then project leadership should preferably come from someone who can articulate a vision of the learning environment, learning tools or materials that need to be created. This doesn't necessarily need to be someone trained as an instructional designer but it should be if the ID discipline is to continue to be relevant relative to the content disciplines (which traditional perceptions hold as the core need in doing training or education). An important distinction that needs to be made is that between project leadership and project management. For practical reasons these two foci can exist in a single individual but that is not a necessity.

References

Dobrovolny, J.L., and Spence R. (1998). Sam Bell: Training Manager. In P. A. Ertmer & J. Quinn (Eds.), *The ID CaseBook: Case Studies in Instructional Design.* Englewood Cliffs, NJ: Merrill/Prentice Hall.

Dobrovolny, J.L., Gillespie, L., and Spannaus, T.W. (1996) *Managing the Virtual Project.* Presentation at the annual conference of the International Society for Performance Improvement (ISPI), Dallas.

DeWeaver, M. F., & Gillespie, L. C. (1997). *Real-World Project Management.* New York: Quality Resources.

Greer, M. (1992). *ID Project Management.* Englewood Cliffs, NJ: Educational Technology Publications.

Richey, R.C.; Fields, D.F. & Foxon, M. (2001) *Instructional Design Competencies: The Standards* (3rd Ed.) Syracuse, NY: ERIC Clearinghouse on Information and Technology.

Richey, R.C., Foxon, M., & Spannaus, T.W. (In process). *Training Manager Competencies: The Standards* (2d Ed.) Syracuse, NY: ERIC Clearinghouse on Information and Technology.

Advanced Learning Object Hub Application (*ALOHA*)

Introduction

A research and development project directed at e-learning has taken on the design and build of an educational object repository. As part of this undertaking, various tools for indexing, sharing, multipurposing, and repurposing learning objects are also under development. Advanced Learning Object Hub Application (*Aloha)* is one of these. It is a suite of tools used for the discovery, management, customization, and delivery of learning objects. For use by indexers, educators and learners, *Aloha* includes versatile and powerful indexing tools for different metadata standards, inter-repository searching and content and object packaging. These management tools include the ability to customize, or repurpose learning objects by educators and their students. The content packages of educational material are created in a standardized way that will allow them to be multipurposed between the desktop, the web, and CD-ROM using other existing software. Development is ongoing and contributions from other projects are being sought. What follows in an outline of some of *Aloha's* features.

IMS, CanCore, DublinCore Metadata Indexing

The current primary function of *Aloha* is indexing educational objects. It is a Java-based client tool. The decision was based on the power and flexibility Java has demonstrating in interacting with the world wide web (Jones, 1997). Its flexible interface is friendly for amateur users and customizable for the professional indexer. It is easy to create, share and customize indexing templates and forms, It is able to automatically parse and fill in the metadata for over 200 file types. . It makes marking up IMS or other forms of metadata much easier. Administration tools managing workflow issues with multiple indexers including the librarian, the educator, and the media developer are also available. This supports the idea of modularity where different users can index objects in context specific ways and share their metadata with other users and metadata schemas (Duval et al 2002).

Any valid xml schema can be brought into *Aloha* and users can begin to use the *Aloha* interface to help them build productive tools for indexing tasks. Learning Objects and metadata can be uploaded simultaneously with a touch of a button to an appropriate media server, handling the job of a FTP program.

Inter-repository Web Searching

A stand-alone application that serves as a client for the world-wide web, *Aloha* allows multiple resources to be searched. Like Apple's Sherlock, its open architecture allows the addition of search-plugs to leading learning object repositories. It comes equipped with plug-ins for several existing learning object repositories. Using xml-rpc other repositories can be added with ease.

There are currently peer-to-peer options available to the user of ALOHA through the SPLASH peer-to-peer network being established by the POOL (what does this stand for and is there a web link) project. The peer-to-peer network will be like any other repository that you want to search, you need pick it as a search option. *Aloha's* search capabilities are simple to use, easy to expand, and more effective than standard web

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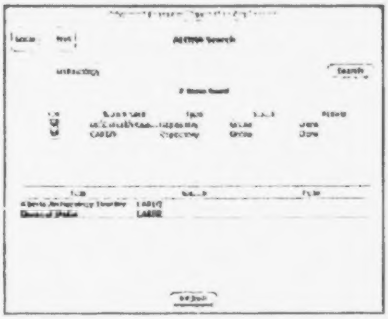
searches as they are based on well-defined standardized, metadata. The current search engines on the Internet are powerful but they are accessing an unmanaged resource which often returns irrelevant material (Pollock & Hockley 1997)



The best centralized learning object repositories will be vetted and restricted in their access, in so far as uploading of learning objects. The ability to set the access level of your uploaded object allows you to create trusted groups that can only view your objects if you give them permission. This will allow personal collections of learning objects to be shared amongst ad hoc communities of educators and learners. Desktop repositories can be batch uploaded to centralized repositories if desired.

Content Management and Multipurposing

Once a user has found a resource, whether it is downloaded or not, or if they have created a learning object themselves, *Aloha's* future features include content management and multipurposing functions. These features are important to enable users to download objects, manage courses, and deliver those objects in a revolutionary way. Aloha will allow users to create SCORM-based *edulists* and courses and organize these for personal use or sharing with educators or students (ADL 2002). Once arranged, *Aloha* will let users share their *edulists*, classes, and courses with students and other educators through the web, email, or uniquely through *Aloha*. The will also be able to publish their course packages with any software that will read these standardized packages. Learning objects can be visualized uniquely, customized to the users needs allowing content re-purposing.

Summary

This paper describes *Aloha* in brief detail. The presentation will demonstrate some of its features. One of the most important principles of *Aloha* is to open its architecture even further to allow a sustainable development environment and promote its usage among educators.

References

ADL
2002 ADL: SCORM Sharable Content Object Reference Model
http://www.adlnet.org/

Duval, E., Hodgins, W., Sutton, S., and Weibel, S.
2002 Metadata Principles and Practicalities. *D-Lib Magazine*, Vol. 8, No. 4
http://www.dlib.org/dlib/april02/weibel/04weibel.html

Jones, P.
1997 Java and Libraries: Digital and Otherwise. *D-Lib Magazine*, March 1997
http://www.dlib.org/dlib/march97/03jones.html

Pollock, A. and Hockley, A.
1997 What's Wrong with Internet Searching. *D-Lib Magazine*, March
http://www.dlib.org/dlib/march97/bt/03pollock.html

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Flowcharts as a Basis for Procedural Training and Task Support

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Abstract

In the work reported here, we have set ourselves the goal of creating cost-effective high-quality automated on-line learning environments for procedural tasks. The result is an initial implementation of a system called the Flowchart Task Tutoring and Tracing Toolkit (FT^4). The procedure language developed for FT^4 is significantly richer than that used in most previous scenario-based procedural Intelligent Tutoring Systems (ITSs). On the other hand, it is less expressive than the plan languages used in previous model-based procedural ITSs. Our aim is to share some of the authorability advantages of scenario-based systems, while achieving much of the generative power of model-based systems. To date, we have designed and implemented the language with an ASCII encoding, built and packaged an interpreter that can interact with external simulations and prototyped a first application, and begun to explore the interaction of the interpreter with a student modeling component.

1. Goals and Definitions

In the work reported here, we have set ourselves the goal of creating cost-effective high-quality automated on-line learning environments for procedural tasks. The result is an initial implementation of a system called the Flowchart Task Tutoring and Tracing Toolkit (FT^4). We start by elaborating on what, exactly, our goal description is intended to mean.

By *procedural tasks*, we mean any process to be carried out (or supervised) by a person, where that process calls for a reasonably well-specified (though by no means rigidly fixed) sequence of operations. Examples might include:

- controlling complex technological systems (e.g. industrial plants, satellite clusters),
- dealing with narrow social or business interactions (e.g. staffing a help-desk or a check-out line),
- or even mastering the cognitive aspects of complex constellations of physical skills (e.g learning to perform cardiac life support techniques, or machine maintenance activities).

By *high-quality learning environments*, we mean settings that incorporate, and effectively interrelate adaptive instruction, practice, and coaching. In on-line environments, practice is typically provided by interaction with *simulations*. Automated instruction and coaching call for artificial intelligence (AI) components that typically go under the heading of *intelligent tutoring systems* (ITSs).

By *cost-effective*, we mean our goal is to lower the costs of fielding these systems. We believe that, at least for procedural tasks, raw technological capability is no longer the barrier to widespread adoption of effective advanced learning environments. We know how to build interesting and useful systems, but typically it takes too much time, expertise (and therefore money) to build, distribute, and support them. Such systems require a mix of domain, instructional, and computer-science expertise.

Thus, in summary, we are interested in building a particular class of simulation-based intelligent tutoring systems, and doing so in a way that makes these systems more affordable in both the short and long run. We believe this is the best way to make truly engaging and effective instruction available to the widest range of students. In addition, the architecture we propose extends neatly to provide on-line task support in those cases where the procedural task is naturally performed with computer-support.

2. Comparing Procedure-Oriented ITSs

There have been a number of systems developed to support intelligent tutoring on procedural tasks, taking both scenario-based and model-based approaches. Prior to the work described here, we at SHAI had developed a library module called the Task Tutor Toolkit (T^3) (Ong and Noneman, 2000) that emphasized authorability of relatively simple scenarios. Likewise, Guralnik (1996) describes an authoring tool, called MOPed-II, that applies a content theory of task knowledge to enable the tutoring system to generate replies to common procedure-oriented questions. The RIDES system (Munro and Pizzini, 1995) and its successors are probably the best-developed systems extant for authoring graphical procedure-oriented training simulations (frequently, of devices) integrated with the intelligent tutor; it too takes primarily a scenario-based approach. In contrast, we could cite more ambitious and elaborate model-based (and dialog-oriented) systems such as the BE&E tutor (Core, Moore, and Zinn, 2000), or the sequence of systems (i.e. TOTS, STEVE, PAT, and PACO) described by Rickel, et. al, (2000).

These systems vary on several dimensions:

- Type of task environment simulation and/or degree of integration with a particular simulator;
- Complexity of procedures that can be specified/trained;
- Relationship between procedure specifications and "problems" or "scenarios";
- Relationship between procedure specifications and student models;
- Attention to and support for authoring;
- Support for lessons/tasks other than procedure practice.

There are two major stances on the issue of how a procedural ITS package might relate to a simulation environment. Either the simulator is integrated into the ITS package as with RIDES, or the tutoring component is explicitly packaged as a module designed to be interfaced with a variety of external simulators as with T^3 and the TOTS et. al. line of work. The first approach allows for a highly integrated system that can fully support all aspects of ITS development. The second approach makes more sense in domains where simulators are either already extant, or are likely to be more complicated than (or inappropriate for) the simulation and authoring tools in the integrated environment. Our current work on FT^4 follows in the tradition of T^3 in being separate from any particular simulator.

The issue of procedure complexity is currently the strongest point differentiating FT^4 from prior work on procedure-oriented ITSs. Scenario-based ITSs such as RIDES and T^3 adopt something like a simple tree representation for procedures, where internal tree nodes can represent either ordered sequences of children or unordered collections of children, and external leaf nodes represent primitive actions. T^3 adds the capability of generalizing the parameters to primitive actions to ranges or sets rather than fixed values. FT^4 for its part, allows a much more general procedure representation that includes not only ordered and unordered sets of steps, but also (1) named sub-procedures with parameters and local variables to supplement global state; (2) conditional branches, and thus potentially loops; (3) exception conditions; (4) alternative steps; and (5) optional steps. Section 3 presents the full procedure language in detail. While a significant generalization over other scenario-based tutors, FT^4 *procedures* remains less expressive than the *plan* language used in most model-based tutors.

Procedure specifications in scenario-based systems are created as part of defining a particular lesson or problem. Each procedure specification essentially represents a particular scenario a student may be asked to work through. Supported by the more complex procedure language, FT^4 takes the stance that a procedure specification may represent a particular scenario, or a large chunk of the curriculum (from which many different scenarios might be generated). Thus FT^4 aims to bridge the gap between scenario-based and model-based procedural ITSs with a representation of intermediate complexity. The basic idea is that mastery of the full procedure requires demonstrated ability to execute all the right steps at the right time (essentially, to run the student through a set of scenarios that exhaustively cover all the branches and transitions in the procedure).

The current FT^4 prototype does not yet fully implement this approach, but many of the underlying facilities are in place. In particular the system maintains student models that reflect the transition structure of the encoded procedures. The system scores a student on three dimensions: (1) how often they correctly execute an action indicating they followed a valid transition in the procedure graph; (2) how often they fail to execute an action that is required by a forced transition in the procedure graph; (3) how often they incorrectly execute an action that represents an incorrect transition out of a conditional test. This strongly procedure-centered view of student model is significantly different from the learning objectives or principles centered view taken by other systems.

One of the nice features of a simpler procedure language is that it is more easily authorable by subject matter experts who are not computer science experts. Both RIDES and T^3 aim to ease scenario authoring by supporting a *scripting by demonstration* capability (in both cases complemented by a post-editing phase allowing somewhat different degrees of procedure generalization, as described earlier).[1] Currently FT^4 offers no authoring support for its procedures, and this is a recognized gap in its aim to address the problem of ITS cost. However, we have plans to integrate FT^4 both with the enacted sequence recording capabilities of T^3 and with a graphical flowchart editor that enables much more significant generalization of enacted sequences. We note that the design of the FT^4 procedure language was shaped by the expectation that a simple flowchart interface would be created; it relies on a primitive branch and link representation rather than more modern structured programming language constructs.

We note also, that flowcharts have been exploited in instructional and task aiding system in other contexts and for other purposes. For instance, FAST (Thompson, Ockerman, Najjar, & Rogers, 1997) is a wearable electronic performance support system intended to offer factory personnel just-in-time advise. One form of advice available is explicit flowchart representations of tasks to be accomplished presented to workers in response to questions such as "How do I do this?" Slightly further afield, Puerta (1993) describes how flowcharts can be used to support authoring of task-specific support tools. In his examples, physicians design protocol flowcharts, that then serve to help structure system behavior and interfaces.

3. The FT^4 Procedure Flowchart Language

In this section we provide a detailed specification of the FT^4 procedure flowchart language. Each flowchart represents a named procedure. There can be any number of procedures defined for an ITS, and steps in one procedure can invoke other procedures (including themselves recursively, either directly or indirectly).

Each procedure contains a set of steps, linked to one another through "next" pointers. Basic steps have just a single "next" pointer, while test steps can have two (or more) "nexts". Steps (or branches out of test steps) without an explicitly defined "next" are taken to constitute the end of a path. A path may be a route through a whole procedure, or may be the end of one chain in a parallel-step (which will be discussed at greater length below).

In addition, a procedure may specify exception conditions. When an exception condition becomes true, all other steps become unavailable, and control jumps to the step specified by the exception handler. When the chain of steps beginning with this initial step of the exception handler is completed, control can either return to the point where the exception occurred (indicated by a special-purpose return-step), or it can jump to a statically specified point in the flowchart.

Ignoring exception return-steps, procedure start-steps and other such special-purpose step types, there are five main kinds of steps:

- **Primitive-Step:** A primitive-step corresponds to a real-world action. In order to move past such a step, some action must be taken.
- **If-Step:** An if-step is a kind of test-step that is a simple if-then-else two-way branch. If the test expression evaluates to true, then the first path should be taken, otherwise, the second path should be taken. Thus an if-step has two next steps, but only one or the other is ever available.
- **Cond-Step:** A cond-step is a more flexible kind of test-step than the if-step; it resembles the "cond" form of the Lisp or Scheme programming languages in that it can have any number of distinct tests, each of which controls a possible branch. The tests are evaluated in order, and the

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[1] An interesting feature of T^3 is that, contrary to the approach in RIDES, it does *not* require tight integration with its own simulator system to achieve this scenario scripting by demonstration capability.

branch paired with the first test that evaluates to true is considered active. A cond-step has as many next steps as it has tests, but again, only one is ever available.

- **Procedure-Step:** A procedure-step represents an invocation of a nested procedure. When a procedure-step is reached, control jumps to the nested procedure. When that nested procedure completes, control resumes with the procedure-step's designated next step.
- **Parallel-Step:** A parallel step consists of several possible chains of execution, some of which may be specially designated as *optional*. A parallel step specifies a minimum and a maximum number of the main (non-optional) chains that must be completed. A chain is completed by reaching a step in the chain that has no next step. The user may jump back and forth between steps in different chains, and can start new main chains, up to the designated maximum number. Once the minimum number of main chains are completed, and so long as no other chains in the parallel-step are in progress, the parallel-step's own next step may be executed.

Parallel-steps are the most complicated type of step. They were designed to support unordered or parallel actions (i.e. a set of N main chains, with the minimum and maximum chain counts both set to N), alternative actions (i.e. a set of N main chains, with the minimum and maximum both set to 1), and optional actions (i.e. allowance for a set of optional chains). But the minimum/maximum capability also allows for the somewhat odder possibility of unordered subsets of the main chains (i.e. a set of N main chains, with the minimum set to J and the maximum set to K, where $1 <= J <= K <= N$).

The FT^4 procedure flowchart language can be cast in several different forms. Currently, we have defined an ASCII file format (based on Lisp-style S-expressions), and an in-memory Java data structure format (suitable for tracing through procedures and determining, at each point, what are the current allowable set of actions a user might take). As suggested by the title of the system, the language was also designed to have a direct mapping to graphical flowcharts. Such a graphical language has been designed, but not yet implemented. Figure 1 shows a sample procedure for making cappuccino, primarily intended to illustrate the majority of features of the language (and to highlight possible problems as well).

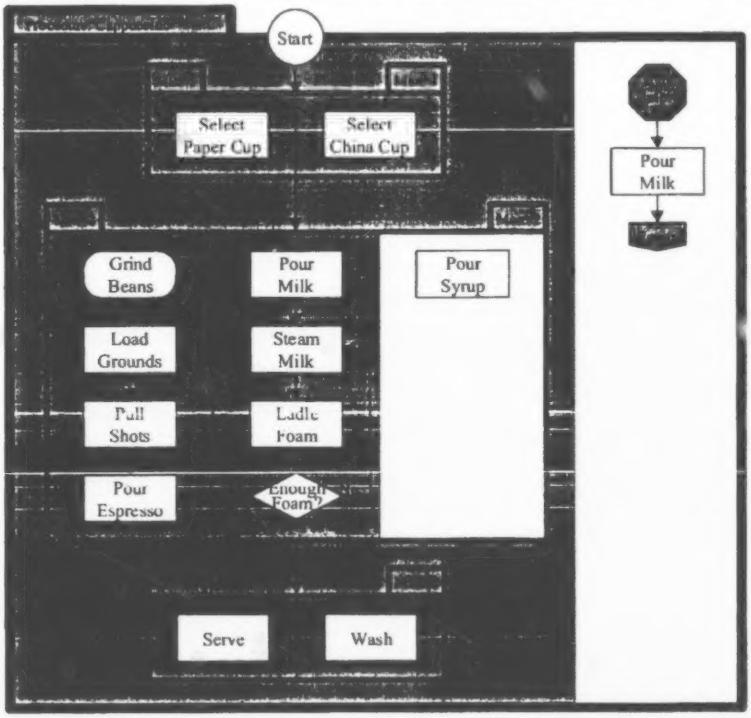

Figure 1. A Flowchart View of the Sample "Cappuccino" Procedure.

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The outermost heavy-lined box in Figure 1 represents the entire "Cappuccino" procedure. It is divided into two parts: (1) the mainstream procedure flow (the larger area with the darker background), and (2) the exception conditions (the smaller area to the right with a lighter background). The main procedure is composed of three major sets of steps, where each set is grouped into a complex parallel-step. The parallel-steps are the boxes with medium-weight lines, and with Min/Max counts shown attached. Again, the parallel-steps are potentially broken up into two parts: (1) the set of main chains (shown with a darker background), and (2) the optional chains (present only in the middle parallel-step, and shown with a lighter background). The thin-lined rectangles represent primitive-steps. The thin-lined rounded rectangle "Grind Beans" represents a procedure-step (the invocation of some other named procedure, whose detailed structure is not shown in this figure). The thin-lined diamond "Enough Foam?" represents an if-step that has the effect of creating a loop.

From the start state of this procedure, the only reachable step is the first parallel-step that packages the two "Select Cup" primitive-steps as the starting (and ending) points of two alternate chains. These are *alternate* chains because the min and max constraints are both set to 1. That means that as soon as one of the "Select Cup" steps is executed, a first chain has been started, and since the maximum number of allowed chains is 1, no other chain can be executed. Whichever "Select Cup" primitive-step is executed also completes the first parallel-step.

From that point, it is legal to start any of the three chains in the second parallel step. The chain consisting solely of "Pour Syrup" is an optional chain, and so its execution does not count towards the min/max counts of the parallel-step. With min and max both set to 2, the two main chains must both be executed to fully satisfy the parallel-step. The two main chains are a bit more complex than those in the first parallel-step. The chain that starts with "Grind Beans" is a straight sequence, except that the "Grind Beans" step is shown as a procedure-step—a reference to another procedure—and therefore could require some arbitrarily complicated set of actions before it is possible to advance to the "Load Grounds" step. In the second chain, we illustrate the use of an if-step, and the creation of a loop; the point here is simply to show that tests of environmental conditions are allowed and can be used to determine what steps ought to be performed next. Finally, as an aside, we note that the chains of this parallel-step adhere to the structural rule that each chain is self-contained: there can be no crossing over from the steps of one chain to those of another.

The third parallel-step is similar to the first, but since its min and max are both 2, it amounts to an unordered "and" rather than an "or"—it is necessary to both serve the cappuccino and wash up to complete the parallel-step, and thereby to complete the entire "Cappuccino" procedure.

The only aspect of the procedure we have not yet discussed is the exception condition set to watch for attempts to steam milk when the pitcher is empty. Structurally, the interesting point is the return-step at the end of the exception-handler; this should cause control to return to "Steam Milk" step (which is the only place the exception could have been noticed). Of course an exception that can occur in only one place might be defined as an explicit test and branch at the point in question. Alternately, this exception might better be defined in the scope of the second parallel-step rather than in the scope of the procedure; however, our current syntax does not allow such distinctions in exception scope.

As noted earlier, this procedure language is less expressive than a plan-oriented language; this leads to procedures that are less flexible than they logically could be. For instance, there is no real reason to force the cup selection to be performed before starting in on preparing the components of the drink. Logically, the cup only needs to be selected before the first pour or ladle step (to ensure there is something to pour our ladle into). On the other hand, in procedural training applications, it is quite common for the "by the book" way to accomplish a task to be defined with limited flexibility (compared to all the possible sequences that might accomplish the goal in question). At least for the applications we have considered, we are not very concerned that the FT^4 procedure language is too restrictive.

4. The SatCon Project

The work reported here was carried out in the context of a project called SatCon (for Satellite Control). The point of this project has been to demonstrate how AI technologies can be applied to build a system for US Air Force satellite controllers that provides both intelligent simulation-based training and job task-support during actual operations. The project ran for six months, resulting in a first prototype that links the current FT^4 with a simulator and a GUI through an agent community. We expect to start development of a more complete operational system in the summer of 2002, as part of a two-year follow-on project. Section 5 on future work lays out some of our goals for the ongoing effort.

Given the dual application requirement, the multiplicity of potentially relevant legacy systems, and the expected overall system complexity, an agent architecture was early identified as particularly appropriate. Given the nature of the satellite control task—complex and somewhat variable, with a wide range of contingencies, and with tremendously valuable resources at stake—operators in current (and projected) practice are largely restricted to acting within the bounds of pre-specified scripts or procedures. Those procedures are far too complex to be expressible in the T^3 task language, thus our invention of the significantly more expressive FT^4 language.

To date, we have (1) designed the FT^4 procedure language (including internal data structures and external representations in both ASCII and graphical form), (2) built a parser to transform ASCII specifications into data structures, and implemented a tracing algorithm that tracks allowable next actions, (3) designed a complementary student modeling formalism, and mechanisms to use such models to drive selection and/or generation of training scenarios, (4) implemented student model creation and update during the procedure tracing process, (5) packaged the existing FT^4 components so as to separate the training and task-support capabilities from any simulation or operational environment, and (6) constructed a first demonstration application by embedding FT^4 in a distributed agent environment.

5. Future Work

Future work will focus on authorability. This will include porting the existing T^3 capability for creating straight-line procedure specifications, and combining it with the interactive flowchart editor. In addition, we will complete implementation of the mechanism for automatically generating individual scenarios based on general procedure specifications combined with student models. With these additions, we expect to fulfill our goal of cost-effective high-quality automated on-line learning environment for procedural tasks.

6. References

Core, M., Moore, J., and Zinn, C. (2000). Supporting constructive learning with a feedback planner. AAAI Fall Symposium on Building Dialogue Systems for Tutorial Applications, Technical Report FS-00-01, November 2000.

Guralnik, D., An Authoring Tool for Procedural-Task Training, PhD Dissertation - Technical Report #71, The Institute for the Learning Sciences at Northwestern University, 1996.

Munro, A. and Q. A. Pizzini (1995), RIDES Reference Manual, Los Angeles: Behavioral Technology Laboratories, University of Southern California.

Ong, J., Noneman, S. (2000). Intelligent Tutoring Systems for Procedural Task Training of Remote Payload Operations at NASA. In Proceedings of the Interservice/Industry Training, Simulation, and Education Conference. Orlando, FL.

Puerta, A.R. (1993). The study of models of intelligent interfaces. Intelligent User Interfaces 1993: 71-78

Rickel, J. Ganeshan, R., Rich, C., Sidner, C., Lesh, N. (2000). Task-Oriented Tutorial Dialogue: Issues and Agents. AAAI Fall Symposium on Building Dialogue Systems for Tutorial Applications, Technical Report FS-00-01, November 2000, pages 52-57.

Thompson, C., Ockerman, J., Najjar, L., Rogers, E., (1997). Factory Automation Support Technology (FAST): A New Paradigm of Continuous Learning and Support Using a Wearable. ISWC: 31-38

Trends for Distance Education: Getting the Big Picture for the Coming Decade [1]

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Abstract: A number of educational and societal trends are analyzed for their potential impact on the practice of distance education. The trends reflect the various ideologies and values currently found within professional communities and publics at large. How the various trends push and pull in different directions, and how they may lead to alternative futures for distance education—These are the subject of the paper.

Distance education has been described as a disruptive technology—an innovation that, while initially posing no threat to established institutions, over time challenges conventional practices and contributes to new ways of thinking (Archer, Garrison, & Anderson, 1999). I agree with this assessment. Distance education has already become more than an alternative form of delivery. It has shaken up the educational establishment, especially at higher education and corporate levels. Precisely because of this success, though, assessing potential at midstream can be a challenge. At times like these, instructional designers and providers can benefit enormously by stepping back, reviewing broad trends, and forecasting likely scenarios based on those trends. That is the purpose of this paper. A number of current trends are outlined and their likely impact on education considered. Then some brief pointers toward the future are presented.

Observers of distance education can point to a number of discernible trends affecting practice over the past several years. Trends do not determine the future, but they can provide a basis for present action and an understanding of possible futures. The trends discussed below are pulling in different directions—some fostering change, others reinforcing the status quo; some using technology in a controlling way, others using technology to empower individuals.

Technologizing of School Systems

School systems, particularly American K12 public schools, are facing pressures to modernize and "technologize" their processes by establishing more predictable outputs and methods (Tyack & Cuban, 1995). Although American public schools are the immediate point of discussion for this section, the principles extend to any schooling or educational system.

Standardized competencies. The standards movement has resulted in a common set of learning outcomes, presented in quasi-behavioral language, but at a fairly high level of generality to accommodate different teaching methods.

System-side assessments and accountability. Standardized assessments are part of an overall move to make schools more accountable to the public or to the government. Test scores are thus indicators of tax dollars and government resources being well-spent.

Incentivization of funding. Increasingly, operational funds are being tied to compliance with specific mandates and regulations. These mandates are made at levels beyond individual schools, intended to bring schools into line with desired teaching and assessment practices.

Regulated processes and methods. With increased emphasis on high-stakes testing, teachers are being asked to fit their teaching methods more closely to the larger system of goals and assessments. Often, methods are established and prescribed by schools, districts, and even states, leaving less room for professional judgment and variations in teaching style.

Alignment of outcomes, assessments, and methods. In a well-coordinated schooling system, an alignment exists between processes and outputs—in particular, between standardized outcomes, assessment measures, and acceptable teaching methods.

De-professionalizing the teacher's role. Tighter alignment of processes and outputs has a definite impact on the teacher's role. As suggested above, the teacher often assumes a "technician's" role of implementing prescribed rules, as opposed to a professional's role of exercising judgment.

Learner- and User-Centered Philosophies

At the same time schools are moving toward efficiency and control, the mood among many educators is definitely learner-centered. The constructivist movement in education stresses individual and collaborative construction of meaning. While many teachers wish they could teach in more learner-centered ways, the system can make it difficult. Teachers and trainers thus face a certain tension between efficiency and control on the one hand, and learner-centered flexibility on the other.

Convenient, anytime/anywhere access. Instead of students going to class, learning is coming to the student—in the workplace or at home. Just-in-time, just-in-place learning resources are increasingly available to learners in their normal living settings.

Constructivism. Constructivist teaching strategies give students complex and engaging projects and tasks to perform, with scaffolding and support from colleagues or a teacher/facilitator. Learning happens via meaningful experiences and direct encounters. Examples include guided inquiry activities such as Webquests, or problem-based learning cases.

Field-based and informal learning. Informal learning happens by virtue of participation in some other valued activity, e.g., work or play. Field-based learning refers to semi-structured activities such as internships, practicum experiences, expeditions and trips, etc.

High-touch connectivity. Many technology innovators maintain a dual focus in their dissemination efforts—providing advanced information tools coupled with high levels of personal support and connectivity among individuals (Naisbitt, 1982; Spitzer, 2001). The commitment to both high-tech and high-touch suggests a need to make tools people-centered rather than the reverse (Norman, 1993).

How does distance education fit within these conflicting forces of standardization versus learner-centered values? Ironically, distance education can be seen to support both movements. A well-conceived distance education program can fit squarely within a strictly controlled standards-based curriculum. At the same time, some aspects of the distance learning experience are completely learner-centered, especially the access and convenience afforded students.

Moves to Streamline and Automate Instructional Design

In this section several trends are outlined that relate to making instructional-design processes more efficient and effective through a process of streamlining or automation of tools and processes.

Standardized taxonomies for learning outcomes and instructional strategies. A basic precept of instructional design is known as the "conditions-of-learning" assumption (Ragan & Smith, 1996). Before producing instruction, you determine what you need to teach, as well as your audience and situation. Then and only then can good instructional strategies be determined. According to this view, rules connecting goals with instructional strategies become essential to the systematic practice of instructional design.

Data-driven generation of rule-based instruction. An automated version of this line of thinking seeks to make instructional development largely a data-driven activity. Automated instructional design is an ambitious concept: Just plug in data concerning learning outcomes, learners, and situation, and the rule system spits out—not only a set of recommended strategies—but draft instructional materials. While research on automating instruction has continued over two decades, the agenda is still in its infancy, and may prove increasingly viable in coming years.

More flexible, adaptable authoring tools. Powerful authoring tools break from linear processes and allow late and iterative changes in design, more in keeping with natural design thinking and envisioning. Examples include 3-D modeling programs that allow for various uses once the model has been created; or authoring tools that allow prototyping and creation of dummy interfaces, to test out concepts at early stages before investing in full-design development.

More modular, re-usable design. The learning-objects movement is about reusing content to make efficiency gains in the instructional development process. Because digital content is "non-rival" in nature (i.e., copies of equal quality can easily be made from originals), reusability for various purposes, media, and occasions become an inviting possibility (Wiley, 2002).

The Digital Shift: Advances in Information Technologies

After their initial emancipating impact, new technologies eventually come to constrain our thinking and actions, especially after heavy investment in their use. Advances in information technologies over the last twenty years are so profound that they are affecting every area of our professional lives. I term this condition the "digital shift" because, as we convert our thinking, knowledge, and communication to digital and informational form, a whole new set of possibilities opens up (Brown, 2000; Brown & Duguid, 1996).

Digitized information is traceable and *archivable*. Exchanges and interactions are more easily captured, at least on a digital level. Digital databases are *searchable* to a degree that we can often retrieve needed resources when solving problems in real time. Because of their non-rival nature, digital resources are *replicable* in that they can be copied and distributed an infinite number of times at zero or extremely low cost. Using webs to *link via hypertext* interconnecting information has become commonplace in the problem-solving practices of information workers. Accompanying digital information is a stronger suite of tools: online communication tools will increasingly allow higher resolution, more modalities, more choice, and more fidelity to everyday encounters. These, along with more powerful representation tools, are leading to virtual worlds that allow for increasingly rich experience and interaction.

Global Marketplace

In recent years, economies worldwide have moved toward greater linkages and interdependencies. This move is called the global economy or the global marketplace (see also Collis & Gommer, 2001a and Collis & Gommer, 2001b for a helpful analysis on this general issue).

Economies of scale. By virtue of the Web and the shift to online learning, markets for learning resources have shifted from local to global. Thus a school in Australia may offer a course that attracts students from all over the world. A portal or website may compete against an office of student services within a community college. These shifts in markets and audiences create new economies of scale—allowing larger investment and larger outreach—but they can also threaten locally developed providers.

Globally distributed labor pool. A company based out of India may hire an experienced PhD at $3/hour to facilitate a graduate-level computer science course. This, in turn, may force a competitive response by a local school or learning-resource provider. By simple virtue of the Web, salary scales and hiring practices for online resource providers are starting to become more globalized

Disaggregation of products and services. It can be hard to put a price tag on residential school experiences. What is a Harvard MBA worth, and where does the value lie? Many graduates would place great value on non-traditional outcomes, e.g., the network of friends and contacts; the exposure to a company's work practices via an internship; the rite-of-passage and developmental roles of schooling; the opportunity to take personal risks and test oneself. Online learning providers will need to somehow differentiate the valued outcomes of a schooling experience.

Commoditization of instruction. As suggested earlier, instruction can be seen either as a mass-produced product or as a unique experience. Because online learning resources require more up-front development than typical classroom experiences, and because online instruction is still seen as an entrepreneurial enterprise, there is a tendency to see online instruction as a commodity. Once investment has been made in the product, providers often want to distribute that product as far as the market will allow. This could also be called a shift from a craft to an industrial model of production and delivery. A view of instruction as commodity, of course, is compatible with viewing education in input-output terms.

Mixing of commerce and education. Many enthusiasts are disheartened at the commercialization of the Web, but it was a predictable effect coincident with increasing choice and individual control. A similar tendency is seen in schools as greater choices and perspectives are accommodated through charter and private schools. Commercial investment can provide the needed stimulus to innovation and development, but it can also reduce innovation and variation, especially small-niche perspectives at the fringes. Commercial appropriation of learning can result in some confusion through blurring of boundaries between consumption and education, between entertainment and learning. In an open market, where satisfaction of desire plays a critical role, learning outcomes may suffer from neglect.

Radical Forces Inspired by Global Connectivity

Web as democratizing, emancipating, empowering force. Early literature about the Internet was infused with optimism and idealism about universal sharing and access. The Web indeed can be an empowering force that gives information access to users who are physically remote from resources (Ryder, 1995). At the same time, the Web, like so many other tools, reflects our own values and ideas. A divide still exists between the privileged and the disenfranchised, but the rules have changed somewhat. Principal barriers now include lack of access and lack of cultural or personal fit with the technology. Age can even be a barrier to empowerment, with younger people tending to have more time and familiarity with technology than older generations.

Open source. The commercial model of technology advancement, exemplified in the software industry by Microsoft, is being challenged right now by the open source movement. Linux, an operating system whose source code is open for the world to see and costs nothing to download and use, has become a major movement in the software development world. Open-source advocates are trying to create a world where software is freely available and a living is made through continuing relationships of service and support. Open-source ideas may be applied to online learning and education: Challenge commercial ownership by making resources freely available, for example, on the Web. If communities of practice can be organized around openly available tools and resources, then the system can become self-sustaining and reinforcing to participants (Schrage, 2000).

Self-publishing and knowledge sharing. Self-publishing is to knowledge management as open source is to Microsoft—an alternative to a hierarchically controlled system. Instead of fixed search categories and a company-designed form, end users themselves can publish solutions and locally valued resources. The Web epitomizes this growing trend, to the occasional chagrin of copyright owners and librarians (Ryder & Wilson, 1997).

Peer-to-peer networking. The Napster phenomenon taught us that downloading from central servers is not the only way to perpetuate an online enterprise. Peer-to-peer networking refers to individual users sharing resources by opening up their hard drives to each other. The core concept is even more radical than Napster's, because once out of the bag and in the hands of end users, true peer-to-peer usage cannot be controlled. In this way peer-to-peer networking constitutes a classic form of self-organizing system, using the technology to bypass every form of central control.

Self-organized learning- and performance-support groups. Peer-to-peer connectivity is the extreme end of self-organizing on the Web, but there are other forms. Interest groups, listservs, support groups of all kinds—Each of these is a self-organizing system that draws on distributed energy and participation for its survival. Slashdot.org is a primary example (Wiley & Edwards, 2002).

Threats to credentialing, degree-granting institutions. In the last decade, competency-based approaches are increasingly offered as an alternative to seat-time approaches for credentialing institutions, thanks largely to growth in online and self-directed learning. For-profit outreach institutions like the University of Phoenix, once ridiculed for giving credit for "life experience," continue to gain market share against residential institutions. In spite of reliability problems, professional portfolios are increasingly used for competency demonstration and evaluation. Online learning, where seat time loses much of its meaning, continues to improve its services and learning outcomes, along with market share. These "disruptive technologies" and accompanying competency-based tools are truly disrupting the status quo.

Global education as an alternative to a national curriculum. Global education refers to a new philosophy of learning that seeks to create responsible citizens of the world. Transcending national interests, the global education curriculum takes broadly based positions on issues of non-violence and conflict resolution; sustainable growth policies; treatment of rich and poor; and protection of the global environment (McEneaney, Kolker, & Ustinova, 1998).

Reflections

How do these various trends add up? I hope the reader engages in some reflection and conversation about that question. What follows is my best effort at generalizing upon the trends. Rather than paint a specific scenario, I highlight a few principles suggesting to how the trends may combine.

The trends keep marching on. Each of the trends listed above will continue to play a role in future developments of education and training, where distance technologies will play an expanding role. The trends may compete with one another, or sometimes cancel each other out. But they all represent significant aspects of the problem space within which distance education of the future will take shape.

Open systems trump closed ones. This is my way of saying, learners and communities will find a way to appropriate emerging tools and technologies, rather than the reverse. I have a bias that says that open systems (self-directed learners, self-organizing groups of learners and workers) constitute the most vital and thriving unit for understanding human actions and choices (*cf.* Hill, 1999). Process efficiencies and mass-produced tutorials can be appropriated and put into service by these learners and groups, and that is good. Where a group can appropriate a tool or technology and use it to learn from, let it do so. Where the technology breaks down, the group will adapt and make do. This is not a Utopian faith in the goodness of people; rather, it is an acknowledgement of the power and priority of groups that identify us and guide our behavior. Schools as collectivized learning institutions will not go away. Teachers or guides, responsible for the growth of novices, will not go away. Collective learning in real time will not go away. These practices are in place, not because we lack alternatives, but because we are social beings who invest considerable time and resources toward local interactions and support. I am confident that the same groups—schools, classrooms, families, workgroups, professional organizations—will find ways for distance-education resources to work in their service.

Technologies are still reflections of us. Through technologies and new ideas, we are always in the process of re-inventing ourselves. Technologies serve as mirrors of our values and aspirations, as well as our weaknesses and intractable problems. This truth about technologies underscores the importance of subjecting our plans to continuing scrutiny. Whenever possible, we want our technologies to reflect our *best* selves and our highest ambitions.

Technology and ideas will continue to co-evolve together. Historians of technology tell us that a technology, often based on the best thinking available, in turn stimulates new thinking and new possibilities. This is certainly true of the Web and networked information systems. A huge spike of promising ideas, models, and R &D efforts has accompanied the new technology. When these new efforts are seen as artifacts themselves, we see how one technology prompts the development of another, and how the cycle repeats itself through new iterations of technology, design, theorizing, and practice. Thus we can be sure that, as technology continues its onward march, new models and ideas will surely follow— and in some cases, precede the technology itself. As John Dewey said more than seventy years ago:

> Many are the conditions which must be fulfilled if the Great Society is to become a Great Community... The highest and most difficult kind of inquiry and a subtle, delicate, vivid and

> responsive art of communication must take possession of the physical machinery of transmission and circulation and breath life into it. When the machine age has thus perfected its machinery, it will be a means of life and not its despotic master. (Dewey, 1954/27)

References

Archer, W., Garrison, D. R., & Anderson, T. (1999). Adopting disruptive technologies in traditional universities: Continuing education as an incubator for innovation. *DEOSNews*, 9 (11). Available: http://www.ed.psu.edu/acsde/deosarchives.html

Brown, J. S. (2000, February). Works in progress. Online: http://www.parc.xerox.com/ops/members/brown/index.html

Brown, J. S., & Duguid, P. (1996, July/August). Universities in the Digital Age. *Change*, 10.

Carr, A. A. (1997). User-design in the creation of human learning systems. *Educational Technology Research & Development*, 45 (3), 5-22.

Cave, D. (2001, July 10). Microsoft to schools: Give us your lunch money! Online: http://www.salon.com/tech/feature/2001/07/10/microsoft_school/print.html

Collis, B., & Gommer, L. (2001). Stretching the Mold or a New Economy? Part I: Scenarios for the university in 2005. *Educational Technology*, 41 (3), 5-18.

Collis, B., & Gommer, L. (2001). Stretching the Mold or a New Economy: Part 2: Realizing the scenarios for the university in 2005. *Educational Technology*, 41 (4), 5-14.

Dewey, J. (1954/27). *The public and its problems*. Athens OH: Ohio University Press. Chapter 5: Search for the Great Community. Also found in J. A. Boydston (Ed.), *The collected works of John Dewey, 1882 - 1953, Later works*, 2, 325-350.

Hebb, D. O. (1949). *The organization of behavior: A neuropsychological theory.* New York: Wiley.

Hill, J. R. (1999). A conceptual framework for understanding information seeking in open-ended information systems. *Educational Technology Research and Development*, 47 (1), 5-27.

Irving, J. (2001, July). SlashLearn: Discussion and debate for instructional technologists. Online: http://www.beota.com/ilt/dwarticle.htm

Law, J., & Hetherington, K. (n. d.). *Materialities, spacialities, globalities*. Online: http://www.comp.lancs.ac.uk/sociology/soc029jl.html

McEneaney, J. E., Kolker, J. M., & Ustinova, H. S. (1998, April). *Technology-based Global Education and its implications for school/university partnerships*. Paper presented at the meeting of the American Educational Research Association, San Diego. Online: http://www.iusb.edu/~edud/global/pub2.htm

Naisbitt, J, (1982). *Megatrends: The new directions transforming our lives*. New York: Warner.

Norman, D. A. (1993). *Things that make us smart*. Reading MA: Addison-Wesley.

Ragan, T., & Smith, P. (1996). Conditions-based models for designing instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology*. New York: Macmillan.

Ryder, M. (2001, July). *Luddism and the neo-luddite reaction*. Online: http://carbon.cudenver.edu/~mryder/itc_data/luddite.html

Ryder, M. (1995, November). *Production and consumption of meaning: The interplay between subject and object in open hypertext representation*. Paper presented at the meeting, Semiotics as a Bridge between the Humanities and the Sciences, Victoria College, University of Toronto. Online: http://carbon.cudenver.edu/~mryder/semiotics_95.html

Ryder, M., & Wilson, B. (1997, March). *From center to periphery: Shifting agency in complex technical environments*. Paper presented at the meeting of the American Educational Research Association, Chicago. Online: http://carbon.cudenver.edu/~mryder/coss.html

Schrage, M. (2000, August). The debriefing: John Seely Brown. Online: http://www.wired.com/wired/archive/8.08/brown_pr.html

Spitzer, D. R. (2001). Don't forget the high-touch with the high-tech in distance learning. *Educational Technology*, 41 (2), 51-55.

Tyack, D., & Cuban, L. (1995). *Tinkering toward Utopia: A century of public school reform*. Cambridge MA: Harvard University Press.

Wiley, D. A. (Ed.). (2002). *The instructional use of learning objects*. Bloomington IN: Agency for Instructional Technology and the Association for Educational Communications and Technology. Online: http://reusability.org/read/

Wiley, D. A., & Edwards, E. K. (2002). Online self-organizing social systems: The decentralized future of online learning. *Quarterly Review of Distance Education*, in press.

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Supporting and Hosting Web-Based Learning Systems in the University of Wisconsin System

(this document was created in MS Word 2000)

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Economy of Scale

The University of Wisconsin System (UWS) consists of 27 individual campuses (two research institutions, eleven 4-year universities, thirteen 2-year colleges, and an extension) plus Learning Innovations (LI) (a UWS organization that focuses on total online programs). Several years ago UWS found itself inundated with requests from these individual campuses and LI for financial assistance for the following.

- Web-enhanced and web-based learning
- Enhancement of their respective libraries
- Expanded curricular redesign efforts

Since it was not possible for UWS to support such endeavors on each campus and since such funding would basically re-invent the wheel 28 different times, UWS decided to implement a Distributed Learning System Environment. The philosophical assumption behind this type of environment is that the 27 campuses of UWS plus LI could receive a much greater return on investment if they collectively take responsibility for infrastructure investments (with infrastructure being defined as a base that is universally accessible, potentially used by all and has value in its commonality).

The University of Wisconsin System has attempted to establish a well-defined set of support services for internet-based teaching and learning for its 27 campuses and LI. The objectives of these services are: 1) to provide all University of Wisconsin (UW) campuses with the opportunity to use distributed learning technologies to enhance teaching and learning, 2) to guarantee a learning and teaching system infrastructure (including software, hardware, and staffing) that enables on-campus and off-campus network-based courseware, and 3) to provide a longer term funding model that will ensure core distributed learning services for all faculty and teaching staff.

UWS's Distributed Learning System Environment includes such services as the following.

- Instructional Design, Course Development and Faculty Support
- Copyright Clearance Center
- Video Production and Digital Television
- Asynchronous Library Services
- Network Services
- Student Support Services
- Statewide Distance Education Communication, Coordination, Support, and Web Maintenance
- Web-Based Learning System (WBLS) Hosting, Help Desk, Training, and Support

It is the last service on which this presentation will focus. UWS sent out RFPs to all 27 campuses and LI to provide this service. The successful campuses were the University of Wisconsin - Eau Claire which focused on LearningSpace, the University of Wisconsin - Madison which focuses on WebCT, and the University of Wisconsin - Milwaukee (dot.edu) which focused on Web Course in a Box and Blackboard. Therefore, instead of providing this service at each UW campus and LI, the Web-Based Learning Systems provide this support from these three central locations for all UW campuses in a much more cost-effective fashion.

Web-Based Learning Systems (WBLS)

Services

For whichever of the products chosen, the following services are provided.

1. Hardware: server access, disk space as necessary
2. Software: for course development (license, vendor support, upgrades, renewals, separate instance); for course delivery to students
3. Staffing: professional development; instructional workshops in the use of the software; accessible and sustained support to institutions, educators, and students; instructional design consultation; 24x7 help desk (toll free number) for faculty and students; Network and System Administrators

Thus, WBLSs provided faculty and teaching academic staff throughout UWS a choice of four web-based learning tools for course presentation.

Faculty Benefits

The faculty using these tools report many benefits: versatile courseware, time for active learning, online courses that can mirror classwork, problem solving activities, and collaboration. These tools vary in ease of use and make it possible for faculty to create meaningful courses that range from the very basic to the highly interactive, from web-enhanced to distance education.

Student Benefits

Student benefits are numerous. Web-based and web-enhanced learning provides a consistent look and feel to course information and resources; provides anytime, anyplace, any pace instruction (most beneficial to non-traditional students); allows students to continue the conversation beyond the traditional classroom's constraints of time and space through collaborative tools such as discussion forums and virtual chats. Students now have the ability to begin the process of becoming lifelong learners.

dot.edu

dot.edu is an Application Service Provider for the State of Wisconsin and beyond. The impact of dot.edu has been tremendous: we have 6880 courses in some phase of development; 4500 faculty have been trained; and 131,000 students are enrolled in these courses. We are in both UW-System research institutions, 10 of the eleven 4-year UW-System universities, all thirteen 2-year UW-System colleges, UW-Extension, and Learning Innovations. We have 29 non UW-System partners who pay to use this service.

This involves 30 Dell servers; 4 larger Sun servers; a very large environment for the most recent web-authoring tool that we've added (Prometheus); a video server; a tremendous amount of travel, coordination, collaboration, strategic partnerships and, at present, a cost of approximately $1,000,000.

dot.edu Partnership Model

Process

The partners of dot.edu include all faculty, teaching academic staff, and administrators in the following categories:

- The UW System campuses
- Wisconsin public and private higher education institutions
- Wisconsin public and private schools and districts as well as education agencies in the state
- Non-educational institutions and those institutions outside the State of Wisconsin

Programs can be selected and uniquely organized to meet the needs of the particular partner. The Utility model is structured as a 3-stage implementation plan that eventually transfers responsibility for course development instruction from dot.edu to the partners.

Stage 1: dot.edu provides direct instruction and support to the on-site trainers

Stage 2: dot.edu provides direct instruction and support to first set of instructors, with support from on-site trainers

Stage 3: On-site trainers provide all direct instruction and support to subsequent sets of instructors, with support from dot.edu.

The course development instructional program design and implementation timeline are determined by the needs of the institution. A written implementation plan is designed jointly by dot.edu and the respective institution. It is developed with the flexibility necessary to meet changing needs. The campus eventually sustains the course development instruction.

Pricing

Pricing is constantly being revisited but, in general, contains an annual fee of approximately $30,000 and a per course section fee of approximately $150. Firm quotes are given upon request and after review of services needed. The fee includes the hosting, 24 hours of training and/or instructional design consultation, the 24x7 Solution Center, unlimited users, unlimited courses, and unlimited disk space. Additional training can be obtained for $200/hour plus expenses.

dot.edu does provide an Incubator for Prometheus (for those customers who might need time to determine if online education is for them, for customers to try out the dot.edu services, and for customers to try out the Prometheus software). A per course fee is charged for this service (prices given upon request; typical charge would be $500/course section).

UWS currently subsidizes the UW-System 27 campuses and LI so that each campus does not have to budget for these services - therefore, these services are provided, sponsored, and funded centrally. Non-UWS customers pay the fees mentioned above.

New Developments

It was realized that the WBLS, WiscNet, Wisconsin Public Television, the Pyle Center, Learning Innovations and others were providing their services to all educational institutions in Wisconsin. In order to make it easier for these educational institutions (with regard to costs, contact information, services provided, and so forth), it was determined that a type of clearing house be established to act as the conduit for the various state Service Providers. Thus, ITS@Wisconsin was formed (Instructional Technology Services @Wisconsin), providing a single point of contact for educational institutions in the State of Wisconsin. In doing so, the old name of Web-Based Learning Systems (WBLS) was abandoned.

As time progressed, UW-Eau Claire ceased offering LearningSpace and Web Course in a Box was purchased by Blackboard. In addition, a new web-authoring tool (Prometheus) was added to the mixture in December of 2000. Thus, UW-Madison offers WebCT and dot.edu offers Blackboard and Prometheus.

dot.edu has formed strategic partnerships with Dell, Sun Microsystems, WiscNet, Blackboard and Prometheus. In addition, dot.edu has recently received the Sun Center of Excellence award. Together with Sun Microsystems, Dell and Prometheus, dot.edu intends to take the dot.edu concept nationally to show other states that education can take care of education and provide a seamless PK-16 education.

Goals and Mission

The goals of dot.edu are not stagnant but ever changing.

- We will be partnering with the Student Accessibility Center at UW-Milwaukee to accompany us on all our training sessions to educate all faculty and students with regard to accessibility issues
- We will be instrumental in the formation of standards through the Wisconsin Co-Lab
- Disseminate knowledge
- Leverage resources to provide an economy of scale
- Support web-enhanced, hybrid, and online education
- Provide appropriate high-quality web-based learning systems
- Remove barriers preventing interaction between the UWS, PK-12, and other appropriate members of Wisconsin's educational community

The mission of dot.edu is also constantly expanding but has always remained the same – provide educational communities with robust and up-to-date e-learning system infrastructure including technology, training, support, and instructional design and to effectively apply these resources to enhance education. dot.edu hopes to be able to provide a seamless e-learning experience to PK-16 and beyond.

What We Have Learned and Reasons We've Succeeded

Lessons Learned

Much has been learned in the process of developing dot.edu. Since nothing like this existed, we are constantly "making it up" as we go along. Continual refinement of policies and procedures, pricing structures, service agreements, and services offered takes place. Some of the specific lessons we've learned follow.

1. Identity issues - each of these Service Providers exist on a specific central UW campus but each is funded and sponsored by the University of Wisconsin System
2. Customer support - this is a very intense and expensive aspect of the dot.edu, much more than anticipated at the beginning
3. Dealing with unknowns on each campus - this comes into play when the training takes place on our partners' respective campuses
4. New products - since this is such a changing, volatile field at present, new products are continually being analyzed and tested
5. Legalities - copyright and intellectual property issues
6. Instructional design - it is quite a challenge to provide instructional design and pedagogical consultation through a distributed system
7. Measuring capacity and demand - regarding disk space, number and types of servers, personnel needed
8. Students - staffing has to be supplemented by student workers
9. External funding - it is imperative that partnerships are developed and external funding is sought
10. Administrative systems - it is becoming more and more apparent that it is necessary that these web-authoring tools integrate with individual campus Administrative back-office systems

Why We've Been A Success

dot.edu has been a tremendous success because of a few very simple reasons.

- Customer service - fast, friendly, and thorough
- A great product which is continually being improved and enhanced
- A buy-in by central administration, campus administration, and faculty
- Having as an end product of all of this - true collaboration and teamwork throughout the State of Wisconsin and beyond
- A willingness to go that extra mile
- An adherence to the mission of the dot.edu and ITS@Wisconsin
- A willingness to take the risk and go where no one has gone before
- dot.edu **is** Education Serving Education

Conclusion

Several years ago the UW-System had the foresight to see that a problem existed and they designed a solution. They then had the tenacity to actually try their solution. Its success has exceeded everyone's greatest expectations. Through dot.edu, the rest of ITS@Wisconsin and the entire Distributed Learning System Environment, the UWS faculty and campuses can now take education in the State of Wisconsin to that next level.

Agent Technologies in the Electronic Classroom: Some Pedagogical Issues

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Abstract: The use of intelligent software agents within computer mediated learning environments has become an important focus of research and development in both AI and educational contexts. Some of the roles envisaged and implemented for these electronic entities involve direct interactions with students, participating in the 'social' dimension of the classroom that is of such importance in contemporary pedagogical theory. Others contribute to the many background tasks that support the teaching/learning process. Each type of activity raises its own special challenges in relation to the capabilities of the software and to our understandings of teaching and learning. Through discussion of both theoretical perspectives and practical examples, this paper explores a selection of these issues.

Introduction

One of the fastest growing applications of AI research is the implementation of computer programs commonly referred to as 'agents'. Among the features distinguishing this type of software from more traditional programs are a high degree of autonomy in decision making and action, the ability to 'learn' from experience and to adapt their behaviour accordingly, and often a highly personified interface. Many are specifically designed to process complex information, make decisions and initiate actions in 'mission critical' areas of human endeavour including health, scientific research, business, defence and increasingly in education. While in some cases we are aware of our interactions with these electronic entities, in many contexts their activity takes place 'behind the scenes', at a level not apparent to the user. Agent roles currently implemented in educational projects around the world include record keepers, information seekers, testers, facilitators of collaboration, tutors or instructors, fellow learners, and tutees.

While the usefulness of this type of software in many contexts is already well proven, a number of issues in relation to its uses in education are not yet fully resolved. The substitution of computer programs possessed of varying degrees of artificial intelligence and 'personality' for various aspects of human presence in the computer based classroom, raises some quite fundamental questions concerning the processes through which knowledge is socially constructed, and the qualities which are necessary to ensure successful participation in those processes. To what extent can socially interactive roles such as tutor and fellow learner be effectively and appropriately fulfilled by a computer program, however 'intelligent'? Where agents undertake less interactive tasks such as record keeping and testing, other issues arise including that of privacy and of students' control over their own learning.

Agents in the electronic classroom

Typical of the broad vision held by many researchers and educators for the implementation of agent technology in the online classroom is that promulgated by Johnson, who writes:

> "Pedagogical agents are autonomous agents that support human learning, by interacting with students in the context of interactive learning environments. They extend and improve upon previous work on intelligent tutoring systems in a number of ways. They adapt their behaviour to the dynamic state of the learning environment, taking advantage of learning opportunities as

> they arise. They can support collaborative learning as well as individualized learning, because multiple students and agents can interact in a shared environment. Given a suitably rich user interface, pedagogical agents are capable of a wide spectrum of instructionally effective interactions with students, including multimodal dialog. Animated pedagogical agents can promote student motivation and engagement, and engender affective as well as cognitive responses" (Johnson 1998, p. 13).

Arguably the most obvious choice of interactive role for an agent would be that of teacher. While one might reasonably fear a resurgence of the heavily instructionist model of 'the computer as tutor' prevalent in the early days of educational computing, there are indications that developers are attempting to base their agent-based manifestations on aspects of pedagogical theory more acceptable to current thinking.

As Solomos and Avouris (1999) write, for instance:

> "The user mental model of the system should be based on the metaphor of the 'invited professor' rather than the 'knowing everything own tutor'. ... Our first findings confirm the observation that today's users, accustomed to hypertext-like interaction, are more likely to accept this collaborative teaching metaphor, according to which their tutoring system is viewed as an intelligent hypertext browser, offering links to other tutoring systems with the right content and at the right time" (Solomos & Avouris 1999, p. 259).

The image of the teacher as a facilitator of learning rather than as the 'sage on the stage' is also reflected in such statements as: "Each student working on the project will have an agent, operating in the background, watching progress, measuring it against the plan, and taking remedial action when necessary" (Whatley et al 1999, p. 362).

The substitution of agents for one or more of a student's classmates or fellow learners is an interesting concept being explored by a number of developers. Successful implication of this idea would add considerable appeal to online learning environments. Currently, while electronic interactions between students can be encouraged and facilitated up to a point, the quality and timing are far less subject to the control of the 'teacher' than is the case in a face to face situation. The presence of 'classmate agents' would not only enhance the general social ambience of the online classroom, but could enable more constructive interactivity to take place at pedagogically appropriate times.

Since the 1980s Chan (Chan 1996, 1998) and colleagues have been working on a range of models of socially interactive agents for learning environments, perhaps the best known being the 'learning companion' – a software entity having limited knowledge of the domain in question, conceptualised as a fellow learner with whom the student may collaborate and even disagree. As in real life, some of these learning companions may be better informed than the student in the relevant domain of knowledge, while others may know less. Perhaps not surprisingly, in learning environments for younger students, animals are a popular choice of persona for such agents, as in this example of a networked learning environment for Taiwanese high school students, as described by Chan:

> "The Dalmation is having the same performance as the student. ... Another animal companion is Dragon, like one of those animal companions in Mulan, a Disney cartoon of this summer. This dragon will "learn" (mainly rote learning) from the student and also from other students on the Net and so may know more than the student. At certain point it'll stop learning and come back to teach the student. In a way, Dragon is protecting the student."
> (Chan 1998)

An interesting development of this concept is suggested by Sheremetov and Nunez (1999, p. 310), who describe the function of a 'monitor agent' as being to modify the role, behaviour or expertise of learning companions. A learning companion's personality could, for examples, be changed from that of strong group leader to a weaker companion or even a passive observer, depending on the monitor agent's interpretation of the degree of guidance required by the learner.

A third socially interactive role that may be enacted by an agent is that of 'tutee'. We are all familiar with the common wisdom that we learn best through teaching others. This principle was invoked in the early days of educational computing through Logo, where 'teaching the turtle' was the chosen metaphor for the activity of programming. More recently, a number of researchers have explored the translation of this concept into electronic learning contexts where agents exist to be 'taught' by the student user, as in the example from Chan quoted above. A further example is described by Ju (1998) who writes of a computer based peer tutoring system employing two categories of agent – an 'expert', and a 'learner':

> "... students become active learners who are guided to learn by teaching a computer. After the students watch how the computer expert solves a set of linear equations [the program] helps the human student act as a teacher in order to learn more about the subject matter. At this time, the computer plays the role of a student ..."
> (Ju 1998, p. 559)

In addition to these highly visible and interactive 'social' roles, there is considerable scope for agents to undertake a range of support activities including monitoring the activities and responses of students, administering tests, recording results and seeking information on behalf of students or teachers. The latter task is, of course, familiar to us in relation to the operation of standard Internet search engines.

Issues for consideration

Each of these implementations of agent technologies raises issues that demand consideration. While some are basically pedagogical, others straddle the boundaries between pedagogy and other areas, such as ethics. While some relate to whether or not the achievement of certain ends is a practical possibility, others go further and question whether what is possible is necessarily desirable.

A key element in the implementation of socially interactive agents is a high degree of personification or 'character'. It is well accepted that an element of personification of program interfaces is inevitable. As Shirk puts it:

> "Although there is some dispute among software critics concerning the advisability of having 'personalities' in computer programs, their presence seems unavoidable. Any time there is communication between a computer and a human, the information presented by the computer has a certain style, diction, and tone of voice which impact upon the human's attitude and response toward the software" (Shirk 1988, p. 320).

Deliberate personification is, however, more problematic. As Masterton notes: "A common problem with AI programs that interact with humans is that they must present themselves in a way that reflects their ability. Where there is a conflict between the ability of the system and the users' perception of that ability a breakdown occurs and users may either fail to exploit its full potential or become frustrated with its shortcomings" (Masterton 1998, p. 215). He suggests the implementation of a style of pedagogical agent with a degree of anthropomorphism intended to convey qualities such as friendliness and usefulness, without the implication of possession of full human capabilities. He describes the development and role of such an entity, a VTA (Virtual Teaching Assistant), which is able to introduce topics and answer simple questions, the more complex types of exposition and interaction being left to the human teacher. In terms of a traditional scenario at university level, the VTA functions somewhat like a tutor or demonstrator as distinct from a lecturer. "In this way faculty is left free of the guiding and assisting issues of the course and is able to concentrate on more complex questions and higher level issues generated during the course" (Masterton 1998, p. 211). The 'learning companions' of Chan mentioned above can be seen as further instancesof this principle. Our expectations in regard the cognitive skills of animals may well be more appropriate to the capabilities of software agents than are our experiences of human-to-human interactions.

An agent's capacity to demonstrate some equivalent to the emotional responses of a human being, and to appropriately recognise and respond to the emotions of users is becoming recognised as an important element both in personification generally and in educational contexts in particular. As Frasson writes, "Emotions play an important role in the learning process and new strategies have to take into account this human factor for improving knowledge acquisition. Intelligent agents can hep in this process, adding emotional behavior to believability of their actions" (Frasson 2000, p. 60).

Apart from the possibility that less fully personified agents might be more educationally effective, there are clear ethical issues attached to the presentation of these programs in a form which students are unable to distinguish from that of a human participant in the learning experience.

Another important characteristic of agent software is its capacity for autonomous or self-directed decision making and action in the pursuit of its goals. This raises the question of the extent to which a pedagogical agent should be furnished with pre-existing goals which could lead it to undertake actions without instruction from the learner, and even contrary to what the learner might perceive as his or her interests and wishes. Loeffler (1996) notes that the unpredictability resulting from significant autonomy might well result in agents who are less 'helpful' to us than we might hope or indeed expect. As Minsky puts it, "There's the old paradox of having a very smart slave. If you keep the slave from learning too much, you are limiting its usefulness. But, if you help it to become smarter than you are, then you may not be able to trust it not to make better plans for itself than it does for you" (Minsky, 1994, p. 25). It is easy to slip from such considerations into the need for a contemporary version of Asimov's laws of robotics as conceived in fictional terms more than 30 years ago.

In educational contexts there is potential for some degree of conflict between the usefulness of an agent possessing a high degree of autonomy, and contemporary understandings of the importance of individuals being able to exercise control over various aspects of their own learning. It could be argued that current trends in educational thinking which favour giving more control and autonomy to the learner would appear to be more in line with the thinking of researchers such as Schneiderman (1983) who favour 'direct manipulation' over the development of interactive agents with a significant degree of independence of action. There is certainly a case for suggesting that pedagogical agents be configured so as to be particularly sensitive to individual user models, more responsive to instruction from the user/student, and that their characteristics and capabilities should be more transparently presented.

A high degree of transparency in relation to the functioning, indeed to the existence of agents within the electronic classroom is also important in relation to maintaining a level of trust which many educators believe to be an important component of any learning environment, whether computer based or face to face.

A further concern in regard to the autonomy of pedagogical agents relates to the issue of intervention in the learning process. It is well accepted that a high degree of unsought assistance whether from a human teacher or an excessively diligent and proactive agent can be quite detrimental, in particular to the metacognitive aspects of learning. The fact that this is also an issue for teachers and learners in face to face educational contexts underlines its complexity, and degree to which it is unlikely to handled with the requisite sensitivity through prior programming of an agent.

An interesting aspect of most agent based educational systems is their use of a multiplicity of agents, many of them capable of a complex range of interactions with the student, with one another, and increasingly with agents associated with other programs. These interactions range in nature from collaboration to competition, and their purposes are derived from theoretical analyses of the various component tasks and activities that make up the human activity of 'teaching'. An example is the Multiple Agent Tutoring System (MATS) described by Solomos and Avouris:

> " MATS is a prototype that models a "one student-many teachers" learning situation. Each MATS agent represents a tutor, capable of teaching a distinct subject. All MATS tutors are also capable of collaborating with each other for solving learning difficulties that their students may have" (Solomos & Avouris 1999, p. 243).

While on the one hand, the variety of functions of agents within a multi-agent environment is an attempt to realise the type of rich user interface which Johnson suggests is necessary if the pedagogical interactions within electronic learning environments are to approximate to any degree to the face to face educational experience, some educators have concerns in regard to the assumptions underlying these practices. They argue that such developments are underpinned by a reductionist rather than a holistic understanding of the processes and relationships involved in teaching and learning. In separating out the different components of pedagogical interactions, are we enabling each part to be realised more effectively, or are we failing to acknowledge that the global act of human teaching may in fact be more than the sum of its component parts?

Central to the work of many theorists and researchers is the belief that it is possible for agents to participate effectively in the social aspects of knowledge construction. Sheremetov and Nunez, for example, whose works derives overtly from the theoretical frameworks of Piaget and Vygotsky, argue that:

> "The design of learning environments, virtual or not, aims to promote productive interactions. In this type of learning a student changes from being a passive information receiver to an active collaborator, interacting with the tutors and colleagues in the learning process. Learning does not only result from acquiring knowledge, solving problems or using tools, but also from interacting about these on-going activities with persons and agents"(Sheremetov and Nunez 1999, p.305 – 306).

But however personified and autonomous the software agent, can it really be said to participate fully in the social construction of knowledge? It has been argued quite extensively that even the most heavily personified of computer programs suffer from an intrinsic lack of ability to participate in the metacognitive aspects of learning. Pufall (1988), for instance, expresses a strong belief that a computer program is unable at any level commensurate with human capacities to modify its own knowledge structures or cognitive processes, and so cannot be regarded as a co-constructor of knowledge in a meaningful sense. While this might well have been the case in relation to earlier computer based learning environments, can we continue to make the same claims with confidence today or in the future? The capacity of software to 'learn' and adapt to experience through the incorporation of new information, the appropriate modification of its representation of the context in which it functions (its 'world') and of its inference mechanisms, is undoubtedly increasing. If our test of full participation depends on an understanding that the agent has 'learnt' in precisely the same way that the human has learnt, then we will have difficulty accepting the electronic entity as genuine co-constructor of knowledge. If, however, we make our claim on the grounds that it appears to the human learner that the agent has participated in the learning that has taken place, then perhaps we can at least tentatively admit such a piece of software to membership of the social milieu that has mediated the educational experience.

Conclusion

The widespread implementation of agent technologies within the electronic classroom is bound to raise a large number of issues of which those listed above are a sample. While it is critical that pedagogical concerns rather than simple technical capabilities are the driving force behind the development of these new learning environments, it is also important to look beyond the extent to which agents can simply replicate existing classroom conditions. Where agent based educational systems can be identified as differing from the traditional classroom, careful research and critical evaluation is required if we are to distinguish between those which simply undermine valued aspects of the educational enterprise as we understand it, and those which have the potential to create fruitful new possibilities in regard to how we teach and how we learn.

References

Chan, T.-W. (1996). Learning companion systems, social learning systems, and the global social learning club. *Journal of AI in Education* 7 (2).

Chan,T.-W. (1998). The past, present, and future of educational agents. http://www.apc.src.ncu.edu.tw/apc/ppt_chan.html (accessed on February 3, 2000).

Frasson, C. (2000). The role of emotional agents in Intelligent Tutoring Systems. *Proceedings of the eighth International Conference on Computers in Education (ICCE 2000)*, Taipei, Taiwan, November 21 – 24, p. 60.

Johnson, W.L. (1998). Pedagogical Agents. *Proceedings of the Sixth International Conference on Computers in Education (ICCE '98)*, Beijing, China, October 14 – 17, pp.13 – 22.

Ju, Y. (1998).'Development and formative evaluation of a computer-based peer tutoring system. *Proceedings of, the Sixth International Conference on Computers in Education (ICCE '98)*, Beijing, China, October 14 – 17, pp. 559 – 566.

Masterton, S. (1998). Computer support for learners using intelligent educational agents: the way forward. *Proceedings of, the Sixth International Conference on Computers in Education (ICCE '98)*, Beijing, China, October 14 – 17, pp. 211 - 219.

Minsky, M. (1994). A conversation with Marvin Minsky about Agent, *Communications of the ACM*, July 1994, vol. 37, no. 7.

Pufall, P. (1988). Function in Piaget's system: some notes for constructors of microworlds. Forman, G. & Pufall, P. (eds) (1988). *Constructivism in the Computer Age*, Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Schneiderman, B. (1983). Direct Manipulation: A Step Beyond Programming Languages. *IEEE Computer*, vol 16, no. 8.

Sheremetov, L. & Nunez, G. (1999). Multi-Agent Framework for Virtual Learning Spaces. *Journal of Interactive Learning*

Research, Vol. 10, No. 3/4, pp. 301 - 321.

Shirk, H.N. (1988). Technical writers as computer scientists: the challenges of online documentation. Barrett, E. (ed.). *Text, Context and Hypertext: writing with and for the computer*, Cambridge, Massachusetts: MIT Press.

Solomos, K & Avouris, N. (1999). Learning from Multiple Collaborating Intelligent Tutors: An Agent-Based Approach. *Journal of Interactive Learning Research*, Vol. 10, No. 3/4, pp. 243 - 263.

Whatley, J., Staniford, G, Beer, M. &Scown, P. (1999). Intelligent Agents to Support Students Working in Groups Online. *Journal of Interactive Learning Research*, Vol. 10, No. 3/4, pp. 235 – 243.

Creativity and Efficacy in Implementing a Guiding Partner Approach: Thinkquest for Tomorrow's Teachers PT3 Project

The ThinkQuest for Tomorrow's Technology project funded by the USDOE is in its second year of work as a catalyst grant. ThinkQuest and fourteen universities are partners in the implementation of work to prepare preservice teacher education candidates to use technology effectively to enhance teaching and learning.

The ThinkQuest for Tomorrow's Teachers project informs university students of the Guiding Partner Approach (GPA) based on student-centered constructivist pedagogy that requires student-to-student and student-to- faculty "elbow to elbow" learning. As students explore their understanding of important academic content for K-12 learning, they also decide on how to use internet-enriched activity design to help to display interesting resources from their research on curricular topics. They also work with their peers and teachers as collaborators, researchers, and co-facilitators, so that they experience the benefits of collaboration, rather than individualism and isolation. This approach to learning will provide a model to students of a new ideological foundation for work in systems such as K-12 education.

In the second year of implementation, faculty at each of the fourteen universities are incorporating digital and internet technologies as skills to be learned and as opportunities for teams of students to work together in creating educational web sites with information and activities of interest to youth, teachers, and university pre-service teachers. At the lead university, the University of the Pacific, teams of students, from team sizes of two to six students, in selected courses in the School of Education have prepared web sites with content relevant to topics they are learning in their course work as well as content and pedagogy pertinent to state academic content standards.

Key to this understanding of the guiding partner approach are insights provided by Judi Harris in her book, *Virtual Architecture: Designing and Directing Curriculum-Based Telecomputing* (1998, ISTE) as she states, "How to apply the tools in curriculum-based educational activities, although less frequently the target of careful thought and in-depth investigation, is a much richer, more complex, longer-term, and more critical area for educators to explore at this point in time. In short, it's not about how teachers use the TOOLS--it's about the USE of the tools" (pp.5-6).

This paper presentation will focus on the results of collaborative work by university students on digital web sites to understand their sense of efficacy in researching academic content and in learning to use the digital and internet technologies. Also, the paper will focus on a relationship between imaginative and creative development of content and students' skill in using the technology. We have observed that as students became creative in their thinking about the content, they correspondingly became more interested in finding interesting ways to display the content in the digital environment.

As an example, students in an Introduction to Language and a Children's Literature course were required to develop web sites as courses assignments. Students in the Introduction to Language course had course paper assignments leading to the web page assignment that required them to investigate information about a topic of interest to them in several areas of language study. Students were invited to research any one topic among several topics such as research in second language acquisition, modern and classical languages, logographic representations of language, language and reading, and dialects in American language communities. Students first developed, individually, annotated bibliographies of ten sources of information from scholarly publications. Then, they prepared conventional five page papers on the topic, using sources uncovered in the annotated bibliography assignment. Students were then asked to group themselves with others in the course who wrote on topics in the same area in order to develop teams to work on development of a web site by each team.

When students first developed ideas about their web site, they organized very brief planning outlines or story boards for their web sites. Students then participated in a brief presentation on the use of a web editor software product. In the teams, students were assured that no one had to be an expert on the content or the digital technology skills, and they were encouraged to work together. Students then investigated how to apply the technological skills to design the artistic backgrounds for their web sites and to include content for the sites. Students also discovered that some of their peers had some background in using web editors, and those students took on a role of teaching others how to use the web editor and its functions. We observed that as students became more confident about the use of the web editor and some of its functions, they also designed creative presentations, with a range of sophistication in the look and content for their sites. Some sites were novice web sites, providing presentations of information from paper based materials, and others were more imaginative web sites with interesting graphic design and use of the web functions and capabilities.

Students in a Children's Literature course also worked in teams to design and implement a web site on a children's book and author. Similarly, students planned out the organization of their web site with story-board-like plans. They worked on ideas for the web site to be a comprehensive tool for a child so that the child could develop comprehension skills and higher level thinking through activities and features of the web site. These students also became more creative and imaginative about their web site and the potential for interactivity and design elements as they became more comfortable with the web editor and as they thought more creatively about the content.

This paper will present work-in-progress with a sample of web sites from student teams and excerpts from their written reflective papers about their progress in the creative process and change in their sense of efficacy as they worked with academic content material and the web editor and its capabilities.

The experiences of these students is illustrative of the purpose of the ThinkQuest for Tomorrow's Teachers grant: To prepare new prospective teachers to be able to combine practice in the Guiding Partner Approach and the use of internet technologies and content knowledge, so that they develop an ideological basis for professional work that encourages exploration, collaboration, and constructivist pedagogy.

The New Scholar's Interface: Virtual Image Technologies Compared

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Abstract

Virtual slide and virtual image technology has the potential to revolutionize the way we teach and share microscopy and other kinds of high-resolution images. This technology applies to not only student-focused instructional media, but also to historical research and web-based publishing. In this paper, the authors compare functional aspects of "virtual image" technologies based on Flashpix, QuickTime VR and other formats. Advantages and disadvantages of each format will be discussed with regard to the content of images, the target audience and the pedagogical purpose. This paper also will discuss some details about technical requirements and basics of authoring.

Why Use Virtual Images?

Increasingly, libraries and academic departments are digitizing and delivering image content for use by researchers and students. In many cases such projects involve web delivery of static images no greater than 72 dpi. This may be sufficient if the content of the image and end-use of the image does not require more than low resolution. However, for intensive analysis and study, higher resolution alternatives are often preferred. Desirable functional mechanisms for interacting with such high-resolution images include the ability to magnify or "zoom in" on an image, pan across an image, or point to landmarks or highlighted areas of an image. Interaction with digital images introduces opportunities that can contribute to greater understanding, particularly when added-value contextual content can be naturally incorporated within the image file itself or the interface within which the image is displayed.

For several years, staff and faculty members at the University of Iowa Libraries and the University of Iowa College of Medicine have been working with high-resolution image content and various methods of delivering that content. In one project involving a formative evaluation of virtual slides used during a first-year histology laboratory, students rated these images equal to the traditional microscope in terms of image quality and utility, and rated them superior in terms of learning efficiency and ease of access. (Harris, et al., 2001). In another project, high-resolution representations of rare anatomical illustrations were rendered in a QTVR format and delivered to the web (http://www.lib.uiowa.edu/hardin-www/mascagni/). Project planners are continuing to explore mechanisms for studying and evaluating how this format (and its interactive functions) impacts the way in which individuals conduct historical research.

The question of when to utilize one particular virtual image format over another depends on several factors: file size and resolution of the digital source; degree of detail required for end use; server resources available for storage and delivery; availability of technical expertise; and budget.

Microscopy Images

In the case of virtual microscope images, typical image acquisition involves the capture of contiguous fields, which are then tiled or stitched together to form one seamless large image. In cases involving a QTVR solution, producers have created virtual image files with starting source files as large as 3,472 x 2,784 pixels (Trelease, 2000). "Hot spots" provide linkages between virtual images. For example, one virtual image captured at 10x magnification could be linked to another captured at 40x. The benefit to using QTVR is that it is based on an industry standard technology, Apple Computer's QuickTime (http://www.apple.com/quicktime/qtvr/). This is free system software already used by millions for playing and authoring multimedia. For the virtual slide project at The University of Iowa, producers captured up to 1,200 images at 640 x 480 resolution, each 300 dpi. After tiling these images, the source image for a virtual slide would be approximately 18,000 x 18,000 pixels, and in TIFF (tagged image file format) would consume close to 1 GB per slide. After compression in a FlashPix format, each slide uses approximately 125 MB of storage. Image quality is impressive in the end delivery of virtual microscope images, which can be accessed via a Java-enabled web browser. Regardless of the approach, a microscope equipped with a high-end digital camera or video camera is required to produce professional quality virtual slides. Of the two options presented above, QTVR is the most approachable in terms of technical expertise required; off-the-shelf software is widely available for producing such images. Production of microscopy images using the FlashPix approach involved significant storage capability, a customized server, and skilled personnel for media production and technical support, which translates to higher costs.

Historical Images

A library-based project where rare images from a special collection were delivered in the QTVR format is being considered the first-pass at working with this source content. Starting with 600 dpi images captured from professionally photographed 35mm slides, producers imported the images into QTVR Authoring Studio, an off-the-shelf software package. Using a variety of compression settings and exporting techniques, each image was produced as a QTVR object, providing zoom and pan capabilities. Hot spots were pre-authored, linking to more focused views of select portions of each image. One of the drawbacks to the format was that any zooming became centered in the middle of the image; to see a magnified portion of an image at the edge of the picture, an user must first zoom in and then pan across. Future project plans include re-authoring the virtual images using a different authoring tool, Zoomifyer, which will fix the zooming issue and will provide alternate file format delivery options, such as Java.

References

Harris T, Leaven T, Heidger P, Kreiter C, Duncan J, Dick F. 2001. Comparison of a virtual microscope laboratory to a regular microscope laboratory for teaching histology. Anat Rec (New Anat) 265: 10-14.

Trelease RB, Nieder GL, Dorup J, Hansen MS. 2000. Going virtual with QuickTime VR: new methods and standardized tools for interactive dynamic visualization of anatomical structures. Anat Rec (New Anat) 261:64-77.

Applying the REAL Model to Web-based Instruction: An Overview

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Abstract: This article deals with a significant challenge in education today: the challenge to teach life long learning and critical thinking skills in web-based environments. This is a challenge for two reasons. First, business and government are pressuring educational institutions to prepare employees who can think critically, solve a range of problems, move easily from one task to another, work in team situations, and continuously enhance their knowledge and skills. Second, consumers (i.e., students) desire more distant learning strategies. Most strategies that develop these skills emphasize small group work, collaboration, and teacher/group interactions. One approach to this challenge is to apply the Rich Environments for Active Learning (REAL) model to web-based learning environments. REALs are interactive, student-centered learning environments that rely on intentional learning, authentic contexts, generative learning activities, collaboration, and reflection to address the learning of content and life long learning skills.

The Collision of Two Educational Goals

Goal #1: Preparing People for an Ever-changing World

Changing global economic circumstances and increasingly complex societal needs place greater and greater pressure on education systems to develop learners who can apply knowledge and skills in new domains and situations. Both public and private institutions expect and demand employees who can think critically and solve a range of problems, move easily from one task to another, work efficiently and effectively in team situations, and constantly adjust and enhance their knowledge and skills to meet emerging needs; yet, these institutions claim that those people are difficult to find.

This isn't too surprising. Conventional instruction often utilizes simplified and decontextualized examples and problems. This leads to inert knowledge (Whitehead, 1929) – knowledge that cannot be transferred to real problems and situations. Learners are not asked to take responsibility for their own learning – they do not set learning goals, ask questions to direct learning activities, assess their learning strategies and approaches, or reflect on what they have learned. This lack of focus on metacognitive and self-directed learning skills interferes with their ability to transfer their knowledge and skills to future needs. Therefore, to meet the goal of "preparing people for an ever-changing world", instructional programs need to apply methods that focus on the development of higher-order learning skills including critical thinking, problem solving, research, and life long learning.

Goal #2: Learning at a Distance on Demand

The learning audience shapes the second goal — the demand for more distance education opportunities. Generally, most definitions of *distance education* include the concept of time- and space-independent teaching and learning. This includes the use of information and communications technologies, interactive video, and computer networks to enable asynchronous and synchronous learner-to-facilitator, learner-to-learner, and learner-to-content interaction. Distance learning alternatives help learners deal with a number of the personal constraints, obstacles, and needs:

- People live in remote geographic areas far from educational institutions.
- Local educational institutions may have a limited number of program options from which to choose.
- People have work schedules that conflict with campus-bound course schedules. This includes people who work shifts, travel frequently on business, work long hours, and are in the armed forces.

- People have personal and family commitments that conflict with campus-bound course schedules including children at home and aging parents.
- After a long day at work, people don't want to battle traffic or parking to get to a campus on time (and encountering the stress caused by trying to is not the best way to start a learning activity).
- Some learners may simply prefer a distance format over a face-to-face format because of their learning styles and preferences (e.g., more comfortable sharing ideas asynchronously).

Coming to Terms with These Goals

The tension created when these two goals collide is an instructional design one: On the one hand, how do you help people learn in a manner that enables them to transfer their skills and knowledge to a wide variety of situations; and on the other hand, how do you address the learning audience's expectation for learning experiences available on demand in highly individualized ways? One approach to this conflict is the application of the Rich Environments for Active Learning (REAL) model to web-based learning environments.

Rich Environments for Active Learning (REALs)

A model for applying the concepts of constructivism to instructional practice, REALs are comprehensive instructional systems that engage learners in dynamic, authentic learning activities that increase their control and responsibility over the learning process while they learn problem-solving and collaborative skills and content (Dunlap & Grabinger, 1995; Grabinger & Dunlap, 1995; Grabinger, Dunlap, & Duffield, 1997; Kommers, Grabinger, & Dunlap, 1996). The REAL model utilizes the following instructional strategies:

- intentional learning and student responsibility
- authentic contexts and relevant, meaningful learning
- dynamic, generative learning activities
- collaboration and the social negotiation of meaning
- extensive reflection and self-assessment

Encouraging Intentional Learning: Taking Ownership

Intentional learning refers to the cognitive processes that have learning as a goal. Students engaged in intentional learning are purposeful, effortful, self-regulated, and active learners (Palincsar, 1990; Palincsar & Klenk, 1992; Scardamalia & Bereiter, 1985; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989; Scardamalia & Bereiter, 1991; Scardamalia & Bereiter, 1997). Encouraging students to take "an intentional stance toward cognition" helps students learn how to monitor their own thinking and learning processes (i.e., metacognitive skills), and to pursue individually determined learning goals (i.e., self-directed learning). When students take responsibility, or ownership, over their own learning, they develop metacognitive and lifelong learning abilities (Honebein, 1996).

REALs help students manage their own learning by identifying their learning needs, setting learning objectives, selecting and employing learning strategies, using appropriate resources, and assessing their overall process. Research (Scardamalia & Bereiter, 1991) indicates that students can assess what they know and don't know and learn to ask questions to guide their knowledge building, thus assuming a "higher level of agency" and more ownership for their learning. To teach for intentional learning means to cultivate those general abilities that make it possible to become independent, life long learners (Palincsar, 1990).

Authentic Contexts

It is difficult to transfer learning from one situation to another. Learning is more likely to be transferred if instruction is situated within a realistic context (Brown, Collins, & Duguid, 1989). Anchoring learning in larger, more complex contexts helps prevent the acquisition of inert knowledge (Cognition and Technology Group at Vanderbilt, 1993). Because understanding is developed as a natural consequence of interaction with a complex environment, learning activities should be authentic, reflecting the types of interactions students are likely to face in the "real world" (Honebein, 1996).

Authenticity is an important part of REALs for four reasons. First, realistic problems hold more relevance to students' needs and experiences because they can relate what they are learning to problems and goals that they see every day (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Pintrich, Marx, & Boyle, 1993). Second, authentic situations that reflect the true nature of problems enable students to develop deeper and richer knowledge structures (Albanese & Mitchell, 1993) leading to a higher likelihood of transfer to novel situations. Third, authenticity encourages interaction through collaboration, and negotiation (Johnson & Johnson, 1979; Lowry & Johnson, 1981). Finally, ill-structured, complex problems require a team approach that provides natural opportunities for learners to seek out information, test and refine their ideas, and help each other understand the content.

Dynamic, Generative Learning Activities

Learners are active constructors of knowledge – not just passive receptors of information. Generative learning activities require students – individually and collaboratively – to be responsible for creating, elaborating, and representing domain knowledge in an organized manner (Cognition and Technology Group at Vanderbilt, 1990, 1993; Hannafin, 1992; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989; Scardamalia & Bereiter, 1991). Through generative learning activities, learners take an active role in forming new understandings through the creation of products and solutions to authentic challenges. This process of "generating" knowledge – instead of passively receiving information – helps learners develop transferable knowledge structures, strategies, and the skills for life long learning.

Some generative learning activities provide students with a context or situation requiring them to take action (e.g., a problem that needs to be solved or a case that needs to be analyzed). For example, Schank, Fano, and Jona (1993) describe a generative learning environment in their discussion of the research method of teaching. Under the research method of teaching, students research a particular topic and then present their results to others (e.g., the class, a collaborative group, etc.). In this way, students take over the responsibilities of information gathering, synthesis, and dissemination from the teacher. To be successful, students need to be allowed to select their own topics to research and report on, so that they have a real interest in proceeding with the assignment and have more control over their learning. Because the learning is student-directed, the learning is more meaningful. Bruner (1961) states, "...in general, material that is organized in terms of a person's own interests and cognitive structures is material that has the best chance of being accessible in memory".

Collaboration

Learning takes place in a social context; higher cognitive processes originate from social interactions (Vygotsky, 1978). Lebow (1993, p. 6) states that knowledge acquistion is "firmly embedded in the social and emotional context in which learning takes place". Thus, collaboration, conversation, communication, and establishing a community of learners are critical to the teaching and learning process (Pask, 1975).

REALs demand collaboration among students to achieve complex goals. By employing collaboration strategies, REALs help learners engage in a number of activities that support successful learning:

- *Collective problem solving*. Groups give rise synergistically to insights and solutions that would not come about individually. While working in collaborative groups, learners are more willing to take on the risk required to tackle complex, ill-structured, authentic problems because they have the support of others (Brown et al., 1989; Vygotsky, 1978).
- *Displaying multiple viewpoints*. Students experience and develop an appreciation for multiple perspectives when working with others. They may also play different roles within the group to gain additional insights. Conceptual growth comes from sharing perspectives and testing ideas with others – a negotiating process that modifies internal representations (Bednar, Cunningham, Duffy, & Perry, 1991).
- *Confronting ineffective strategies and misconceptions.* In collaborative work, group members draw out, confront, and discuss both misconceptions and ineffective strategies. Through collaborative participation, students also refine their knowledge through argumentation, structured controversy, and the sharing and testing of ideas and perspectives.

- *Providing collaborative work skills.* Students learn to work together in a give-and-take interaction rather than just dividing the workload. By participating in collaborative learning activities, learners gain an appreciation for the value of cooperation and the individual strengths that members of the team bring to the group.

Reflection and Self-Assessment

Self-reflection activities are embedded into REALs in order to support both the development of knowledge and metacognitive skills. Von Wright (1992) defines metacognitive skills as "the steps that people take to regulate and modify the progress of their cognitive activity: to learn such skills is to acquire procedures that regulate cognitive processes." Glaser (1984) describes this as knowing what one knows and does not know, predicting outcomes, planning ahead, efficiently apportioning time and cognitive resources, and monitoring one's efforts to solve a problem or learn. More specifically, metacognitive skills that are required for life long learning include (Ridley, Schutz, Glanz, & Weinstein, 1992):

- recognition of content and skill limitations;
- setting goals and creating action plans based on those defined limitations;
- activating the appropriate prior knowledge to achieve set goals;
- assessing progress in learning and task performance and effectiveness of learning resources selected;
- awareness of what still needs to be completed to reach a goal, and how best to allocate time and resources; and
- modification of strategies, tactics, processes, and resource selection based on the needs of the task at hand.

Even though reflective activity is important, it is possible for students to be so caught up in completing a task that they fail to reflect, impeding the learning process. "We can keep students so busy that they rarely have time to think about what they are doing, and they may fail to become aware of their methods and options" (Wheatley, 1992, p. 536). Schön (1983) refers to this as being "in the action" rather than reflecting "on the action." If students do not have opportunities to examine their methods and options, they will not develop the metacognitive skills needed for life-long learning. Therefore, learning activities need to support students in reflecting on their own learning and problem-solving processes, as well as on what they have learned (Schön, 1987).

Conclusion

A consistent theme within each of the REAL guidelines is "interaction." Interaction refers to the engagement of learners in the learning process. By engaged learning, we mean that all student activities involve active cognitive processes including creating, problem solving, reasoning, decision making, and evaluation (Kearsley & Shniederman, 1998). Interactivity involves the learners in options: watching, browsing, finding, doing, using, linking, annotating, constructing, creating, and elaborating (Ambron & Hooper, 1988; Sims, 1997). The use of technology does not diminish the importance of good pedagogy and good pedagogy demands interaction. This is especially true for web-based instruction with the critical need for learner-to-content, learner-to-learner/s, and learner-to-facilitator interaction.

References

Albanese, M. A., & Mitchell, S. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine, 68*(1), 52-81.

Ambron, S., & Hooper, K. (Eds.). (1988). *Interactive Multimedia.* Redmond, WA: Microsoft..

Bednar, A. K., Cunningham, D., Duffy, T. M., & Perry, J. D. (1991). Theory into practice: How do we link? In G. J. Anglin (Ed.), *Instructional technology: Past, present, and future*, (pp. 88-101). Englewood, CO: Libraries Unlimited, Inc.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist, 26*(3/4), 369-398.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, January-February*, 32-42.

Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, 21-32.

Cognition and Technology Group at Vanderbilt (1990). Anchored instruction and its relationship to situated cognition. *Educational Researcher*, August-September, 2-10.

Cognition and Technology Group at Vanderbilt (1993). Designing learning environments that support thinking. In T. M. Duffy, J. Lowyck, & D. H. Jonassen (Eds.), *Designing environments for constructive learning*, (pp. 9-36): Springer-Verlag.

Dunlap, J.C. & Grabinger, R.S. (1995). Applying the Rich Environments for Active Learning (REAL) model to higher education classrooms. In B. Wilson (Ed.), *Designing constructivist learning environments: Case studies in instructional design*. Englewood Cliffs, NJ: Educational Technology Publications.

Glaser, R. (1984). Education and thinking: The role of knowledge. *American Psychologist, 39*, 93-104.

Grabinger, R.S., & Dunlap, J.C. (1995). Rich environments for active learning: A definition. *Association for Learning Technology Journal* (ALT-J), 3(2), 5-34.

Grabinger, S., Dunlap, J. C., & Duffield, J. A. (1997). Rich environments for active learning in action: Problem-based learning. *Association for Learning Technology Journal* (ALT-J), *5*(2), 3-17.

Hannafin, M. J. (1992). Emerging technologies, ISD, and learning environments: Critical perspectives. *Educational Technology Research and Development, 40*(1), 49–63.

Honebein, P. (1996). Seven goals for the design of constructivist learning environments. In B. Wilson (Ed.), *Constructivist Learning Environments: Case Studies in Instructional Design*. Englewood Cliffs: Educational Technology Publications: 11-24.

Johnson, D. W., & Johnson, R. T. (1979). Conflict in the classroom: Controversy and learning. *Review of Educational Research, 49*, 51-69.

Kearsley, G. & Shniederman, B. (1998). Engagement Theory: A Framework for Technology-Based Teaching and Learning. *Educational Technology*, September-October 1998, 20-23.

Kommers, P., Grabinger, R. S., & Dunlap, J. C. (Eds.) (1996). *Hypermedia Learning Environments: Instructional Design and Integration*. Hillsboro, NJ: Lawrence Erlbaum Associates, Inc.

Lebow, D. (1993). Constructivist values for instructional systems design: Five principles toward a new mindset. *Educational Technology Research and Development, 41*(3), 4-16.

Lowry, N., & Johnson, D. W. (1981). Effects of controversy on epistemic curiosity, achievement and attitudes. *Journal of Social Psychology, 115*, 31-43.

Palincsar, A. S. (1990). Providing the context for intentional learning. *Remedial and Special Education, 11*(6), 36-39.

Palincsar, A. S., & Klenk, L. (1992). Fostering literacy learning in supportive contexts. *Journal of Learning Disabilities, 25*(4), 211-225+.

Pask, G. (1975). *Conversation, cognition, and learning*. New York: Elsevier.

Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63*, 167-199.

Ridley, D. S., Schutz, P. A., Glanz, R. S., & Weinstein, C. E. (1992). Self-regulated learning: The interactive influence of metacognitive awareness and goal-setting. *Journal of Experimental Education, 60*(4), 293-306.

Scardamalia, M., & Bereiter, C. (1985). Fostering the development of self-regulation in children's knowledge processing. In S. F. Chipman, W. Segal, & R. Glaser (Eds.), *Thinking and learning skills: Research and open questions*, (Vol. 2, pp. 563-578). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: a challenge for the design of new knowledge media. *The Journal of the Learning Sciences, 1*(1), 37-68.

Scardamalia, M., & Bereiter, C. (1997). Sociogognitive design issues for interactive learning environments across diverse knowledge building communities, *American Educational Research Association*, . Chicago, Illinois.

Scardamalia, M., Bereiter, C., McLean, R. S., Swallow, J., & Woodruff, E. (1989). Computer-supported intentional learning environments. *Journal of Educational Computing Research, 5*(1), 51-68.

Schank, R., A. Fano, Bell, B., & Jona, M. 1993. The Design of Goal-Based Scenarios. *Journal of the Learning Sciences 3*:4. 305-345.

Schön, D. (1983) *The Reflective Practitioner.* How professionals think in action, London: Temple Smith.

Schön, D. (1987) *Educating the Reflective Practitioner,* San Francisco: Jossey-Bass.

Sims, R. (1997). *Interactivity: A Forgotten Art?* [Online] Available http://intro.base.org/docs/interact/, January 27 1997.

Von Wright, J. (1992). Reflections on reflection. *Learning and Instruction, 2*, 59-68.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University.

Whitehead, A. N. (1929). *The aims of education and other essays.* New York: The Macmillan Company.

Xtreme Learning Control: Examples of the Open Source Movement's Impact on Our Educational Practice in a University Setting

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Abstract: This paper describes how Open Source philosophy – a movement that has developed in opposition to the proprietary software industry – has influenced our educational practice in the pursuit of scholarly freedom and authentic learning activities for our students and ourselves. This paper provides a brief overview of the Open Source movement, and describes three Open Source-inspired Web-based tools/environments developed to promote open sharing and constructing of scholarly work on the Web.

Overview

Do you know the story about the discovery of the structure of DNA? Or, the discovery of the Rosetta Stone cipher? Both are stories of not only brilliance, but also competition. Relying on the foundational work of Linus Pauling, Francis Crick and James Watson discovered the double helix. Then separately, relying on the foundational work of Thomas Young, Jean Francois Champollion deciphered the Stone's script. However, due to competition and secrecy, which kept all parties from openly sharing their findings (and possibly sharing the rewards of discovery...after all, whose name do you remember?), the progress of science may have been delayed. This type of competition is in direct conflict with the nature of science and discovery – a process of evolving exploration founded on the work of others.

Educators are concerned with the impact this type of competition and secrecy can have on their practice as well; educational innovation can be stymied by industry and individuals that perpetuate the politics and control over professional sharing and advancement – such as the publishing industry or the proprietary communication and collaboration software industry. Although some educators may hold secret the work they are doing to advance knowledge and practice around good teaching and learning, most are interested in advancing the collective understanding – in sharing insights, ideas, solutions, and materials that can help us all do our work more effectively. Educators are also interested in creating tools and structures that support the type of learner-centered, collaborative knowledge sharing that can lead to discovery and innovation. Often, educators are stymied in these pursuits due to excessive proprietary software costs and dwindling institutional budgets.

This paper describes how Open Source philosophy – a movement that has developed in opposition to the proprietary software industry – has influenced our educational practice in the pursuit of scholarly freedom and authentic learning activities for our students and ourselves. This paper provides a brief overview of the Open Source movement, and describes three Open Source-inspired Web-based tools/environments we have developed with our students and colleagues to promote open sharing and constructing of scholarly work on the Web.

Open Source Movement

Encouraging innovation through open sharing to facilitate replication and discovery, the Open Source movement is a grassroots revolution that has taken shape in the world of information technology. The Open Source movement is challenging the commercial model of technology advancement, exemplified in the software industry by Microsoft. Linux, an operating system whose source code is open for the world to see and costs nothing to download and use, has become a significant force for change in the software development world. Other information technology products emerging from the movement include Netscape/Mozilla, Apache, Perl, and GIMP. Open Source advocates are trying to create a world where software is openly available and a living is made through continuing relationships of service and support. These same Open Source ideas are influencing our teaching and learning practice. The following are three examples of how Open Source has impacted our work with students at the University of Colorado at Denver.

Self-Publishing: *NOVAtions Online Journal [in Joni's voice]*

A year ago, I was informed that it was my turn to teach a doctoral course focused on instructional technology during the up-coming fall semester. This course is part of a doctoral program in educational leadership and innovation, and – as such – the participating doctoral students were interested in a wide range of educational foci: teacher education, paraprofessional preparation, teaching and learning in K-12 and adult settings, and technology-enhanced learning. In preparing for the course I anticipated insightful, yet challenging, discussions and collaborations given the diverse backgrounds and interests of the students. I realized that there was no way for me to be the "expert" in all of their interest areas during our experience together, and that I didn't need to be because the students were emerging experts in the topic foci they were studying. So, I looked for a way to create a unifying theme and project while at the same time taking advantage of the developing expertise of the students to create a valuable learning experience for everyone – including myself. To this end, we built a grassroots online professional journal.

NOVAtions is an online journal for emerging scholars built using the Slashdot.org Open Source code (see http://novations.opencentric.com). Slashdot.org is an online self-organizing social system (OSOSS) (Wiley & Edwards, 2002) that is a Web-based news source in which the readership contributes and reviews news items, and has significant influence and control over the direction of and themes covered by the site. Our *NOVAtions* journal is designed to provide a forum for a community of practice – scholars interested in educational innovation in teaching and learning. Contributors to the journal also function as the editorial review board, in much the same was as Amazon and Barnes and Noble enable the book buying public to serve as reviewers.

The doctoral students in my course built the *NOVAtions* journal from scratch (see Figure 1). Self-publishing the online journal provides the doctoral students with an authentic, enculturating leadership experience in which they:

- publish articles and collaborative book reviews to learn more about the process of sharing scholarly ideas with others and publishing ideas in a journal, and
- serve as the editorial review board to learn about the editing process and improve their own writing.

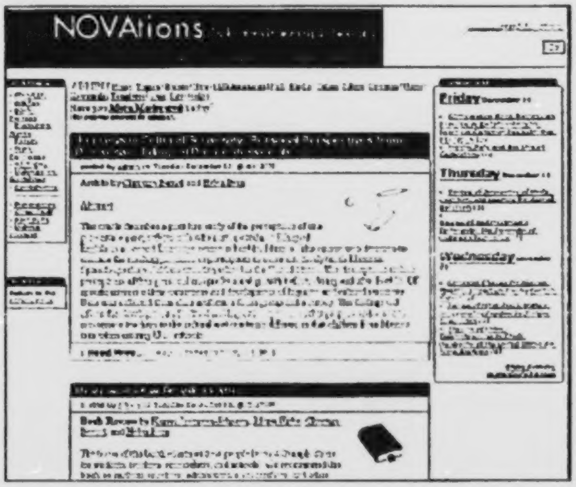


Figure 1: Students self-publishing in *NOVAtions* online journal

This fledgling journal was launched in December 2001, and plans are now in the works to extend the journal participation to the larger community of practice in educational leadership and innovation.

BEST COPY AVAILABLE

Knowledge Sharing: *Web Resource Collaboration Center (WRCC) [in Joni's voice]*

The Web Resource Collaboration Center (WRCC) (Dunlap, 1999) is a Web-based tool which empowers learners to build their own Web-based resource centers – using the Web to provide on-demand access to integrated information, guidance, advice, assistance, training, and tools – to support their learning, professional development, and performance.

A few years ago, I was hired by an information technology organization to "get to the bottom" of why its elaborate electronic performance support system (EPSS) which was available on the company's intranet was not being utilized by employees. The company had used its training and development resources to build this EPSS to help employees keep up with all of the new technologies they were expected to master for the various contractual projects of the organization. Since a front-end analysis was not actually conducted before the development of the EPSS, this is where I started. The employees were pleased that the EPSS provided a variety of resources (e.g., tutorials, white papers, job aids, business cases, etc.) to support their various learning needs and preferences. Instead of conventional training, they wanted access to learning and professional development resources that would help them keep their knowledge and skills "cutting edge".

Although they were not against the idea of an EPSS, the employees did not believe that the developers of the EPSS understood what resources they needed. In addition, they certainly believed that developers did not know how to present them in contextualized ways (e.g., resources that would help with one type of project vs. another type of project). They were also concerned that there was no way to capture the "here's how I did it" expertise of the people in the organization, and in the external community of practice. Finally, the EPSS was static. This was in sharp contrast to the constantly evolving information and tools these employees were using. The most up-to-date information was being distributed on the Web. The EPSS was not dynamic enough to capture those changes, so the employees were using the Web to support their learning and professional development – albeit not very efficiently which led to frustration. Bottom line, the employees had been cut out of the process, and believed that they were better judges of what was needed to support their learning and work.

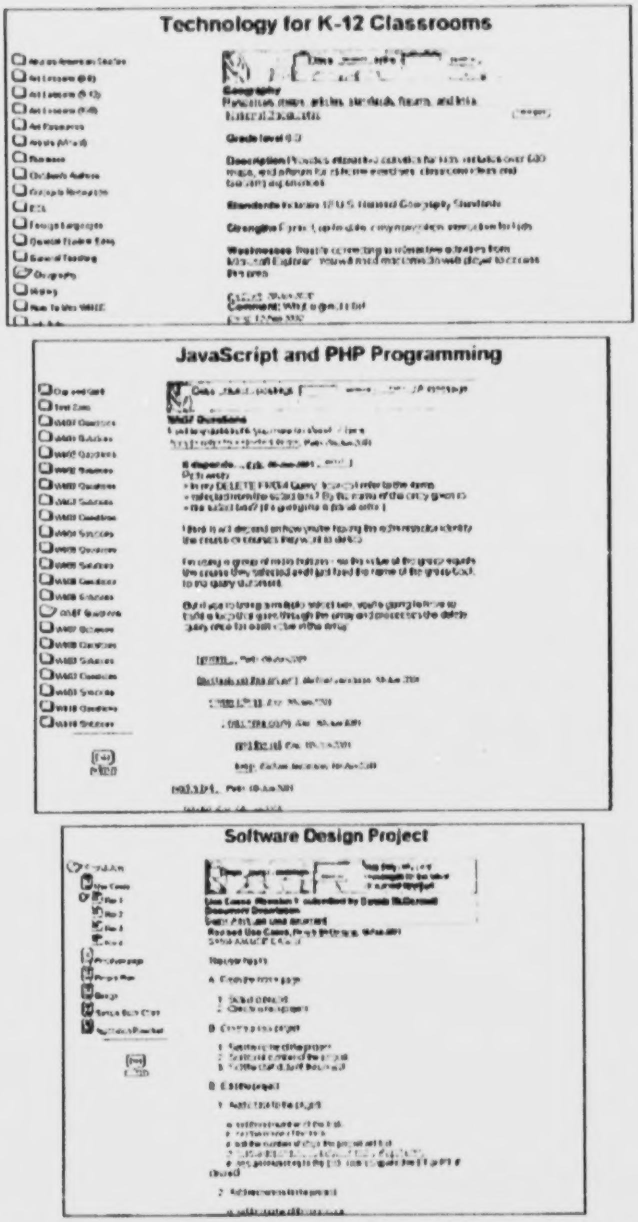
This consultation led to my interest in developing a tool that would (1) take advantage of some of the structural qualities of EPSS, (2) harness the resources on the Web (since it was a distribution source for some of the most up-to-date information and tools), and (3) provide a structure for learning communities and communities of practice to build their own unique content to support both lifelong learning and professional development activities. To meet this challenge, we created a Web-based development tool called the Web Resource Collaboration Center (WRCC).

By creating a structure that supports individualized and collaborative knowledge building by the people who will actually be using the knowledge, the higher-order thinking, problem-solving, and decision-making involved in the selection and utilization of appropriate learning materials and performance support is done by those who can get the most out of the process. Additionally, because these activities occur in the workplace and are driven by the needs of the job at hand, the learning activities are contextualized, authentic, and meaningful. The WRCC meets the following goals:

- The users learn about the domain while they are locating, evaluating (which requires utilization of resources), organizing, and creating resources to support their learning and job performance activities – making the process relevant and productive;
- The content of the WRCC is information that has been applied/articulated from the perspective of reflective practice, making the WRCC a knowledge management forum;
- The WRCC is developed by and for the people involved in the project, challenge, or domain; and
- The WRCC can change and adapt based on the changing organizational and learning/performance needs because the end-users control the content.

In this way, the WRCC not only enables learners to build a learning and performance resource that will provide them with immediate support and guidance, but also helps them develop structure, strategies, and skills for subsequent learning activities.

To provide a structure for these activities, the WRCC is broken into three functional areas: the Discussion Forum, the Link Manager, and the Resource Construction System (see Figure 2). These tools – written entirely in Perl – are not unique – there are similar tools available from a variety of sources. The impact is in the use and integration of the tools, and the fact that they are Open Source and support learner-centered knowledge sharing.



Technology for K-12 Classrooms

JavaScript and PHP Programming

Software Design Project

Figure 2: Examples of WRCC's Link Manager, Discussion Forum, and Resource Construction System

Once built, I recognized the value of this type of tool for learning communities in general, including the students I work with at the university. The WRCC is being used to support instructional activity in both face-to-face and online courses, and as a performance support and knowledge management tool by self-organizing learning communities (see http://carbon.cudenver.edu/public/wlc/wrcc/techfork12/ for an example of a WRCC).

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Self-Organized Learning and Performance Support Groups: *Electronic Knowledge Base (EKB)*

In our Information and Learning Technologies (ILT) Master's program, we organize students into cohorts. As a cohort, students progress through the program together, and quickly develop of professional bond that lasts beyond the program. One ILT Master's cohort of 20 K-12 teachers shared a common purpose of learning how to best integrate technology into their instruction, classrooms and schools. This group was constantly sharing their views, understandings, and opinions, as well as information and research they unearthed. This collective base of knowledge was the lifeblood of their common endeavor, and they wanted to "capture" the knowledge they were discovering and constructing with each other.

Inspired by Jonassen, Peck, and Wilson's (1997) note that "learning and knowledge-building communities depend heavily on ... a rich collection of information and learning resources to support them," this cohort designed and developed Electronic Knowledge Bases (EKBs) using adapted Perl scripts available at no charge to educational institutions (Young, 2000; see http://carbon.cudenver.edu/public/ilt/pages/). They used the EKBs as a way to formalize the process of collecting a rich source of knowledge resources. These databases served as an easily accessible and amendable repository of knowledge assisting them in their search for specific information and research related to teaching and learning. The EKBs supported their efforts as a dynamic learning community, and became a source of knowledge for other educators not participating in the ILT Master's program (see Figure 3). Dave Young, then a student and more recently a faculty colleague and co-author, was the primary developer of the resource.

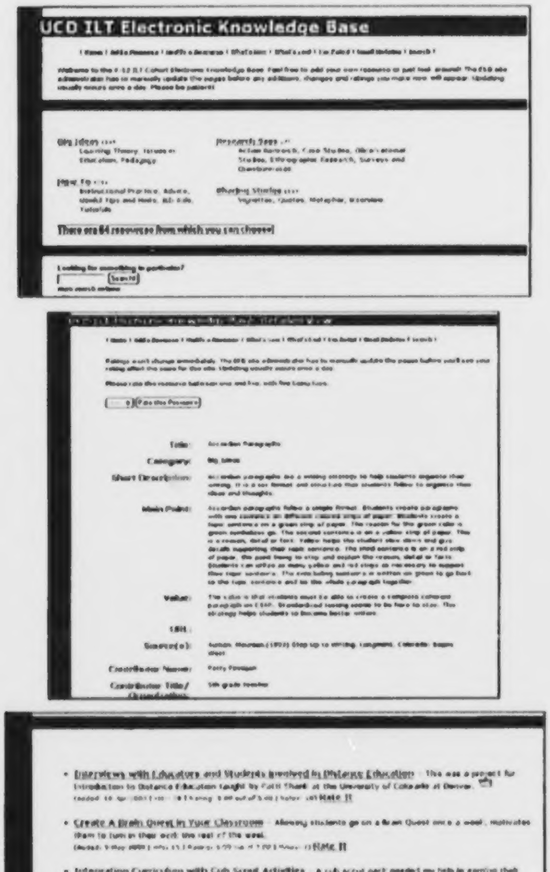

Figure 3: EKB Homepage, Detailed View of Contribution, and Resource Review Feature

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Peer-to-peer networking: *Our Next Adventure*

Although we haven't implemented peer-to-peer networking in our environment, we are very intrigued by the possibilities and planning it as a next step in our adventure in reclaiming learner control. Peer-to-peer networking refers to individual users sharing resources by opening up their hard drives to each other – a group of computers communicate directly with each other, rather than through a central server. Besides potentially having a positive impact on collaboration and knowledge sharing, it can also make good technical, infrastructure sense – if computing power and resources are distributed then no one server or network connection is over-taxed.

The Napster phenomenon taught us that downloading from central servers is not the only way to perpetuate an online enterprise. The core concept is even more radical than Napster's, because once out of the bag and in the hands of end users, true peer-to-peer usage cannot be controlled. In this way peer-to-peer networking constitutes a classic form of self-organizing system, using the technology to bypass every form of central control and put the control in the hands of learners.

Conclusion

The Open Source movement is a reenergizing catalyst for our reclamation of *learner control*. Influencing how we think about supporting collaboration, knowledge sharing, and teaching and learning in general, we are embracing the message of Open Source with open arms. The three examples described above – as well as the work being done by colleagues at other institutions, such as Utah State University's SlashLEARN project (Irving, 2001; see http://www.slashlearn.org/) and StorageTek's COSS project (Ryder & Wilson, 1997) – have inspired us to continue to enrich our practice and our students' learning experiences through the integration of Open Source-inspired tools and environments. We bok forward to sharing our projects and implementation results with our ED-MEDIA colleagues.

References

Dunlap, J. C. (1999). Developing Web-based performance support systems to encourage lifelong learning in the workplace. WebNet Journal, Charlottesville, VA: AACE.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). Learning with Technology: A Constructivist Perspective. Columbus, OH: Prentice Hall.

Irving, J. (2001, July). SlashLearn: Discussion and debate for instructional technologists. Retrieved December 5, 2001 from the World Wide Web: http://www.bcota.com/ilt/dwarticle.htm

Ryder, M., & Wilson, B. G. (1997). From center to periphery: Shifting agency in complex technical learning environments. Paper presented at the meeting of the American Educational Research Association, March 27, 1997, Chicago. Retrieved December 5, 2001 from the World Wide Web: http://carbon.cudenver.edu/~mryder/coss.html

Wiley, D. A., & Edwards, E. K. (2002). Online self-organizing social systems: The decentralized future of online learning. Retrieved December 5, 2001 from the World Wide Web: http://wiley.ed.usu.edu/docs/ososs.pdf

Young, D. L. (2000). Electronic Knowledge Base in support of a dynamic learning community. Paper presented at the meeting of the Association for Educational Communications and Technology, October 28, 2000, Denver. Retrieved December 5, 2001 from the World Wide Web: http://ceo.cudenver.edu/~dave_young/portfolio/EKB_and_LC_Action_Research.rtf

Using Technology to Create and Enhance Collaborative Learning

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Abstract: Oklahoma Christian University has implemented a ubiquitous computing program where every student and faculty member are equipped with IBM ThinkPad laptops that connected to a wireless network. The technological enhancements provided by this program helped to create an environment where collaboration between students and faculty could be increased. During the first full year of implementation, one course typically taught in a lecture-based format was re-designed to foster more collaboration and active learning. The instructor enhanced the course with collaborative technology, delivered most of the first exposure to the materials online, and created collaborative assignments to be done during the classroom time. A survey and several interviews were conducted to glean student feedback. Students found the course challenging and they rose to meet that challenge.

Introduction

Oklahoma Christian University is blazing a new trail with the e-campus concept instituted in the Fall of 2001. "The new technologies provide opportunities for creating learning environments that extend the possibilities of "old" (Bransford et al., 1999). Oklahoma Christian launched its wireless e-Campus in the Fall of 2001 by distributing IBM ThinkPads with wireless networking capabilities to every full-time student. It is the first university in Oklahoma and one of the few nationwide that offer to all students a wireless campus and laptop computers. Students can access the Internet or myOC (the university's personalized, web-based portal) from virtually anywhere on campus. Such a culture change affects not only students, but also faculty. For some, this culture change is an easy adjustment; for others, a seemingly insurmountable hurdle. Yet, the change affects everyone and it demands adjustments in the way teachers teach and students learn.

The use of technology does not guarantee that effective learning will occur in a course. Bransford, Brown and Cocking (1999) say that technology can, in fact, hinder learning if used inappropriately. However, when used appropriately technology can connect teachers, the instructional experience, and learners in ways that enhance learning (Newby, et. al. 2000). The goal of this collaborative effort is to use technology as an instructional intervention in the creation of an effective learning environment that is based on current research regarding how people learn.

Integration of Pedagogy and Technology

The Office of Educational Research and Improvement of the U.S. Department of Education charged a 16 member committee with the task of evaluating new developments in the science of learning (Bransford, et al., 1999). This committee reviewed research and consulted with experts in the process of reporting the most current information regarding how people learn. Their recommendations are instructive for all educators.

These new conceptions of learning have created a shift from an emphasis on rote learning and repetition to a focus on depth of understanding and the ability to apply new knowledge. The implications of this new focus require new or renewed instructional interventions and learning environments (McLaughlin and Shepard, 1995).

The foundation of the classroom model that follows is a learner-centered approach to education. This model is steeped in collaborative learning and has a strong emphasis on formative assessment (Poindexter et. al, 2001). This discussion continues by exploring each aspect of this model course

"Learner-centered" environments value the knowledge, skills, attitudes, and beliefs that learners bring with them to the classroom (Bransford et al., 1999). The conceptual knowledge and beliefs that students bring to the classroom are the starting point of instruction. The pre-assessment in the model class purposefully investigates the knowledge that students are initially bringing to this course.

Learning is greatly influenced by the context in which it occurs. Instructors are charged with creating a learning community that facilitates students sharing their preconceptions, questions, and taking learning risks in pursuit of academic growth. Cooperative and collaborative learning are strongly supported instructional tools in the research literature. They have been shown to lead to cognitive development (Johnson and Johnson 1984; Slavin, 1991; Sharan and Sharan, 1989/90; Bransford et al., 1999).

The model course that follows requires students to read and listen to lectures outside of the classroom so that classroom time can be spent on collaborative pursuits. Students are placed in learning teams as they work through multiple milestone assignments. They will also produce a capstone project. The instructional technology embedded in the course encourages collaboration beyond the four walls of the classroom. Students may use Microsoft NetMeeting to work together online, as well as communicate and collaborate with the instructor. Synchronous chats, message boards and email will provide students with the opportunity to receive feedback from peers outside of their learning team. The instructor will serve as a guide, but students will be charged with directing their own learning. Student-involved learning has a strong link to academic achievement (Stiggins, 2001).

A unique and innovative aspect of this course is its use of formative assessment. Educators of the twenty-first century are functioning in an assessment climate that is almost completely focused on summative assessments (Stiggins, 2001). While these summative assessments provide very specific information about what students know, they do little to promote learning (Gallagher, 2000; Stiggins, 2001). Dylan Wiliam (2000) defines summative assessment as assessments that are "used to certify student achievement or potential" (p. 1). He goes on to describe formative assessments as assessments that "provide feedback to learners about how to go about improving" (p. 1). Crooks (2001) talks about formative assessment as assessment *for* learning. Several research projects highlight the connection between formative classroom assessment and academic achievement. Professor Terry Crooks (1988) of the Univeristy of Otago, New Zealand conducted a synthesis of over 200 studies on the use of formative assessment. He concludes that formative classroom assessment can have a very positive impact on student achievement. He further chronicles the connection between classroom assessment and student decision-making. "The decisions students themselves make, he (Crooks) contends, are the decisions that determine what is learned (Stiggins, 2001). "It [classroom assessment] guides students' judgments about what is important to learn, affects motivation and self-perception of competence, structures their approaches to and timing of personal study…consolidates learning and affects the development of enduring learning strategies and skills" (Crooks, 1988, p. 267).

English researchers Paul Black and Dylan Wiliam (1998) conducted a meta-analysis of more than 40 controlled studies centered on the impact of improved classroom assessment on student achievement as reflected in summative assessments. They asked three questions in this project:

- Is there evidence that improving the quality and effectiveness of use of formative assessments raises student achievement?
- Is there research evidence that formative assessments are in need of improvement?
- Is there evidence about the kinds of improvements that are most likely to enhance student achievement?

The results conclude a resounding "yes" to all three questions. The results cross all content areas, knowledge and skill types and all levels of education. Results reveal unprecedented gains in achievement. They report effects between 0.4 to 0.7.

> An effect size of 0.4 would mean that the average pupil involved in an innovation would record the same achievement, as a pupil in the top 35% of those not so involved. An effect size gain of 0.7 in the recent International comparative studies in math would have raised the score of a nation in the middle of the pack of 41 countries (e.g., US) to one of the top five.
>
> (Black and Wiliam, 1998, p. 141).

Strong evidence supports the use of formative classroom assessment. This model course provides multiple opportunities for students to receive feedback from the instructor and fellow students so they can adjust their learning. It also provides opportunity for the instructor to assess students and then make instructional decisions based on those assessments.

Current research encourages educators to "Explore the potential of new technologies that provide the opportunity to incorporate formative assessment into teaching in an efficient and user-friendly manner" (Bransford et. al., 1999, p. 39). This model course is an exploration of that potential.

Case Study Context

The model course consisted of 37 freshman-level students. Eighty-three percent of the students were between 18 and 20 years old; 10 percent were between 23 and 24 years old; and 7 percent were 25 years old or older. Sixty percent of the class was male, 40% were female. There were only three international students in the course, one from Venezuela, one from Australia, and the third from Africa. Ninety percent of the students lived on-campus and, therefore, had 24/7 access to the technology described above.

The model course was designed to make heavy use of technology, yet the technology was meant to be "transparent," used as a tool of the trade (much like a pencil or textbook). Priority was given to student learning. If the technology inhibited student learning, it was changed or removed. This course was designed so that it could be offered as a hybrid course (i.e., a course that has both F2F and online components) or as a distance education course.

The course followed a 20/80 rule (sometimes 10/90), meaning only be about 20% of face-to-face (F2F) time was used for lecture while about 80% of the F2F time was designated for students to collaborate on assignments or for in-class presentations (Poindexter et. al., 2001). To accomplish this, every lecture meant to give the students first exposure to the material was moved outside the classroom and into the Blackboard course management system (Walvoord & Anderson, 1998). Each lecture was accompanied by the instructor's notes. The learners logged into the Blackboard course site, clicked into the lecture area, and listened to the lecture prior to the class meeting. These lectures consisted of digital audio of the instructor (or guest lecturer), accompanied by PowerPoint slides which were synchronized with the recording. The student could stop, play, pause, or resume these presentations. Moreover, s/he could jump ahead or back in the presentation by clicking a hyperlink to the desired slide. These lecture materials were available to the students for the entire semester (and beyond) and could be reviewed at the discretion of the student. After listening to the lecture, the students took quizzes over the material that was introduced (all quizzes will be given online using the built-in assessment feature in Blackboard). The instructor reviewed the scores of this assessment and adjusted the 10%-20% classroom lecture time for remediation as necessary. Other than these quizzes, no exams were given in this course.

The students were grouped into teams in order to collaborate on assignments and the final project. The groupings were based on several criteria:

- results of the Keirsey version of the Myers-Briggs temperament analysis
- learning styles
- self-selection (limited)

(Poindexter et. al., 2001)

Teams collaborated on multiple milestone assignments and one final project. The milestone assignments demonstrated the learners' abilities to identify and accomplish the steps in the interpretive process. Each team chose a passage from *The Acts of the Apostles* and they worked on that text throughout the semester. These passages were the subject of the milestone assignments as well as the final project. The milestone assignments were primarily written assignments, but occasionally students were asked to present their work in class.

The final project had two parts. First, each team submitted an interpretation paper to their instructor in which they offered and defended an interpretation of the passage from Acts they chose. Next, each team gave an in-class presentation of their interpretation. This presentation required the use of a technological medium for its delivery. The student could have chosen from PowerPoint, digital video, web sites, or some other digital medium. Their presentations could not exceed 20 minutes in length, in order to allow time for critical peer review. The team of students filled the role of teacher during these presentations.

The instructor provided several ways for students to communicate with him and even collaborate on assignments as necessary. First, Blackboard has many built-in features to allow this: e-mail, message boards, and the virtual classroom (i.e., synchronous chat), to name a few. Moreover, the instructor had embedded Microsoft NetMeeting into a web page and uploaded it to the Blackboard course site. He pre-configured the software to call his computer at the click of a button. NetMeeting allowed the learners to call the instructor over the Internet and collaborate with the him on the assignment or to simply receive feedback. For example, if a student needed feedback on a milestone assignment, s/he may call the instructor using NetMeeting. NetMeeting allows application sharing over the Internet, so s/he could open the word processing application, share that application through NetMeeting, and give control to the instructor. Then the instructor could actually mark up the student's document with comments, suggestions, and corrections as necessary. This allowed for more than just feedback; it also allowed the student (or team) to actually collaborate on an assignment with the instructor.

The instructor provided several ways for the team members to collaborate as well. First, they, too, could have used NetMeeting for collaboration in the same manner described above (NetMeeting allows multiple users to connect with each other). Next, the instructor enabled the groups feature in Blackboard. Each group could collaborate using message boards, chat, e-mail, and file sharing—all of which are built into Blackboard. Each team had its own message board, chat room, e-mail address, and digital drop box, and those tools were only open to members of the same team.

The instructor provided all reading and research materials to the student in at least one of the following ways:

- digital format via Blackboard (articles will be scanned to PDF and uploaded to the content areas of the course web site in Blackboard)
- on reserve in the university library
- links to content available on the Internet and World Wide Web.

Those items that could not be provided were listed in a digital bibliography so the students could order items from the library using the Interlibrary Loan service or found them on Net Library in e-Book format.

Findings and Discussion

A survey was conducted at mid-term of the course and several interviews with students were conducted at various times throughout the semester. Each of these assessments revealed some interesting information. First, 50% of the students agreed or strongly agreed that the technology used in this course enhanced their ability to learn the material. The students found themselves interacting with the material and with each other more in this course than in any of their other courses. Because the lectures were online and because the technology allowed them to communicate with each other so much easier, they found themselves engaged in the course material even on days the class was not meeting.

The survey and the interviews uncovered another interesting fact. On the survey, the students were asked if they agreed or disagreed with the following statement: "If given the opportunity to take this class again, I would choose an Acts class with a more traditional lecture format." Fifty-four percent of the students agreed or strongly agreed with this statement, 20% were neutral, and 27% disagreed or strongly disagreed. However, several interviews with different students enrolled in the course revealed at least one reason why they would have chosen lecture-based course: it is easier. Every student interviewed commented that this course was very demanding, whereas lecture-based courses are not as demanding because "all you have to do is show up, memorize facts for the exam, regurgitate those answers on the exam, and that is it. There are really no assignments where we have to work, like there are in this class." Students will, however, rise to meet the expectation of a course. While there are many factors contributing to one class's grades being higher, it is still interesting to compare grades from this course and the same course taught in a lecture-based format (see Tab. 1).

	Lecture-based	Technology-enhanced
A	8 (25%)	9 (26%)
B	10 (31%)	20 (57%)
C	5 (16%)	4 (11%)
D	2 (6%)	0 (0%)
F	7 (22%)	2 (6%)

Table 1

It appears that students in the technology-enhanced, collaboration-heavy course performed better than those in the passive, lecture-based course.

Finally, it was also discovered that students enjoyed working on the assignments in teams. As one student put it, "There was still pressure to do the assignment and to do it well, but pressure on a team is a lot different than pressure one a single individual." In the beginning, there were grumblings about the way teams were chosen, but those grumblings ceased and even turned into positive results. One student remarked, "At first, I didn't like the team I had been placed on, but as the semester went on, I developed a strong relationship with my team members—I trusted them to do their best and they trusted me to do my best. When I needed help, they helped; when they needed help, I helped." Yet, as is normal, there were a couple of dysfunctional teams. Usually, the root of the dysfunction was related to external circumstances and not issues within the group.

There were also several lessons learned during this course. One lesson shows that while technology makes it easier to collaborate, students still desire face-to-face contact with the instructor and other students. Interestingly, the students enjoyed and even wanted the collaborative technology in place—and they used it. However, they also wanted a high level of face-to-face collaboration. Many of the teams worked out schedules of when they would meet online and when they would meet face-to-face. When meetings were online, usually every team member was "present" at the meeting; face-to-face meetings were not as well attended, but the quality of the meeting at the face-to-face meetings was often better than those conducted online. According to those who reported this fact thought it was due to the level of focus or distraction: there tended to be a greater focus at the face-to-face meetings and more distraction at the online meetings.

In terms of the collaborative technology provided for the students (e.g., Microsoft NetMeeting), the students tended to find their own technology for collaboration. By far the most popular was instant messenger software that the students obtained on their own. A close second, however, were the collaboration tools built into the Blackboard course management system.

Implications of this work for Oklahoma Christian University

This course provides faculty with one possible teaching model that integrates technology and pedagogy. This model is based on current pedagogical research. Moreover, the model serves as a stimulus for conversations regarding best teaching practices in classroom instruction at the college level.

The course also provides a model for teaching a course via distance education. As mentioned, the model course was designed in such a way that it could be taught in a face-to-face setting or a distance education setting.

Implications for Other Institutions

We would like to encourage other institutions of higher learning to have conversations about best pedagogical practices and how technology can facilitate learning in classroom settings.

References

Black, P. and Wiliam, D. (1998). Assessment and classroom learning. *Educational Assessment: Principles, Policy and Practice*, 5(1), 7-74.

Black, P. and Wiliam, D. (1998). Inside the black box: raising standards through classroom assessment. *Phi Delta Kappan*. October, pp. 139-144.

Bransford, J., Brown, A., and Cocking, R. eds. (1999) *How people learn: brain, mind, experience, and school.* Washington, D.C.: National Academy Press.

Chickering, A. and Ehrmann, S. (1987). Implementing the seven principles: technology as lever. *American Association for Higher Education Bulletin.* Winona, Minnesota: The Seven Principles Resource Center Publishing.

Covington, M. (1992). *Making the grade: a self-worth perspective on motivation and school reform.* New York, NY: Cambridge University Press.

Crooks, T. (2001). The validity of formative assessments. *University of Otago,* Dunedin, New Zealand.

Crooks, T. (1988). The impact of classroom evaluation on students. *Review of Educational Research,* 58(4), 438-481.

Gallagher, C. (2000). A seat at the table: teachers reclaiming assessment through rethinking accountability. Phi Delta *Kappan.* March 2000, v. 81/7, 502-507.

Johnson, D., and Johnson, R. (1984). *Circles of learning: cooperation in the classroom.* Alexandria, VA: Association for Supervision and Curriculum Development.

McLaughlin, M. and Shepard, L. (1995). *Improving education through standards-based reform.* Washington, D.C.: National Academy of Education.

Newby, T. J., Stepich, D. A., Lehman, J. D., and Russell, J. D. (2000). *Instructional technology for teaching and learning.* Upper Saddle River, NJ: Merrill.

Poindexter, Sandra, Basu, Choton, and Kurncz, Steve (2001). Technology, teamwork, and teaching meet in the classroom. *Educause Quarterly*, 24/3, 32-41.

Sharan, Y. and Sharan, S. (1989/90). Group investigation expands cooperative learning. *Educational Leadership,* 47, 17-22.

Slavin, R. (1991). Synthesis of research on cooperative learning. *Educational Leadership,* 48/5, 71-82.

Stiggins, R. (2001). *Student-involved classroom assessment, 3rd ed.* Columbus, OH: Merrill.

Stiggins, R. (2001). The unfulfilled promise of classroom assessment. *Educational Measurement: Issues and Practice,* Fall 2001.

Walvoord, Barbara E., and Anderson Virginia Johnson (1998). *Effective Grading.* San Francisco: Jossey-Bass.

Wiliam, D. (2000). Integrating formative and summative functions of assessment. Paper presented to Working Group 10 of the International Congress on Mathematics Education, Makuhari, Tokyo, August 2000.

Adoption of Computer-Based Instructional Methodologies: A Case Study

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Abstract: Qualitative data collected from 24 lead faculty members at a regional comprehensive university were analyzed to discover barriers and incentives to the adoption of educational technology. Leading barriers to adoption of educational technology are; time, resources, and lack of confidence in the benefit of educational technology. Incentives that were mentioned included; because it's the right thing to do, personal satisfaction, and student demand. The effect of mentor role models, modeled use of educational technology, and other exposure to educational technology methodology is also discussed.

Introduction

One of the challenges for implementing technology-based learning on college campuses is providing support for instructors who are already motivated to engage in new approaches to teaching and learning. Another challenge is to provide the initial motivation that will convince faculty that the time and effort required by these new approaches is justified. The University of Southern Colorado[1] in Pueblo, Colorado is a regional comprehensive institution that has begun to address both of these challenges with an innovative program which supports faculty who are early adopters with the time and resources necessary to develop showcase projects. These projects in turn will be used to attract and recruit other faculty within their colleges, hopefully inspiring them to take the plunge into the world of technology-enhanced teaching and learning.

The use of educational technology on the USC campus has been, until recently, determined on an individual basis, or departmentally. In 2000, Blackboard course management software was installed on campus. In the same year, the University developed a strategic plan that recognized the importance of educational technology to teaching and learning. And most recently, the faculty handbook was modified to include appropriate use of educational technology as a criterion on which faculty performance is evaluated.

A national survey found that almost 47% of classes were taught utilizing web page supplementation nationwide at public universities (Green, 2001). Currently, approximately 33% of the University of Southern Colorado's classes employ web pages as adjunct information for student use. At 55% of participating universities, including USC, on-line course management tools, e.g., Blackboard, WebCT, or e-education, are provided. On other campuses with course management capabilities, 22% of classes were offered using these tools, whereas, at USC approximately 18% of all courses utilized the on-line supplemental interface. Nationwide, 34% of all faculty members have their own web pages, whereas at USC less than 20% of faculty members do so. USC is among those institutions that; require all students to take a mandatory introductory computer class, offers supportive instructional training for faculty, and provides computer access for every faculty member. The comparative results would suggest that USC shares the number one challenge highlighted by the national participants, that "assisting faculty to integrate technology into instruction is the single most important Instructional Technology issue confronting their campuses over the next two to three years" (Kenneth Green, personal communication, November, 26, 2001).

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[1] The University of Southern Colorado is a member of the Colorado State University System. During the 2001-2002 academic year, the University enrolled 4,000 students in twenty-nine undergraduate and six graduate programs with approximately 500 full-time faculty and staff. The University has been an Hispanic Serving Institution since 1998, and is accredited at the bachelor's and master's levels by the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools.

It is in this context that the University received a $1.6 million Title III grant from the U.S. Department of Education to create the Instructional Technology Center (ITC)—a facility charged with faculty training in education technology methodologies. A major goal is to increase faculty use of educational technology for the purpose of enhancing student performance and academic success. To accomplish this goal, the grant enables the creation of an environment on campus where faculty leaders or "champions" are empowered—through training, release time, and access to current technology—to develop discipline-specific projects that will supplement traditional avenues of student learning through the appropriate use of educational technology. At the same time, these projects will serve as incentive models for other faculty members in their departments, colleges, and in the university at large. According to Horgan (1998), "Using faculty more proficient with the technology to support their less knowledgeable or more reluctant peers is another way to focus on teaching rather than just the technology. A faculty mentor program, with release time or other special incentives, is often an excellent way to jump-start innovation."

As part of this mission, the ITC conducted a survey in the autumn of 2001 of representative faculty members from each department to establish a base of information on attitudes toward educational technology, current use patterns, philosophies of education related to computer-assisted education and factors affecting the adoption of technology by faculty members.

Theoretical Foundation

The adoption or "diffusion of innovation" curve developed by Rogers (1995) illustrates the way that an innovation is first adopted by a few members of a community, and how, over time, other members join in and begin to use or deploy the innovation. According to Rogers, an innovation is a concept or practice that is perceived as new by an individual, and diffusion is the process by which the innovation moves through the system. Members of a community who are more receptive to the innovation and who lead the other members are labeled "innovators" and "early adopters." These are followed by the "early majority," the "late majority" and, finally, the "laggards."

One of the ways that innovation spreads through a community is via interpersonal communication and information sharing. Personal contact with an esteemed colleague, often including a personal demonstration, is key to the diffusion process in higher-education settings (Hutchinson & Huberman, 1993). Perceived leaders who adopt an innovation are particularly instrumental in the promotion of a new idea or practice. According to one study of mid-sized to large research universities, chemistry and mathematics professors favor different dissemination approaches depending on their current level of understanding and exposure (Foertsch, et. al., 1997). The same study, however, indicated that in most cases personal contact with an esteemed colleague was strongly preferred by the adoptee.

It has been posited that university faculty who fit the "innovator" model are self-motivated and, given the appropriate infrastructure, will integrate instructional technology even when incentives or rewards are absent (Jacobsen, 1998). With the sense that innovators are already "on board," proponents of change have often focused on those in the early adopter and early majority categories because of a perception that they hold the most promise for advancement with the investment of the limited resources at hand. In contrast, those predisposed to the other end of the scale are oftentimes viewed as a poor investment in terms of the time and energy that is required to move them towards adoption.

Kurt Lewin's (1951) "field theory" also provides a framework to analyze incentives ("driving forces") and barriers ("restraining forces") that faculty encounter. Identification of barriers to adoption is the first step in the process. Once barriers to change are identified, it is possible to remove the barriers or give the faculty the tools or resources that they need to overcome them.

Methodology

Full-time faculty from 24 campus departments were interviewed to elicit responses to closed and open-ended questions about their use of educational technology. For the purpose of this study, educational technology was defined as, "recent developments in computer-based technologies (hardware and software) used to facilitate learning." The survey garnered responses from one representative within each department, with three exceptions where representatives could not be reached and did not return telephone calls or e-mail contacts. By interviewing a population of 24 (representing 11.8%) of the 204 full-time faculty, the researchers obtained a significant cross-section of opinion which is believed to be representative of general campus sentiment among faculty.

Results

Faculty interviewees were assigned a category of educational technology use based on their response to three questions. The first question asked them to self-evaluate their personal level of use on a five-part scale. The second question asked them to identify the educational technology that they used in their teaching. And the third question asked them the frequency of their use of educational technology. Based on their responses to these three questions each of the 24 respondents was assigned to one of three categories; below average ($n=8$), average ($n=11$), and above average ($n=5$).

Incentives

Next, respondents were asked to identify factors that convinced them to become (and remain) users of educational technology. Five choices were offered, along with the opportunity to name additional factors. The five choices were; personal satisfaction (selected by 58.3% of respondents), support from administration (selected by 16.6% of respondents), required by administration (selected by 4.2% of respondents), student demand (selected by 37.5% of respondents), and, because it's the right thing to do (selected by 62.5% of respondents)[2]. Respondents were also asked to indicate which of the factors was the most important factor for them. The most common response was "because it's the right thing to do" ($n=6$), followed by "student demand" ($n=2$). Other factors mentioned as being influential in adoption of the use of educational technology are:

- more student friendly*
- efficiency and efficient use of class time*
- convenience*
- good source of info and students have access to it*
- it raises student achievement*
- immediacy of communication*, sense of teamwork with students and between students
- I'm hoping that after I've been through it once, that my updating of material will be easier
- I think it's the right thing to do to familiarize students with resources
- richness and convenience of resources*
- kinds of material that can be accessed*
- found that students were gaining employable skills, need for visuals to provide relief...they are so visually oriented, students have to be at cutting edge of technology*
- students learn many different ways, and this type of technology allows you to use all three areas (visual, auditory, kinesthetic) and it enhances student learning*
- accommodating various student learning styles and achieving the desired learning outcome* I think it made me a better teacher.
- personal decision*

*Note: * indicates factors that were considered to be the "most important" factor for the respondent's choice to adopt educational technology*

When considering the response to this question in relation to the faculty member's designation as a below average, average, or above average user, it is interesting to note that, with one exception, the "below average"

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[2] Multiple responses were allowed, resulting in total in excess of 100%.

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users selected as their most important factor either "personal satisfaction" or another response that focused on student or instructor convenience. In contrast, all of the "above average" users selected either "because it's the right thing to do" or a responses that focused on student outcomes, e.g., "it enhances student learning." This sense of almost a mo ral obligation to provide the best possible experience for the learner is consistent with the belief that educational technology can accommodate a wider range of learning styles and can result in higher levels of student achievement.

Barriers

In an attempt to better understand what respondents perceived to be impediments to their adoption of educational technology, we asked them to list three barriers and the one that they considered the greatest barrier. Because of the wide range of responses, we attempted to group the responses into three main categories; time constraints, resource restraints, and questions about effectiveness. Responses that fit into the first category are:

- time to learn technology
- time to develop, time required
- too busy*
- planning time*
- time constraints on prep time*
- time constraints within class itself
- time to do it*
- because it wastes time
- time to experiment and discipline to learn the techniques that I don't know*
- time to prepare*
- time it takes to find out what's out there, find out what's most effective and time to integrate it into what you do*

*Note: * indicates factors that were considered to be the "most important" barrier to adoption of educational technology*

A sense that resources are not available to support development and implementation of educational technology is also an issue as indicated by the following responses:

- cost/availability of equipment
- resources
- lack of knowledge
- training/knowledge
- access*
- convenience of access*
- cost of purchase
- lack of hardware and facility*
- cost*
- funding
- lack of access
- shortage of classrooms that are equipped
- lack of help/facilitators
- money to purchase it*
- there was no one to provide assistance (when I got started)*

*Note: * indicates factors that were considered to be the "most important" barrier to adoption of educational technology*

There continues to be concern that educational technology does not deliver on its promise or that its usefulness is still to be proven. The following statements reflect these views:

- doesn't see how it always benefits students*
- not significant
- not so important to me…my current methods still work
- it doesn't help*

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- part of the technology would be harmful to my pedagogy…some of the technologies out there, e.g., PowerPoint, are used poorly. Something is lost when you get away from FTF interaction
- technology in general has not always been accommodating for people in the visual arts…a lot of the technology is not image friendly*
- wondering if this is legitimate and achieving the desired outcomes
- not convinced of its usefulness*

*Note: * indicates factors that were considered to be the "most important" barrier to adoption of educational technology*

And finally, there are additional barriers that do not fit into the above categories. The following statements reflect these concerns:

- apprehension
- doesn't always work
- comfort level*
- obsolescence
- difficulty of planning
- inertia
- difficulty of use
- copyright problems have created access problems

*Note: * indicates factors that were considered to be the "most important" barrier to adoption of educational technology*

Role Models

When faculty were asked if a mentor had used technology, and whether that experience had contributed to their use of technology, those in the "below average use" group generally stated "no", even if the mentor had used technology. In the "average use" group, there was equal indication that mentors had or had not used technology. Among the faculty who were mentored by technology users, more faculty indicated that they used technology as a result, in part, of the mentor model. In the "high use" group, a majority of respondents enjoyed the tutelage of mentor users, and indicated that this influence was a strong encouragement for them to model. Statements regarding mentor influences included:

- everything I've done is because of my mentor…since he has left I've backed away from it somewhat
- my mentor created positive attitude toward technology
- positive modeling of use
- that particular person led me to make that a large part of my doctoral dissertation and although the technology has changed, it has had long lasting effects
- I had two wonderful mentors were I was before, and that's why I became interested in technology…it made all the difference for me

Other Influences

Faculty were queried on their observation of technology use in other venues, such as at conferences, and if that experience affected their personal view and use of technology. All responders indicated that they had seen technology, such as PowerPoint, employed. However, the "below average" and "average" user categories indicated more reservations about the effectiveness of technology as it was experienced. More "below average" users indicated complete dissatisfaction with the experience than did "average" users. Also, more "below average" users indicated that they did not use this technology, or used it with reservations, than did "average" users. In contrast to these two groups, the "above average" users unanimously indicated a positive experience, and that the use had favorably impacted their own use of technology. Respondents offered the following comments about viewing the use of technology by others, and its effectiveness:

- Sometimes it was good, but talking heads w/slides are also present so quality may be questionable
- it made me more committed not to use it
- limited helpfulness
- some are and some are not…I've really grown to dislike PowerPoint.

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- If person is not organized, presentation can reflect this
- as long as the technology worked
- inspired me
- I've gotten ideas from people…usually through discussion groups or looking at their web sites
- generally not…I've run into dull PowerPoint presentations
- that is where I get ideas about what to try. I belong to the ASEE (American Society of Engineering Educators) and they talk a lot about instructional topics

Faculty exposure to articles and on-line sources of information related to technology in education was also explored. Faculty were asked if they had viewed such content, and if so, how had it influenced their use of technology. Most respondents indicated that they had read about technology and issues related to its use, and had found the information helpful. Most faculty responded favorably when asked about the positive model that such material presented. Comments included:

- I refer students to tech resources that I find
- it opens up so many sources and resources for information, e.g., on the Internet
- it puzzles me
- it has made me see the value and importance of it
- those discussions are ongoing in our field…effective vs. non-effective uses for my discipline. One thing that you get from these public discussions is a sense of the value of the choices
- provided ideas for newsletter, forms
- hearing other faculty present ideas
- distance learning techniques (Chronicle of Higher Ed)
- it influenced me to a part that it has convinced me that it is a very important tool…even though I cannot keep up with the innovation
- reference again to papers at conferences. I like to see how others do things and then incorporate them in my classes.
- garnered some info, but not very persuasive
- ideas on what it does and how it works
- minimally, articles on teaching & pedagogy, not major input
- journals like Syllabus and others give me ideas about hardware and ideas about use, e.g., using handheld devices for education
- not really
- reading those sorts of things gives you an idea of what's going on in the rest of the country. Being involved in TLTR , Steve Gilbert, etc. they encourage one to use technology when it is appropriate, because it will add value if used appropriately.

Participants were also asked their opinion about the level of educational technology use and implementation on the USC campus as compared to other institutions of comparable size and mission. There was clearly a correlation between users' own use of educational technology and their perception of where the university in general was in relation to peer institutions. Using a scale of 1-3, with 1 being "behind", 2 being "equal to", and 3 being "ahead", faculty members in the "below average" user group thought that USC was ahead of peer institutions (mean = 2.67), while faculty in the "average" group thought that USC was "average" as compared to similar institutions (mean = 1.94), and faculty in the "above average" user group believed USC to be behind similar institutions in terms of use and implementation of educational technology.

Discussion

University faculty members enjoy a high degree of autonomy and self-determination. Change in behavior is seldom achieved by the use of top-down approaches (Noblitt, 1997). Rather, change is usually the result of the removal of barriers and the presence of incentives. Identification of barriers is one possible starting point for adoption and diffusion research. Interviews with faculty leaders on our campus suggest that the leading barriers to adoption of educational technology are; time, resources, and lack of confidence in the benefit of educational technology. Our grant allows us to directly address the first barrier by providing 6 credit-hours of release time and a summer stipend for faculty who successfully propose a project that uses educational technology to enhance teaching and learning. The second barrier, perceived limitations of resources, is one that the University

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has been addressing and continues to address using a variety of means. Campus computing infrastructure is currently being enhanced both in terms of functionality and performance. The decision to purchase Blackboard as our course management software has resulted in a growth from zero to 165 courses that utilize Blackboard in just the first year of use. A student-supported technology fee generates approximately $220,000 each year for technology infrastructure that directly affects students. All of these efforts are attempts to address concerns by faculty that their working environment is supportive of their efforts to acquire, create and deploy technology-enhanced resources. Perhaps the last barrier, faculty members' concerns about the effectiveness of educational technology, is the one area where much of the work remains to be done. This is an area where effective modeling by peers and respected colleagues shows promise for attitude changes that can lead to changes in behavior. Jacobsen (1998) found that faculty members prefer to receive help and instruction from colleagues on campus. While responses to our question suggests that demonstrations of successful use of educational technology by a respected peer early in one's career is a positive influence, it may also be that those who are early adopters of educational technology are more likely to recall such experiences. Other types of exposure to educational technology seem to send mixed messages. Exposure to use of educational technology in external settings and in academic and scholarly publications was as often as not seen as a disincentive. Dull or poorly executed PowerPoint-enhanced presentations were noted by several respondents.

And finally, the presence of incentives for faculty to adopt and deploy educational technology is an area where both resources and faculty development play a role. As mentioned earlier, stipends are being offered to faculty whose projects are supported by the Instructional Technology Center on campus. Other faculty mentioned the convenience and efficiency that educational technology affords. But more often than not, the incentives that respondents mentioned were the benefits that they believed were accrued by their students. The belief that technology-enhanced instruction supported a wider variety of learning styles, and that students were learning both course content and picking up employable skills at the same time, were cited as incentives. While this study is exploratory in nature, it appears to support the idea that adoption of innovation, in this case the decision to employ educational technology, is multi-faceted and efforts to increase participation by faculty members must take an equally multi-faceted approach if it is to be successful.

References

Foertsch, J, Millar, S. B., Squire, L., & Gunter, R. (June 1997). *Persuading professors: A study of the dissemination of educational reform in research institutions.* LEAD Center report on an NSF-funded study.

Gibson, J. W. & Herrera, J. M. (1999). How to go from classroom based to online delivery in eighteen months or less: A case study in online. *THE Journal.* [Online] Available: http://www.thejournal.com/magazine/vault/A2080.cfm (October 2001)

Green, K. (2001). *The Campus Computing Project.* [Online] Available: http://www.campuscomputing.net (Dec., 2001).

Horgan, B. (August 1998). Faculty, instruction, and information technology. *The Technology Source.* [Online] Available: http://horizon.unc.edu/TS/default.asp?show=article&id=75 (October, 2001).

Hutchinson, J., & Huberman, M., (1993). *Knowledge dissemination and use in science and mathematics education: A literature review.* Washington, D.C.: National Science Foundation.

Jacobson, D. M. (1998). Adoption patters of faculty who integrate computer technology for teaching and learning in higher education. *Proceedings of the ED-MEDIA AND ED-TELECOM 98: World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications*, Freiburg, Germany, June 20-25.

Lewin, K. (1951). *Field theory in social science; selected theoretical papers.* D. Cartwright (Ed.). New York: Harper & Row.

Noblitt, J. S. (1997). Making ends meet: a faculty perspective on computing and scholarship. *Educom Review, 32*(3), 38-43. Also, [Online] Available:
http://www.educause.edu/pub/er/review/reviewArticles/32338.html (October, 2001).

Rogers, E. M. (1995). *Diffusion of Innovations, 4th Ed.*, New York: Free Press.

Mediating Collective Discussions Using an Intelligent Argumentation-Based Framework

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Abstract: This paper describes AMANDA[1], a method for mediating asynchronous discussions among distant learners. AMANDA is intended to help tutors achieve better results from group discussions and improve knowledge transfer among the participants. The method consists of launching a set of issues for collective debate and involving the participants in successive discussion cycles with negligible human mediating effort. Along the discussion, specific mechanisms search for potential interactions that might improve the debate and propose new interactions among the group. This paper also presents the software prototype that implements the method, as well as some sample screens from tests carried out in actual training situations.

Introduction

Collaborative learning is about promoting knowledge transfer among the apprentices through a series of learning interactions. Among these learning interactions is the *group discussion*, a collective process of articulating knowledge by means of argumentative statements. Several works, such as (Quignard, 99) and (Veerman, 00) investigate the role of argumentative discussions in learning. In the knowledge creation theory by (Nonaka, 99), group discussions are characterized as *externalization spaces*, where the implicit knowledge (or mental models) of each participant is made explicit by means of the articulation of ideas. In traditional classrooms, such a dialoguing activity is achieved by face-to-face discussions and teamwork. In distance learning environments, asynchronous and collective discussions are implemented by discussion forums.

The experience with discussion forums, however, shows they often fail to promote group learning. They either suffer from the lack of participation or grow two much to be followed by the tutor. The reason is the absence of a method that articulates the discussion and promotes group interaction. In this paper, we propose a method and a system for mediating discussions among a group of distant learners with negligible or no interference of a human tutor.

Method Overview

The AMANDA method is a computational solution for mediating asynchronous collective discussions over multiple issues. Initially, a set of issues (questions) is distributed among the participants. The resulting answers give rise to successive discussion cycles, during which the participants argue over their peers' propositions. The collective discussion is mediated by a set of intelligent mechanisms that reason over the current discussion and propose new interactions among the group. The participants provide answers to the proposed questions and argue over their peer's propositions by means of discussion forms (Fig. 6).

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[1] AMANDA (Agent de Modélisation et ANalyse de Discussions Argumentées) is a joint R&D effort between the Pontifical University of Paraná, Brazil (PUCPR), the Technology University of Compiègne (UTC) and CEGOS, France.

Internally, the interactions among the group are organized in a *discussion tree* (Fig. 1), a collection of questions, answers and argumentations representing the current state of the discussion. The mediating effort of AMANDA is focused on intentionally expanding the discussion tree with new nodes and thus creating new interactions among the group.

The Discussion Tree

The discussion tree is the underlying model of the discussion in AMANDA. It is an extension of the argumentation model proposed in (Karacapilidis, 98) and the Simari-Loui model presented in (Chesñevar, 00). In AMANDA, the discussion tree represents multi-issue, multiparty argumentative discussions. It is composed of question nodes (Q-nodes), answer nodes (Alt-nodes) and argumentation nodes (Arg-nodes), as shown in figure 1.

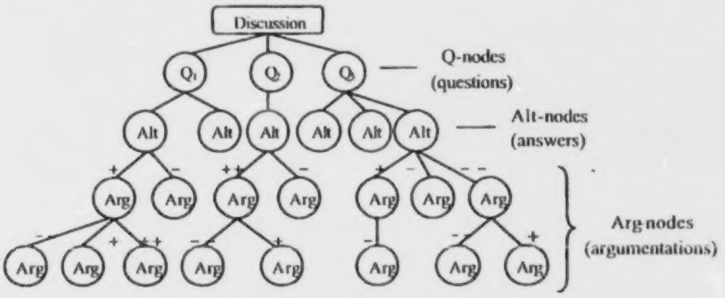

Fig. 1: The discussion tree (an example)

A Q-node represents an issue to be debated. It contains a natural language question, such as "Which types of connection elements may exist in a computer network?". A Q-node can be classified as a *content-expected interrogative speech act* (Porayska-Pompa, 00), for which one expects an answer that conveys a certain "content" as response. In AMANDA, a question can be either typed by the tutor or automatically generated from the domain models[2]. A Q-node can be linked to a number of answers, represented by the Alt-nodes.

An Alt-node is an alternative answer to a given question. The answer contained in an Alt-node is the "content" expected by its Q-node. In Karacapilidis' model, an Alt-node is a *position over an issue*. Every Alt-node is assigned to a given participant, who is the author of the answer. Formally, an Alt-node is a triple $<a, Q, I>$, where a is the textual content of the answer, Q is the related question and I is the author of the answer.

An Arg-node is a supporting/refuting reaction from a given participant over a position expressed by his peer. It conveys both an intention (supporting or refuting) and a proposition (a pro- or contra-argument). In fact, according to (Searle, 70), an argumentation is an illocutionary speech act composed of two elements: an essential content (intention to justify/refute a proposition) and a propositional content (the proposition that holds the intention). In AMANDA, the essential content is expressed in four levels: *total agreement* (Arg++), *partial agreement* (Arg+), *partial disagreement* (Arg-) and *total disagreement* (Arg--), while the propositional content is a free text provided by the participant. Every Arg-node is assigned to a participant, who is the author of the argumentation. Formally, and Arg-node is a 4-tuple $<g, H, w, I>$, where g is the propositional content, H is the corresponding parent node, $w \in \{++, +, -, --\}$ is the essential content, and I is the author of the argumentation.

The Advance of the Discussion

AMANDA advances the discussion by expanding the discussion tree with new nodes, based on the current interactions among the participants. Figure 2a shows an overview of the proposed method. In stage 1 (*Launching*), the set of issues (Q) is distributed among the set of participants (P), which creates the first configuration of the discussion tree (DT) and the first generation of discussion forms (DF). In stage 2 (*DF*

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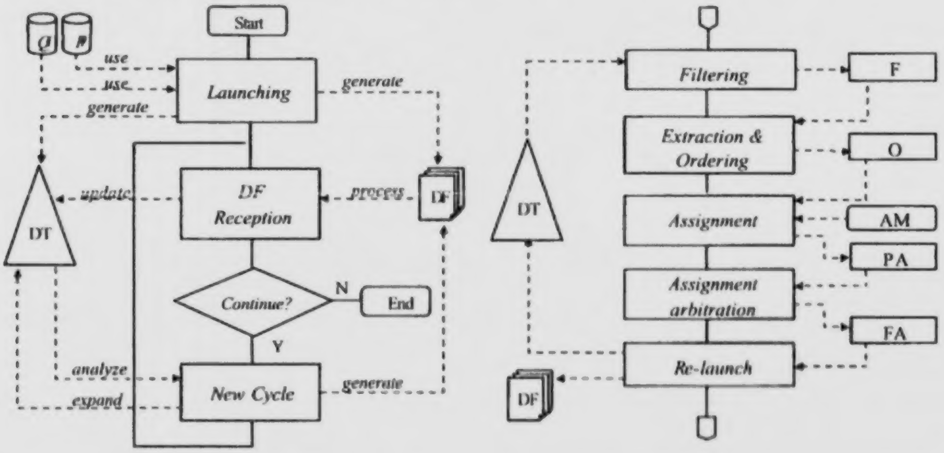
[2] Although the generation of natural language questions from domain models is an important feature of AMANDA, it will not be explored in further details, since it does not directly relate to the discussion mediation.

Reception), the discussion forms are received from the participants and the discussion tree is updated accordingly. In stage 3 (*New Cycle*), a new discussion cycle is opened, which corresponds to the aggregation of new nodes to the discussion tree and the generation of the corresponding discussion forms. New discussion cycles are successively opened until the discussion cannot be advanced any further.

Most of the reasoning employed in the method occurs in the *New Cycle* stage. The opening of a new discussion cycle occurs in five steps, as illustrated in figure 2b. It starts by filtering all nodes of the discussion tree that are not worth re-launching, i.e. nodes with empty textual content, highly supported nodes or nodes belonging to depth levels above a certain threshold. The *Filtering* step produces a set of re-launchable nodes (F).

In the next step (*Extraction & Ordering*), each node in F is assigned a re-launch score (RS). The RS reflects the importance of a node for the discussion, being expressed as the average among four attributes: (i) the agreement level of the node; (ii) the depth level of the node; (iii) the degree of support/refutation of the node in relation to its parent and (iv) the percentage of participants covered by the node. The higher the RS of a node, the more likely it is that this node will contribute to the advance of the discussion. The output of this step is an ordered list of nodes (O) sorted according to the RS values.



a) general flowchart

b) detailed flowchart of the *New Cycle* stage

Fig. 2: Overview of the AMANDA method

The *Assignment* step analyses each node in O to search for potential interactions that might advance the discussion. To handle this heuristic and multiple-criteria procedure, we propose the use of independent assignment mechanisms (AM), which attempt to find coherent matching relations between the set of nodes and the set of participants. Each mechanism applies its own assignment rules to find the most suitable participant to work on a given node of the discussion tree. If a given participant I is considered 'suitable' to work on a given node $N \in O$, then N is re-launched (an 'empty' child-node N' is created) and N' is assigned to I. The pair <N, I>, resulting from this matching, is called an *assignment*. Five assignment mechanisms are currently proposed (EXT, REPLY, BUDDY, EQUAL and VLD-ATCK), each one attempting to address specific objectives in the discussion.

The EXT mechanism proposes assignments to assure that all issues (Q-nodes) are answered by all the participants. The REPLY mechanism assures the right of response to every participant whose proposition was refuted in previous cycles. The BUDDY mechanism allows the participants to argue over answers on issues they have already answered. The EQUAL mechanism aims at spreading the participants over the discussion, so that every argumentation is equally argued among the group. Finally, the VLD-ATCK mechanism assures that all refuting argumentations are validated by the mediators/tutors (if any).

Each assignment mechanism proposes its own set of assignments. However, not all proposed assignments (PA) can be aggregated to the discussion tree. We must respect the maximum workload per participant and avoid undesirable assignments. This is done by the *Assignment arbitration* step, which filters the proposed assignments (PA) to produce the set of final assignments (FA).

The assignments contained in FA are finally turned into new nodes and aggregated to the discussion tree by the *Re-launch* step. This is achieved by re-launching each assignment <N, I> in FA and assigning each new 'empty' node N' to the corresponding participant I. In addition, the next generation of discussion forms (DF) is made available to the participants and the method goes back to stage 2 (*DF Reception*).

Method Implementation

The AMANDA method described above was implemented and tested in various training situations. The corresponding system (Fig. 3) is composed of a central *Coordination Module* that implements the flowchart of figure 2. The system has two user interfaces: a *local interface* that allows full control over the discussion and a *learner interface* that generates the discussion forms via the Internet. In addition, the system is provided with a *Knowledge Base (KB)* module that allows the construction of the domain models (ontologies and task models) and a natural language generator (*NL Generator*), which generates questions based on the domain models.

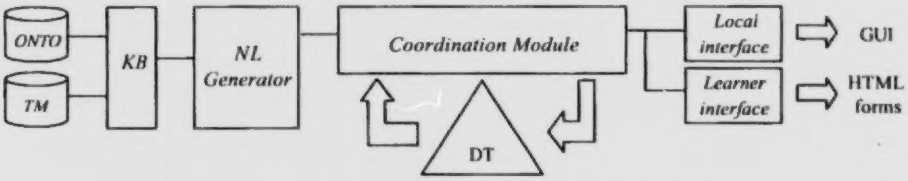


Fig. 3: System overview

System interfaces

The local interface (Fig. 4) enables all actions on the discussion, such as: creating a new discussion, adding participants/questions, viewing/editing the discussion tree, updating the discussion (*DF Reception*), inspecting parameters and opening discussion cycles. For research purposes, it also allows to simulate discussion scenarios with the aim of validating the method in a wide range of situations.

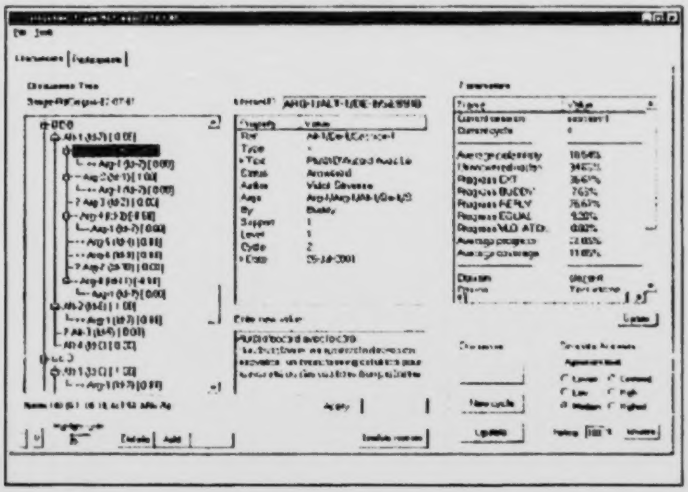


Fig. 4: The local interface

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From the local interface, we can advance the discussion to the next cycle by clicking on the *New cycle* button. This calls the *New Cycle* interface (Fig. 5). On this interface, the assignment mechanisms can be individually triggered and the proposed assignments appear in the "To be assigned to" column beside the node to be re-launched. The *Adjust* button serves to filter undesirable assignments and to limit the number of assignments according to the maximum workload per participant (see *Assignment arbitration*). The *Apply* button finally opens the new cycle, by aggregating the new nodes to the discussion tree (*Re-launch* step).

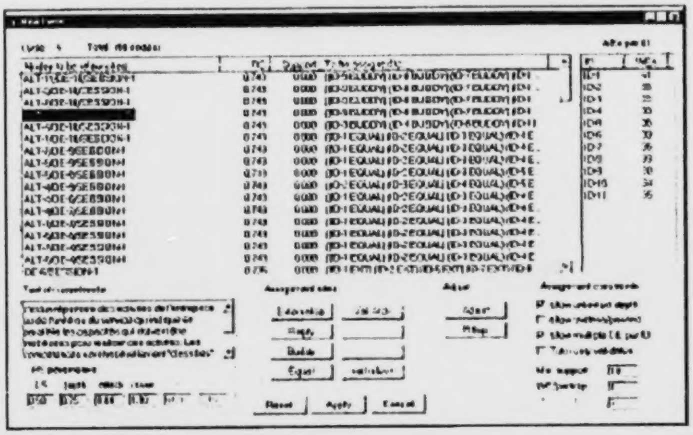
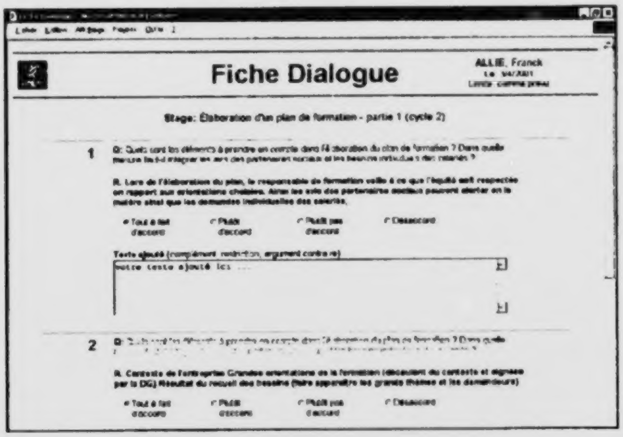


Fig. 5: The *New Cycle* interface

As a new discussion cycle is opened, a new generation of discussion forms is made available to the participants. The discussion form for a given participant is built by grouping all 'just-relaunched' nodes assigned to him and formatting them appropriately, so that they can be answered and sent back to the system. Figure 6 shows a real discussion form in HTML format, as it appears through the Internet.


Fiche Dialogue

ALLIE, Franck

Stage: Élaboration d'un plan de formation - partie 1 (cycle 2)

Fig. 6: The learner interface (HTML discussion forms)

The discussion forms are answered by the respective participants and are sent back to be processed by the system (*DF Reception*). The answers and argumentations contained in the discussion forms are used to fill the corresponding 'empty' nodes created by the latest re-launch and the discussion cycle is terminated. At this

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moment, a new cycle can be opened and new interactions among the group can be proposed based on the latest inputs from the participants.

Conclusion

In this paper we proposed a computational method for mediating group discussions, with the objective of relieving the tutor from the time-consuming task of articulating the discussion and improving the knowledge transfer among the group. This method was fully implemented and has been applied in actual distance training situations, where it has been the test-bed for various algorithms and coordination strategies.

The results obtained in the field so far are promising. They show that AMANDA enables to conduct collective discussions among large groups of participants over a large set of issues with negligible or no human interference. It is capable to autonomously articulate a discussion and find interesting patterns of interaction among the group. This yields in a 'disciplined' discussion, where the discussants are given equal chances to answer the issues, defend their refuted viewpoints and participate equally throughout the discussion. Another effect of this articulation is that the debate is progressively focused on polemical propositions rather than on common agreements, yielding in a better use of the effort employed by the participants and improving their motivation.

In addition to the discussion mediation, we also conducted experiences on domain modeling and NL generation. We've had surprisingly positive results on generating natural language questions from domain models (ontologies and task models) and using the resulting questions as discussion elements. We noticed that system-generated questions can be even 'better' than those proposed by human tutors, specially when the domain models are well constructed.

Although it is still unclear how well the proposed method performs in comparison with a discussion mediated by a human tutor, we have reasons to believe that AMANDA can be a valuable aid for distant learning and a start point for further research.

References

Eemeren, F.H. van and R. Grootendorst (1983) Speech Acts in Argumentative Discussions. Foris Publications – Dordrecht.

Chesñevar, C., Maguitman, A and Loui, R. (2000) Logical Models of Argument. ACM Computing Surveys, volume 32 number 4, p. 337-383.

Karacapilidis N., Papadias D. (1998) A computational approach for argumentative discourse in multi-agent decision making environments. AI communications 11, 21-23.

Nonaka I., Toyama R., Konno N. (1999) SECI, Ba, and Leadership: A Unified Model of Dynamic Knowledge Creation; D.J. Teece and I. Nonaka (Eds). Oxford University Press.

Porayska-Pompa K, Pain H. (2000) Aspects of Speech Act Categorization: Towards Generating Teacher's Language. International Journal of Artificial Intelligence in Education.

Quignard M., Baker M. (1999) Favouring modellable computer-mediated argumentative dialogue in collaborative problem-solving situations; Proceedings of the 9th Conference on Artificial Intelligence in Education (AI-Ed 99) 1-8, Le Mans. IOS Press, Amsterdam.

Ravenscroft A., Pilkington R. (2000) Investigation by design: developing dialog models to support reasoning and conceptual change. International Journal of Artificial Intelligence in Education.

Searl. J.R. (1970) Speech acts; An Essay in the Philosophy of Language. Cambridge University Press.

Veerman, A. (2000) Computer-supported collaborative learning through argumentation; PhD Thesis; University of Utrecht.

Developing a Large Web-Based Learning Environment – Can a Style Guide Help Learning Material Developers?

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Abstract: An application specific style guide was produced for a large web-based multi-media and hyper-media learning project. It was introduced to 15 different sets of developers at Universities in disparate locations to promote consistency and good HCI practice for the whole project. This paper discusses the reactions to the use and practicality of the style guide through the findings of a survey undertaken one year later. In general, many negative and neutral attitudes towards the style guide were recorded. However, specific trends were observed due to exposure and use of the style guide, the background and experience of the developers and task involvement of developers. The paper discusses the understanding of HCI in the project and the need to encourage developers to use a style guide in multi-media and hypermedia learning projects.

Introduction

During the development of multi-media and hyper-media based learning material, there are often many Human-Computer Interaction (HCI) issues that arise. Developers therefore need to pay attention to good HCI practice when developing learning material. This is particularly important when an e-learning project is large and involves many developers, since it is often impractical for HCI checks to be made on every piece of learning material produced. One way to help achieve consistency in interface design is the use of a project-wide style guide. The use of a style guide can positively influence projects that are geographically dispersed, even, as in this case, when there is only a small group of Human Factors experts working on the software development project (Colbert, 1997).

Style guides, in one form or another, are used extensively in many industrial projects that use human-machine interfaces. They are also common place in many large web-site developments. However, the use of style guides in e-learning projects has not been widely documented. Universities and colleges often maintain a *corporate* style guide for their externally focused informational web sites, yet there are few examples of Higher Educational organisations using style guides during the design of user interfaces for computer-based learning materials. In places where they are used, it is normally in the form of *look and feel* or *corporate* guides, rather than helping the developer with task specific *application* style guides.

Much of the research in the area of styles guides that has been done to-date has been in commercial and industrial settings. There have been accounts from a number of authors on the benefits and problems of using style guides (Colbert, 1997; Hill, 1995; Kostelnick, 1998; Simpson, 1999; and Washington, 1993). The reported benefits of style guides are often more about the outcomes of applying good HCI practice, rather than empirically studying the implementation of the style guide. Those that have studied the development and use of style guides report that developers benefit from having more specific advice at hand (Simpson, 1999), that guidelines can be distributed quite cheaply and can be practical without the need for a HCI specialist and that user testing may not be necessary in aspects of the interface that are covered by the style guide (Hill, 1995). Accounts of specific problems with the implementation and use of style guides are more easy to pin-point. A re-occurring theme is that of the difficulty in managing the style guide. The process for managing the development, implementation, use and revision of a style guide is not well defined (Simpson, 1999). Washington has also reported that the "requirements analysis" and "promotion" of the style guide are often ignored or overlooked which often has detrimental affects. Hill identifies that guidelines can (1) be difficult to interpret; (2) often give contradictory advice and therefore need to be interpreted in context; and (3) often consider theoretical problems which, in practice, are not experienced often. Similarly, Kosteinick reported that developers can become frustrated deciding which style to adopt, particularly in the event that two or more styles conflict.

Use of a Style Guide in a Large Web-Based Educational Project

The authors of this paper were brought in to advise on the Human-Computer Interaction (HCI) issues of a large web-based educational project. It was decided to introduce a style guide that all learning material developers could use. The team began by performing a "requirements analysis". A review was carried out of all fifteen University partners who were producing chemistry related distance learning material. As was expected, each partner was offering learning material in a format that they had developed independently. Therefore, inconsistencies existed in the whole look and feel of material, in the organisation of the content and in the way interaction between the learner and the information was initiated and completed. More importantly, there was an extensive amount of what could be deemed as "bad practice" being adopted across the University partners. Therefore, paramount was the construction of a style guide that would address the variations and contradictory signals being sent to the learner and to instill "good practice" principles in the developers. The purpose was to produce a style guide that would help application developers at the University partners - so that learners could concentrate upon learning the material, rather than wrestling with the interface.

Style Guide Development

A style guide should advise when and how to use controls and input methods and should encourage consistency and re-use within the aims of the project (Colbert, 1997). Therefore, the goal of our style guide was led by the need to provide clear direction on consistency and good practice during the development of learning material. This required guidance on application specific HCI design elements such as the design of interactive experiments, affordance and system navigation, as well as expected features such as text layout, design of primitive elements and the use of colour. In all, 44 separate elements that affect the interface design for websites were addressed. Particular features of the application style guide included:

- a section of readable prose explained why a style guide was necessary and how ensuring a similar *look and feel* throughout the project would be of help to the learner;
- individual recommendation sections on each of 44 different HCI design elements;
- a pull-out A3 size "pictorial reference" guide sheet at the back of the style guide that provided synopses of guidelines, with references to the main sections in the guide itself;
- full use of laser printed colour copying to offer the best clarity possible;
- softcopy production on CDROM in PDF format for convenience and accessibility.

In each of the 44 individual recommendations sections on design elements, the guide offered background information and a description of features, together with a diagram, and then outlined explicit recommendations or design guidance. The recommendations were tailored specifically towards the project and the use of the design elements for learning materials. Recommendations were provided on what developers should, and should not do with the item and indicated the degree of flexibility in the use of the item in the project. Following these recommendations, a set of examples was provided for each section of the style guide. These examples were screen-dumps of existing practice within the project or associated learning material and were accompanied by notes explaining any good points and possible usability issues.

The style guide was offered with the full backing and consent of the project management, the technical team and the educational content advisory group. It was introduced to the project partners and the learning material developers at a conference. The partners took hardcopy and softcopy guides away with them, in anticipation that they would be used in the further development of the learning material in the project.

Research into the Use of the Style Guide

During the following year, the use and influence of the style guide was noted whenever visits were made to developers. One project partner made full colour copies of the style guide for each member of the project team, which showed a commitment (at least in monetary terms) to the use of the guide. In other partner locations, the hardcopy of the guide was on the shelf of the project leader, apparently unused. Therefore, the authors of the application style guide sought to find out the usage of the guide, its practicality and any recommendations for improvements that could be made. At a conference, one year after the launch of the original guide, feedback forms were handed out to all conference attendees. The form included simple answer, Likert-based rating scales and detailed answer questions, on a two-sided sheet of A4. Responses were collected and collated. The remainder of this paper discusses the results obtained and the implications both for this specific project and also for others seeking to use a style guide in educational multimedia developments.

Investigation into the Effective Use of the Style Guide

Response Rate

The response rate of relevant conference participants was approximately one third (n=18). Of those who responded, 2 people had not had any exposure to the style guide and did not answer any specific rating-scale questions. A further 4 people only answered the first section of rating questions, relating to initial impressions but did not provide responses to their current attitudes towards the style guide. Therefore, only around 65% of respondents (n=12) fully answered all of the questions on the feedback questionnaire. Respondents comprised chemistry teachers (n=3, all completed all questions), other chemists (n=8, only 5 completed all questions) and computer scientists (n=7, only 4 completed all questions).

General Attitudes

One of the main findings from this feedback was that very few developers had truly used or referred to the style guide in the one year period. One third of respondents answered that they had only seen, but never used the style guide. The remaining two thirds had used the guide a few times during the course of the year but only two of these people said that they were currently using the style guide in their work.

Generally, trends were observed in the respondent's use of the style guide and how positive their answers were. However, usage made no difference to the responses for some of the questions. In particular, most respondents provided negative feedback when asked if the guide offered them any new information or improved their knowledge of interface design issues. Feedback from the questionnaires also indicated a lack of understanding about the use of a style guide. Rating scale responses on initial impressions were mixed and included a lot of negative attitudes towards the style guide, even before it had been used. Free text answers from respondents suggested that they believed the style guide to be just something of interest, rather than to be actively used in day to day development of learning material. Many believed that the technical management group should sift through the recommendations and then present a standard set of icons and buttons and controls and should force all developers to do *exactly* the same thing with their material every time. Feedback also showed that they did not consider the style guide useful when it offered choice. In general, developers did not want general comments and ideas, they said that they wanted to be told what to do in each circumstance. They assumed that this would be the only way to provide the learner with a feeling of seamless interchange between the learning material in different modules, that had been developed by different partners in the consortium.

Respondents were asked about their attitudes towards each presentation idea used in the style guide. They were asked to rate the usefulness of the *look and feel* section, the detailed recommendations, the good and poor usability examples and the A3 pictorial reference guide. A nearly equal mix of positive, negative and neutral responses were recorded for every presentation idea except the use of examples, which had five times as many positive responses as negative ones. Free text answers also offered support for the use of good and poor usability examples and indicated that developers found these a good foundation for internal discussions, so that mistakes were not repeated in future. However, there was sense of egocentricity in responses. The project involved sixteen different partner groups developing learning material for a single learning environment, yet most respondents only wanted to see views on their part of the development. Respondents did not want to see examples of errors that others had made, indicating that the believed they would not learn from others mistakes.

Trends in Negative and Positive Attitudes Towards the Style Guide

Importantly, the exposure and use of the style guide appeared to be related to the attitudes offered in the responses to the rating scales. The most negative responses were from the one third of people who had not actually used the style guide. Most of those who had not used the style guide provided few responses to questions. Where there were responses from non-users, they were either negative opinions or indifferent attitudes. This was in contrast to those who had used the guide, who offered many positive responses. Also, the most positive responses came from the person who was currently using it in their day to day work.

Results showed some trends in attitudes for those with similar backgrounds. In particular, chemistry teachers offered the most negative responses. All chemistry teachers provided negative reactions to the use of the style guide in helping the development of learning materials, solutions to problems during development and the production of multi-media elements. They also said that it did not improve their knowledge of interface design or help improve the learning material that they were developing. In contrast, the computer scientists offered much more favourable responses. They were positive about the guide being clear, initially helpful and still helpful one year on. They indicated that it was helpful in finding solutions to interface problems, helping develop learning materials generally, and was specifically helpful in the development of multi-media elements.

Responses were also considered in terms of the tasks that people performed and the computer packages they used during development. Trends in attitudes towards the helpfulness of the style guide were observed for these task groups. Figure 1 summarises each group's attitude towards the 6 questions that were asked involving the helpfulness of the style guide during development.

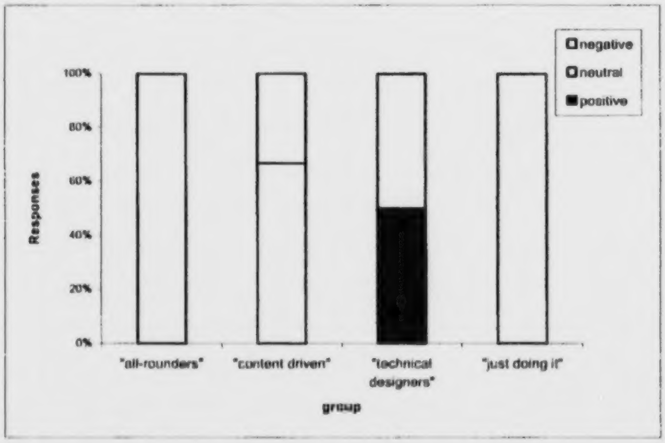

Figure 1: the attitudes of different task groups in response to 6 questions on the helpfulness of the style guide in design and development.

The first distinct task group were the "all-rounders" (n=6) who had very high involvement in the development of content and the design and who also used a number of packages including editors (HTML or other Web enabling package), graphics and animation or video packages. These were all chemists or chemistry teachers, with a mix of qualification levels. No particular pattern was observed in their exposure or use of the guide with some never having used it, some using it a few times during the year and one currently using it. This task group offered different opinions on their general attitudes about the clarity, usefulness and whether they were happy using the guide. However, they all provided similar, negative, attitudes towards the guide in terms of helpfulness in finding solutions to problems and developing learning material. The negative responses in figure 1 relate only to attitudes about the helpfulness of the style guide for design, development and review of resources.

The second task group were those who were "content driven" (n=4). These people were involved in the development of text, graphics and some animation or video work, but did not use as many packages as the "all-rounders". They were all chemists and one was a teacher as well as a chemist. As seen in figure 1, the views of this group were less extreme, although generally not positive. This group also did not think that the style guide offered them any new information and did not improve their knowledge of interface design issues.

The third task group identified were the "technical designers" (n=3). These had no influence over the development of the content and therefore concentrated upon the design of text, graphics, animations and video using a number of appropriate computer packages. Again, there was a mix of exposure and use of the style guide in this group. Interestingly, this group provided mostly positive attitudes towards the style guide. They believed that the style guide was helpful in developing learning material and multimedia elements and helped them find solutions to interface design problems.

The fourth task group could be defined as "just doing" their job (n=3). Two of these group were computer scientists, the other was a chemist, all had lower level qualifications. They were not involved in the development of the content and were limited to the production of text and graphics. The only computer package used was an editor. This group offered more neutral responses than anything else – they were neither positive nor negative in their attitudes towards the usefulness, helpfulness and ease of use of the style guide.

Discussion

The negative and neutral attitudes recorded in the feedback questionnaire, together with a high non-response rate indicate that this group of learning material developers had many problems with the style guide. The lack of exposure and use of the style guide emerged as one possible reason for the unenthusiastic reaction. Indeed, initial impressions (before the guide had been used) were often not positive. Therefore, as a consequence of the original disapproving attitudes together with the style guide not being employed by the developers, the opinions one year on were understandably negative. The following discussion suggests three possible reasons why this situation occurred in this project. These are (1) the lack of understanding of HCI by the developers; (2) the workload and background of developers; and (3) the way that the style guide was managed in the project.

The Understanding of HCI in the Project

Responses to the free text questions in the feedback questionnaire gave the impression that there was a lack of understanding on how to use a style guide, and of HCI in general. Very few developers had come across a style guide before, which was reflected in their search for exact standards, rather than wanting a set of recommendations that they could apply in the right circumstances. Since a style guide should not de-skill the designers but should allow them to spend more time meeting their main objective of supporting user tasks (Browne, 1994) our guide was designed to offer some freedom to designers, whilst ensuring that they did not infringe any standard rules of good HCI practice. However, the developers on this project did not appear to understand this and often felt that there was too much information available. The comprehensive nature of our style guide may have, therefore, been an error, as producing unnecessarily complex style guides caused problems for developers in the past (Colbert, 1997). Yet, the production of detailed methodological guidance and compliance rules for a development environment for complex learning material is not easy. Therefore, providing more information, rather than less, and allowing designers the freedom to choose should still be considered, before offering a smaller sub-set of guidelines.

There was also a general attitude that most HCI information offered the developers nothing new. Most believed that they would not learn anything from the information contained in the style guide and that it was all "common sense". Many thought that past experience as a teacher and personal "feelings" about the design would ensure that learning material would be correct for all learners. These attitudes reflect very little change in developers from those reported by other authors in the past towards acceptance of style guides (Lowgren and Lauren, 1993; Tetzlaff and Schwartz, 1990). These findings are particularly discouraging, since the style guide was introduced at a conference of the developers and also included a section explaining why consistency in the project and the use of a style guide was necessary. Perhaps the case for consistency to help convince the reader of the value of the style guide document (Browne, 1994) has not been presented fully enough in this project. In contrast, a particularly encouraging finding was the apparent relationship between exposure to the style guide and the positive feedback received, generally. Therefore, the conviction exists that if only developers could be encouraged to actually use the style guide, they would find it a more helpful document.

Workload and Background of Developers

The most positive responses came from those who only had a technical involvement with the project. These people were not involved in the production of the actual learning material *content*, but developed animations, graphics and text to support it. Therefore, task orientation may be a reason for the findings. It is possible that "technical designers" are happier using a style guide because they have a better understanding of the use of it, or have previous practice and education in using such materials. Also, they understood the computer packages used and had a better working knowledge of such applications, so they have more time to spend thinking about the design of the material. We recorded a number of feedback answers that implied that "all-rounders" and "content-driven" people felt that they had no time to look at the guide - taking a step back and learning about HCI design principles and their application was not a high priority for them. The design of the material was frequently viewed as one of the easiest parts of the project by teachers and, as such, developing the content took up most of their time and effort. Many "all-rounders" had to learn how to use the package as well as develop the content to the learning material, so time pressures may have meant that they ignored the style guide. Our results have shown a trend that indicates negative views of the style guide are held by those with many things to do in the development of multi-media and hyper-media educational resources, whereas those who have specific design problems have more positive attitudes towards the guide. This implies that more assistance is required to help every developer get the most out of a style guide.

Style Guide Management

The style guide was produced in hardcopy and in softcopy. However, there was little regular use of the style guide in any form. Unfortunately, each partner University was issued with only one hardcopy of the guide. In some cases there were up to 15 different developers working on the project at each partner University and visibility of the style guide was certainly less than we expected. In one partner University copies were produced for every developer but these were very expensive (136 pages, full colour). In most cases only the one hardcopy existed and this, more often than not, resided in one place with the team leader. PDF file format softcopies were not copied to everyone, or used as often as expected, even though the project was being produced on the computer network. We were not aware of these issues until our one year feedback questionnaire was collected and analysed. We expect different results if there were copies on every developers desk. Therefore, it is recommended that a follow-up on the use of the style guide and how well the information is being disseminated to *all* developers is examined in e-learning projects.

There is also one particular latent issue in the management of the entire project that seems to have had an adverse affect upon the use of the style guide. During the year, the technical management group implemented a cascading style sheet (CSS) to provide consistency in the colour, font size and style of the text in web (HTML) pages. The use of the CSS was simply to ensure that standard text was not formatted differently between different project partners. However, the partners saw the development and application of this style sheet as the answer to all of their interface consistency and re-use problems. It did, of course, help the layout of text but could not affect anything within graphics, animations or other applets placed outside of the standard HTML code. One year on, the pages look similar, but there are just as many HCI mistakes taking place in areas that are not formatted HTML text. The implications of the use of a CSS system for web design is that those who are not well informed on HCI issues may have their perceptions on the meaning of "look and feel" and "interface consistency" changed detrimentally.

Conclusions

The style guide produced specifically for this e-learning project was not well used by developers. Exposure to the style guide did prove to be a positive experience for those developers who tried to use it. However, many developers did not use the guide because their prior understanding of HCI issues, the use of a style guide and the meaning of "look and feel" did not encourage them. The background, workload and familiarity with the use of computer packages also affected their attitudes towards the potential helpfulness of the style guide. We have learned that in order to succeed, the implementation of a style guide needs to be closely managed and factors that affect the exposure and use of the style guide by the developers considered.

References

Browne, D. (1994) ***STUDIO: STructured User-interface Design for Interaction Optimisation*** Prentice Hall.

Colbert, M. (1997) "Style guide and their application: the case of Microsoft 'Windows' and a remote tutoring environment" in ***Behaviour and Information Technology*** 16, 1. pp. 25-42.

Hill, S. (1995) ***A practical introduction to the human-computer interface.*** DP Publishers Ltd.

Kostelnick, C. (1998) "Conflicting standards for designing data displays: following, flouting and reconciling them" in ***Technical Communication.*** 45, 4 (November). pp.473-482.

Lowgren, J. and Lauren, U. I. (1993) "Supporting the use of guidelines and style guides in professional user interface design" in ***Interacting with Computers.*** 5, 4 pp. 385-396.

Simpson, N. (1999) "Managing the use of style guides in an organisational setting: practical lessons in ensuring UI consistency" in ***Interacting with Computers*** 11. pp323-351.

Tetzlaff, L. and Schwartz, D. R. (1990) "The use of guidelines in interface design" in ***Proceedings of CHI'90 Human Factors in Computing Systems.*** pp329-333.

Washington, D. A. (1993) "Creating the corporate style guide: process and product" in ***Technical Communication.*** 40, 3 (August) pp. 505-510.

Universal Design for Learning: Curriculum, Technology, and Accessibility

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Abstract: This paper examines how teachers, as educational designers, can utilize universal design for learning (UDL) concepts. UDL is a comprehensive approach to the design of educational systems that addresses elements necessary for the achievement of desired educational goals and objectives: elements such as, equity among the participants, environmental supports, and the coupling between participant abilities and task requirements. The essential principles of UDL, which work synergistically, are: equitability, ergonomic soundness, perceptibility, cognitive soundness, error management, flexibility, and stability/predictability. The UDL principles presented in this paper draw from Enabling Technology Laboratory experiences as well as the knowledge and experience of many individuals, ranging from educators to engineers. Educational designers can systematically apply UDL principles to create more efficient and effective educational environments.

Introduction

Teachers commonly refer to their preparation work as "lesson plans". Yet what they are really doing is design work: they are designing educational activities, materials, and curricula. Thus, teachers are educational designers. As such, educational designers have one simple goal: to create the best possible design. Universal design for learning is a conceptual approach that enables educational designers to more fully realize that goal.

Universal design for learning (UDL) is a comprehensive approach to the design of educational systems that addresses elements necessary for the achievement of desired educational goals and objectives: elements such as, equity among the participants, environmental supports, and the coupling between participant abilities and task requirements. The application of UDL principles targets the educational needs of all students while addressing different learning styles. Truly *every* student, from the gifted to the at-risk to the one with physical and cognitive disabilities, benefits from UDL. Technology plays a pivotal role in these endeavors by enabling increased adaptability and flexibility. The International Technology Education Association states that technology is "the diverse collection of processes and knowledge that people use to extend human abilities and to satisfy human needs and wants" (ITEA, 2002).

UDL builds on universal design principles developed by architects and engineers, but goes on to add principles gleaned from psychology and educational research. UDL strives to create environments, educational materials, and activities that are more physically and cognitively accessible. Physical accessibility includes wheelchair accessibility and computer access through the use of assistive technology such as alternative keyboards or screen readers. Perceptual accessibility includes dealing with disabilities such as color blindness, hearing loss, or visual impairments. While the distribution of IQs associated with cognitive disabilities must be considered, cognitive accessibility is not limited to individuals with disabilities. UDL must also include the creation of materials that support different learning styles and strengths, providing students with multiple ways of engaging the material, presenting material, and reporting results. In short, UDL should be regarded as simply *good design* practice.

The movement toward universal design has world-wide following. In the United States IDEA 97 (the 1997 amendments to the Individuals with Disabilities Education Act) is a major impetus for utilizing universal design principles in education, in that it mandates a fuller inclusion of individuals with disabilities in general education classrooms and activities. In a recent resolution the Council of Europe, Committee of Ministers, state the need to integrate people with disabilities into the community using universal design or "design for all" principles. Education was one of the specifically mentioned areas of need (Council of Europe, Committee of Ministers, 2001).

The European Concept for Accessibility Network makes the case for equating universal design with good design. In discussing diversity in the years 2000 and beyond they urge Europeans to "no longer talk about the specific needs of certain categories of people, but talk about human functioning. We should look at every aspect of human functioning, without categorizing. ... Accessibility will loose its stigma and become a mainstream issue. We won't need terms like Design for All or Universal Design anymore. We will only refer to good design and bad design" (European Concept for Accessibility Network, 2001).

The Enabling Technologies Laboratory (ETL) at Wayne State University embraces the definition of technology as "the diverse collection of processes and knowledge that people use to extend human abilities and to satisfy human needs and wants" (ITEA, 2002). This definition reinforces and supports the principles of universal design in that it allows technology to be not only devices, or things, but also processes, quality tools, and organizational/planning techniques. Through its partnership with eight southeastern Michigan Intermediate School Districts, ETL has worked with teachers to bring UDL applications into numerous classrooms. The UDL principles presented in this paper draw from ETL experiences as well as the knowledge and experience of many individuals, ranging from educators to engineers.

UDL Principles

The application of UDL should yield products and processes that are: equitable, ergonomically sound, perceptible, cognitively sound, error managed, flexible, and both stable and predictable.

Equitable: Educational products and processes should provide the same means of use for all users: identical whenever possible; equivalent when not. The products and processes should avoid segregating or stigmatizing any users, making the design appealing to all users (Connell, 1997). Figure 1 exemplifies this aspect of universal design. If a science classroom has binoculars available for field trips, then at least one of them should provide image stabilization.

Figure 1. An example of universal design. The binoculars contain microprocessor technology that stabilizes the image for all users. This allows a tired person or a person with tremors or other motor problems to use the same device.

Ergonomically Sound: The physical demands of educational activities must be within acceptable limits for a wide range of users. All individuals must be able to physically access the activity. Appropriate space for wheelchairs must be provided. The relative placement of materials, equipment, and users should be ergonomically sound. Students should be able to easily lift items, carry objects, turn knobs, press keys, and/or move computer mice; if they cannot easily perform such ergonomic tasks, alternative means of physical engagement must be available.

Perceptible: The product, system, and environment must effectively communicate necessary information to the user, regardless of ambient conditions or the user's sensory abilities (Connell, 1997). The design should utilize redundant modes of information presentation (e.g., verbal, iconic, pictorial, tactile). The design should maximize legibility by providing adequate contrast between the information and its surroundings. The expanded use of sound field systems exemplifies this principle. The teacher wears a cordless microphone and a portable amplifier/transmitter that transmits a signal to a receiver that then distributes the signal to speakers placed around the classroom. The sound field technology started in Special Education classes, but research shows that at any given time a high percentage of general education classroom students have hearing problems due to colds, flu, allergies, fatigue, and other temporary conditions (Crandell, Smaldino, & Flexor, 1999). Research also shows that students in sound field classes perform better academically than those not in such a class (Crandell et al., 1999). Hence, there is a growing trend to install sound field technology in all classrooms.

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Cognitively Sound: The cognitive demands of educational activities must be within acceptable limits for a wide range of users. The task structure should be appropriate to the task – neither too wide nor too deep. The material must support different learning styles and human intelligences (Forrester, 2001).

Understanding the pivotal role of representations is central to the application of UDL principles. The educational material must provide different representations, which in turn appeal to different learning styles. Figure 2 shows a concept map illustrating habitats. This map was produced by a computer program that allows one to flip back and forth between a pictorial representation to a words-only outline form, thereby supporting different learning styles.

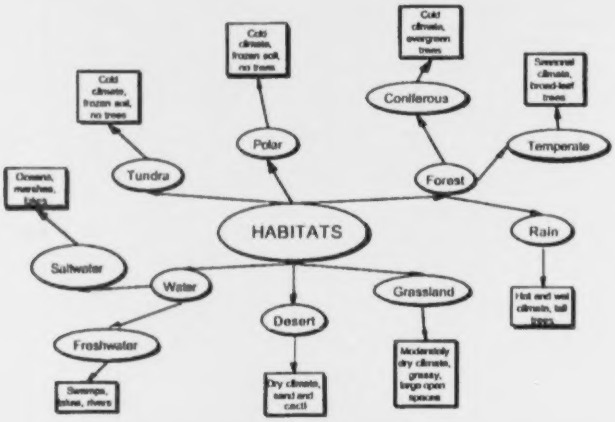
HABITATS
Tundra
Cold climate, frozen soil, no trees
Polar
Cold climate, frozen soil, no trees
Forest
Coniferous
Cold climate, evergreen trees
Temperate
Seasonal climate, broad-leaf trees
Rain
Hot and wet climate, tall trees
Grassland
Moderately dry climate, grassy, large open spaces
Desert
Dry climate, sand and cacti
Water
Saltwater
Oceans, marshes, lakes
Freshwater
Swamps, lakes, rivers

Figure 2. An example of a concept map illustrating habitats. This conceptual map was produced using Inspiration® a software tool to help develop ideas and organize thinking. A menu option allows the user to express the map in an outline form – words rather than images.

Creating appropriate representations of thoughts and concepts is also critical for reflection and discovering higher-order relationships. The process of a learner reflecting and forming ever more complex mental models of reality is central to the constructivist's learning theory (Jonassen, Peck, & Wilson, 1999). Educational designers use the laws of calculus to formulate, simulate, model, and test hypotheses concerning the physical behavior of elements. The ability to represent physical concepts such as force and electrical activity with mathematics allows us to analyze systems and design products. Graphs, charts, flow-diagrams, cause-effect diagrams, affinity diagrams, and conceptual maps are also examples of representations.

The representation should facilitate, not hinder, the reflective process of the learner. For example, Figure 3 shows two ways of representing numerical density data. The shading represents the data. In Row 1 there is no correspondence between the numerical density data and the visual shading density. In Row 2 the shading deepens as the numbers increase; thus, there is a relationship between the shading and the data. Row 2's shading is more intuitive than Row 1's shading because the visual shading becomes denser as the numerical density data it represents increases (Norman, 1993). The representation in Row 1 forces one to think about and compare the visual shading to the numerical data values; there is no natural mapping between the two representations. If the educational objective is to analyze the data and draw inferences about some physical process, then the extra cognitive processing introduced by Row 1's encoding interferes with learning.

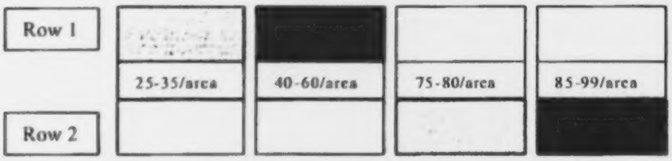
Row 1
Row 2
25-35/area
40-60/area
75-80/area
85-99/area

Figure 3. Example representations. The numbers represent some elements per unit area. Row 1's representation is less intuitive than Row 2's representation because in Row 2 the visual density increases as the numerical data density increases.

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Flexible: The Center for Applied Special Technology (CAST) has formulated three principles that capture essential aspects of UDL in a simple and straightforward manner. Educators should provide students: 1) multiple means of representation, 2) multiple means of expression, and 3) multiple means of engagement (CAST, 1999). Multiple means of representing concepts, ideas, data, and information allow people with different learning styles or disabilities to more readily comprehend the essential concepts presented by the representations. Multiple means of expression provide people with a variety of ways to express themselves with respect to communicating, reporting, assessment, and evaluation. Lastly, and in some respects most importantly, multiple means of engagement enable people with different interests, learning styles, or disabilities to be more readily motivated to pursue and maintain engagement with the material. Motivation is a critical factor and, in that respect, providing multiple means of engagement is an essential element of UDL.

Flexibility is the key to providing multiple means of representation, expression, and engagement. Flexibility can be achieved in many ways across several dimensions. Table 1 presents five key dimensions of flexibility.

Table 1. Dimensions of flexibility as modified from (Collis & Moonen, 2001)

Dimension	Fixed ← element → Flexible
Time	Times for starting and finishing a course. Times for submitting assignments and interacting within the class. Tempo/pace of studying. Moments of assessment.
Content	Topics of the course. Sequence of different parts of a course. Orientation of the course (theoretical, practical). Key learning materials of the course. Assessment standards and completion requirements.
Requirements	Conditions for participation.
Instructional approach & Resources	Social organization of learning (face-to-face, group, individual). Language to be used during the course. Learning resources: modality, origin (instructor, learners, library, WWW). Instructional organization of learning (assignments, monitoring).
Delivery & Logistics	Time and place where contact with instructor and other students occur. Methods and technology for obtaining support and making contact. Types of help, communication available, technology required. Location and technology for participating in various aspects of the course. Delivery channels for course information, content, and communication.

Figure 4 demonstrates flexibility; it shows a student in an adjustable, mobile, seating system. When the student was provided with this seating system, rather than her wheelchair, her teacher remarked that she "was now part of the class." She could sit at the same tables, at the same height as her classmates. The student was excited and her classmates were also excited that she could now participate in classroom activities just as they could. (Also note that the seating system allows her to remain in her seating orthosis, which is critical for her ergonomic stability.) Thus, figure 4 exemplifies the UDL principal of flexibility because the special seating system enables this student to participate in "regular" classroom activities that were precluded when she is in her wheelchair.

Figure 4. Use of an agile device – a movable, adjustable chair made of Creform, a pipe and joint technology for creating agile devices. The student is out of her wheelchair and at the same level as her classmates, able to sit at the same tables.

Error Managed: Individuals learn by making mistakes; hence, UDL must manage errors. Educational activity associated with desired learning can be termed *value-added* activity. Activity not associated with the desired learning activity can be termed *non-value-added* activity. The non-value-added portions of the process must be error-proofed, while the value-added portion of the process must allow errors to occur (Erlandson, Greenwood, Perrin, & Zapinski, 1997). Figure 5 illustrates this idea for the educational objective of improving writing skills. The writing objective, inside the heavily outlined box, could just as easily be a computer program for mathematics or physics instruction.

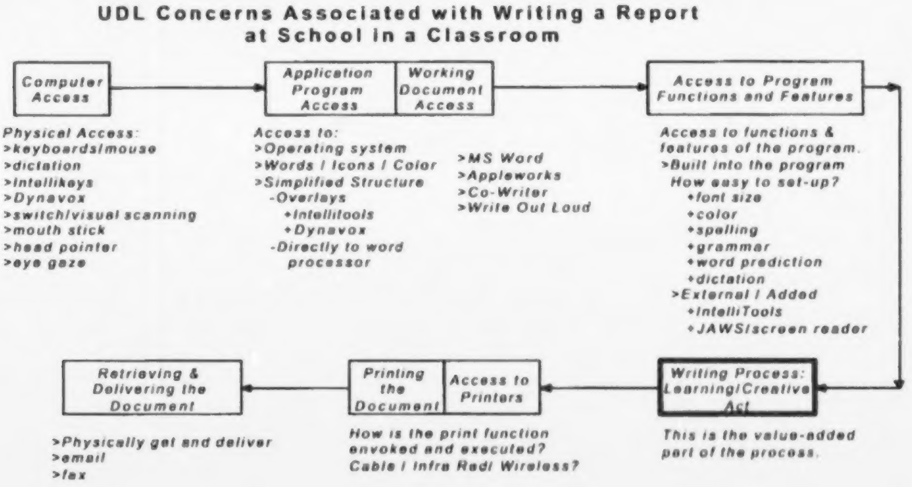
UDL Concerns Associated with Writing a Report at School in a Classroom
Computer Access
Application Program Access
Working Document Access
Access to Program Functions and Features
Physical Access:
>keyboards/mouse
>dictation
>Intellikeys
>Dynavox
>switch/visual scanning
>mouth stick
>head pointer
>eye gaze
Access to:
>Operating system
>Words / Icons / Color
>Simplified Structure
-Overlays
+Intellitools
+Dynavox
-Directly to word processor
>MS Word
>Appleworks
>Co-Writer
>Write Out Loud
Access to functions & features of the program.
>Built into the program
How easy to set-up?
+font size
+color
+spelling
+grammar
+word prediction
+dictation
>External / Added
+IntelliTools
+JAWS/screen reader
Retrieving & Delivering the Document
Printing the Document
Access to Printers
Writing Process: Learning/Creative Act
>Physically get and deliver
>email
>fax
How is the print function envoked and executed? Cable / Infra Red/ Wireless?
This is the value-added part of the process.

Figure 5. If the educational objective is to develop writing skills, the activities contained in the heavily outlined box, then everything outside the outlined box must be considered non-value-added activity. If students experience errors in setting-up or getting to the writing process, they may be so frustrated that they do not learn what is desired. If they experience errors and cannot print or otherwise obtain a copy of their work – this might also diminish the learning process.

Stable and Predictable: Educational environments need to be stable and predictable in that the learners, teachers, and other participants can expect an environment that supports the desired learning. A school classroom requires an environment different from a field trip, or community based experience. A metal shop will have different requirements than a library. The desired educational objective dictates what is or is not acceptable.

While each environment presents unique requirements for stability and predictability, a common theme across all environments is the need to reduce the inherent variability of the educational processes or activities that take place in the environment. The inherent variability of an educational process is not to be confused with providing variation and variability of curriculum material or activities. These are very different conditions.

The reduction of the inherent variability of a process is a fundamental principle of universal design and key to the creation of stable, predictable systems. Every task and process naturally has a certain amount of variability or variance. Deming termed this variability *common cause* (Deming, 1982). Everyday occurrences, such as traffic volume and the timing of traffic signals, contribute to the time variability associated with one's drive to work. An accident or severe storm is an exceptional event that is not common to the process. Deming termed such events *special causes* (Deming, 1982). In terms of educational activities and the educational environment, educational designers need to plan for the occurrence of special cause events (fires, tornados), but they typically have no control over these special cause events. On the other hand, educational designers do have the ability to reduce common cause events and problems associated with such variability.

The task of balancing a broom on the open palm of one's hand, broom bristles up, provides an example of common cause variability. The laws of physics introduce a great deal of variability and can make this task quite

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difficult. An accomplished balancer has the expertise and skills necessary to balance the broom; however, most people would scurry around trying, with no avail, to keep the broom balanced. Most individuals simply do not possess the skills necessary to overcome the variation inherent to the process to successfully perform this job.

However, if the process is redefined by holding the broom in two hands, and introducing some technology, such as bracing the broom handle against a desktop, many more people can successfully perform the task. The redefined process and use of *enabling technology*, technology that enables improved performance, makes the task more accessible by reducing the variation inherent to the process. This illustrates a typical strategy for reducing the variability associated with processes: redefine the processes and incorporate enabling technology.

Workplace organization, standardized work procedures, and the use of visual controls all help reduce common cause variability. For example, the parking place lines and directional arrows present in parking structures organize the parking environment. As long as people understand and comply with these visual controls, the environment is largely self-managing. The knowledge built into the environment helps everyone perform correctly and allows optimal utilization of parking resources. The self-managing features of workplace organization, standardization, and visual controls built into the environment reduce the variability of human performance and create more stable, predictable environments for everyone (Erlandson, Noblet, & Phelps, 1998; Erlandson, 2001b; Erlandson et al., 1997).

Likewise, educational designers need to utilize design principles that reduce the common cause variability inherent in educational environments. Providing a safe, clean, and comfortable facility is an obvious and critical step. Creating a classroom flow that minimizes movement around the room and hence the opportunity for students to bump into each other and cause disciplinary problems is another technique for variation reduction. Providing environments that are more self-managing is another step. Figure 6 shows a shadow diagram in a shop. This simple technology provides significant self-managing features as well as error-proofing. Everyone knows by looking at the board if a tool is present. Everyone knows to put the tools back over the corresponding shadow diagram.

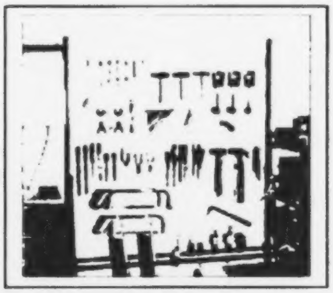

Figure 6. A shadow board builds knowledge into the environment and creates a more self-managing environment.

Conclusions

The UDL principles of equitability, ergonomic soundness, perceptibility, cognitive soundness, error management, flexibility, and stability/predictability work synergistically. For example, Figure 7 shows three sets of dials. If the educational objective is to conduct an experiment wherein the dials (representing some part of the experimental setup) must be in the proper range for the experiment to proceed, then reading the dials is a non-value added activity not the essential learning objective. UDL principles would suggest use of the Level 4 arrangement. The experimenter can quickly see if the dial readings are appropriate. Not only are they within the marked area, but they are all vertical. This is a quick pattern recognizing cognitive operation, one that people are very good at. The Level 1 arrangement requires interpreting the three dial positions, a highly error prone operation with a large amount of inherent variability. The Level 3 arrangement is less error prone and possesses less inherent variability but still requires more cognitive effort than Level 4. In this example the visual controls build knowledge into the environment; thereby facilitating a more self-managing environment. Since the visual controls work for everyone, they are non-stigmatizing as they provide error proofing.

The systematic application of UDL principles creates educational environments that support competent participation by all students. UDL principles are good design principles that support a variety of learning theories. Educational designers can use the UDL principles to create more efficient and effective educational environments, curricula, materials, and activities (Erlandson, 2001a; Erlandson, 2001b).

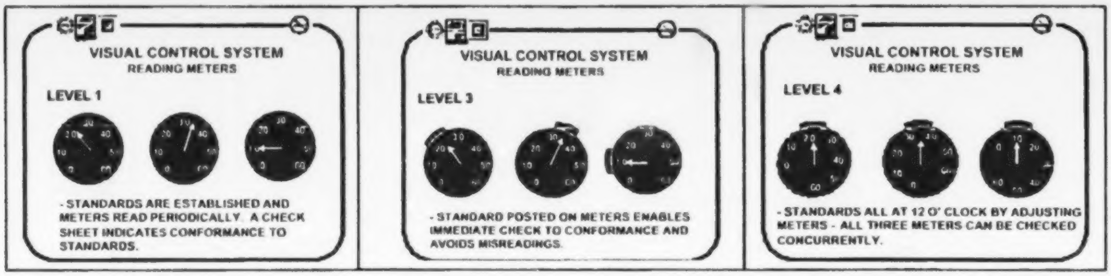
VISUAL CONTROL SYSTEM
READING METERS
LEVEL 1
- STANDARDS ARE ESTABLISHED AND METERS READ PERIODICALLY. A CHECK SHEET INDICATES CONFORMANCE TO STANDARDS.
VISUAL CONTROL SYSTEM
READING METERS
LEVEL 3
- STANDARD POSTED ON METERS ENABLES IMMEDIATE CHECK TO CONFORMANCE AND AVOIDS MISREADINGS.
VISUAL CONTROL SYSTEM
READING METERS
LEVEL 4
- STANDARDS ALL AT 12 O' CLOCK BY ADJUSTING METERS - ALL THREE METERS CAN BE CHECKED CONCURRENTLY.

Figure 7. An example of error-proofing using visual control, drawn from the General Motors Quality Network Workshop series on the application of quality and process improvement tools.

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References:

CAST. (1999). *Center for Applied Special Technology*: http://www.cast.org/.

Collis, B., & Moonen, J. (2001). *Flexible Learning in a Digital World.* London, UK: Kogan Page.

Connell, B. R., Jones, M., Mace, R., Mueller, J., Mullick, A., Ostroff, E., Sanford, J., Steinfeld, E., Story, M., & Vanderheiden, G. (1997). *Principles of Universal Design.* NC State University, The Center for Universal Design. Available : http://www.design.ncsu.edu:8120/cud/univ_design/princ_overview.htm [2002, 3/9/02].

Council of Europe Committee of Ministers. (2001). Resolution ResAP(2001)1 on the introduction of the principles of universal design into the curricula of all occupations working on the built environment. *(Adopted by the Committee of Ministers on 15 February 2001, at the 742nd meeting of the Ministers Deputies), http://www.fortec.tuwien.ac.at/bk/BK-DOK-UnivDes.htm*.

Crandell, C., Smaldino, J., & Flexor, C. (1999). Sound Field Systems Improve Learning. *The Hearing Review, Vol 6*(6), p40-42.

Deming, W. E. (1982). *Out of Crisis* (15th ed.). Cambrifge, MA: Massachusetts Institute of Technology.

Erlandson, R., F. (2001a). *Research on Training Engineers in Accessible Design.* Paper presented at the RESNA: 7th ANNUAL RESEARCH SYMPOSIUM:Emerging and Accessible Telecommunication and Information Technologies - Challenges in Engineering Design to Encompass Disabilities, Considerations for Inclusive Consumer Use, and Future Opportunities to Address the Mandate for Universal Access, Reno, NV, Saturday, June 23, 2001.

Erlandson, R., F, Noblet, M., J, & Phelps, J., A. (1998). Impact of Poka-Yoke Device on Job Performance of Individuals with Cognitive Impairments. *IEEE Transactions on Rehabilitation Engineering, 6*(3), 269-276.

Erlandson, R. F. (2001b, June 24-27, 2001). *Accesible Design Issues and Principles in the Undergraduate Engineering Curriculum.* Paper presented at the 2001 American Society for Engineering Education Annual Conference & Exposition, Albuquerque, NM.

Erlandson, R. F., Greenwood, L., Perrin, M., & Zapinski, R. (1997, 11/9/19997). *Kaizen and Kids.* Paper presented at the The National Governor's Conference: Quality in the Classroom, Dearborn, MI.

European Concept for Accessibility Network. (2001). Web Home Page: European Concept for Accessibility Network. *http://www.eca.lu/, Text Sites: History http://www.eca.lu/history.html Definitions http://www.eca.lu/def.htm*.

Forrester, D. J., J. (2001). *Learning Theories*. Available: http://www.ucalgary.ca/~gnjantzi/learning_theories.htm [2002, 2/23/02].

ITEA. (2002). *What is Technology*: http://www.iteawww.org/TAA/Whatis.htm.

Jonassen, D. H., Peck, L. P., & Wilson, B. G. (1999). *Learning With Technology: A Constructivist Approach.* Upper Saddle River, New Jersey: Merrill, an imprint of Prentice Hall.

Norman, D. A. (1993). *Things That Make Us Smart.* Cambridge, MA: Perseus Books.

An Exploration of the Potential of Causal Influence Diagrams for Assessing Progress of Learning in Complex Domains

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Abstract:
Despite the recent developments in the field of instructional design and technology, assessing learning complex domains remains quite challenging. This case study explores the potential of causal influence diagrams used by System Dynamicists for assessing the progress of learning in complex domains. The performance of eleven novice instructional designers is compared with the improvement in their causal influence diagram before and after the course. The results of this case study suggest that the evaluation methodology based on causal influence diagram is promising for assessing progress of learning in complex domains; however, more research is necessary to validate the methodology.

Introduction

An important yet little understood question remains as how to facilitate learning (and promote expertise) in complex domains (Spector & Andersen, 2000). Our knowledge about the facilitation of learning has significantly increased in the past two decades. Now, we know quite well how to facilitate learning in simple, well-defined domains. Unfortunately, we are not yet able to effectively facilitate learning in domains that possess highly interrelated dynamic variables and/or components.

A number of researchers propose different instructional approaches that may facilitate learning in complex, dynamic domains. Situated learning, cognitive apprenticeship, and cognitive flexibility theory are some of the perspectives that are being emphasized in this regard. On the other hand, some researchers also experiment with advance learning technologies hoping that they will uncover part of the mystery with learning and expertise in complex domains (Achtenhagen, 2000; Alessi, 2000; Spector, 2001). The biggest challenge in this line of inquiry is that a validated methodology for assessing learning in complex domains does not exist.

A review of System Dynamics literature suggests that causal influence diagrams[1] (CID) is a very useful methodology to graphically represent complex, dynamic systems (Davidsen, 1996; Davidsen & Spector, 1997; Spector et al., 2001; Sterman, 1994). This paper presents the results of a case study, which explores the potential of causal influence diagrams for the purposes of assessing progress of learning in complex domains.

Method

A total of 11 graduate students at a large university in eastern United States, enrolled in introductory level instructional design theory and practice course participated in this study. Of these, 63% of the participants were female. All students were pursuing either a masters or a certificate degree in the field of education. None of the students had any prior professional or academic knowledge or experience in the domain of instructional design. Moreover, the students were not familiar with systems thinking, System Dynamics, or causal influence diagrams.

At the beginning of the course, the students' learning preferences were assessed by VARK questionnaire developed by Fleming (2001). The results suggest that 63% of the students are not strong in visual cues. This means that they do not prefer the depiction of information in charts, graphs, flow charts, and all the symbolic arrows, circles, hierarchies and other devices for the purposes of learning or teaching. The rest of the students, as well as the instructor, were multimodal with varying degrees of preferences in all of the visual, oral, read/write, and kinesthetic modes.

To assess the degree to which participants would demonstrate an understanding of the complex problem domain, causal influence diagram was used. A causal influence diagram can be viewed as a kind of concept mapping technique tailored especially for dynamic and complex domains. It visually represents the dynamic influences and interrelationships that exist among a collection of variables. A causal influence diagram consists of a collection of nodes (key factors) and links. The nodes maybe entities that can be counted, such as products or people, or they might be rates or processes that represent how things are changing. An annotated causal diagram has a description associated with each node to indicate the specific nature of that factor. The links connecting nodes are directional to show how one conceives of the causal relationship among the factors (e.g., a rate of change in weight might have a causal influence on blood pressure- the arrow in this case would point from *rate-of-weight-change* to *rate-of-blood pressure-change*). The links are also annotated as either SAME (+) or OPPOSITE (-) to indicate whether a change in the causal factor tends to create a change in the same or opposite direction in the effected factor.

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[1] Some System Dynamicists use the term "Causal Loop Diagram" instead of "Causal Influence Diagram". The author prefers to use the latter but also acknowledges that the two are synonymous.

During the first week of the course, the students were asked to choose an instructional design problem in an area with which they are familiar and submit a short description of the context as well as the problem. Upon their submission of the problem description, they received feedback from the instructor and revised their initial description of the problem. Afterwards, the students were asked to draw out a causal influence diagram showing the relationships between the variables or concepts related to the problem of their choosing. After the students submitted their CID, they were asked to reflect on their experiences with this initial exercise in an online discussion forum. The students were also asked to post their CID in the forum and reflect on each other's CIDs. Then, the instructor provided feedback to each student.

Throughout the course, the students were encouraged to practice with a number of different concept mapping techniques while working with the course materials and their course projects. After learning each instructional design step, the students submitted that part of their project assignment, received feedback and moved on to the next step. At the end of the course, the students were asked to submit the final version of the total instructional design solution for their project. Also, at the end of the course, they were given a different instructional design problem and were asked to draw a causal influence diagram for this problem domain.

Results and Discussion

After their first encounter with CID, the students reported the overwhelming feeling of confusion. They had problems while trying to represent the domain of their choice even though they felt they knew the domain very well. Also, some of them reported they were not used to represent their thinking in graphics; they were simply not *visual*. These students were not also familiar with any of the concept mapping methodologies.

While reviewing each other's CID, the majority of the students thought their friends had done a fine job representing the domain (even though they were not good representations at all) so they assigned high grades to each other. However, as some students stated the reason of these high grades were not just for the work itself but also mainly due to the fact that they knew how much effort each put into that work. Most of the students also expressed their inability to judge the content of the diagrams.

The results were analyzed in terms of the improvement in their thinking on the instructional design problem. In general, their causal influence diagrams still lacked comprehensiveness but an overall improvement was noted. Afterwards, the students' letter grades (which excluded CID exercises completely) were correlated with the improvement in their CID. The results suggest that causal influence diagrams do reflect the improvement in student learning. Students who showed improvement in the way they think about instructional design case as evidenced by their project work also showed improvement in their causal influence diagrams. However, one may argue a better system for comparison is needed in order to be able to better judge how novice CID compares to those of experts. Also, one may question the reasoning behind the letter grading during the course projects. Indeed, the grading method used was subjective although the instructor tried to be fair in her judgment. In fact, it is difficult to induce a more objective assessment tool to assess learning in the domain of instructional design due to its complex nature. In such complex domains, CID emerges as a very promising assessment tool of learning progress provided that it is further researched and validated in a variety of complex domains.

References

Achtenhagen, F. (2000). Reality, models, and complex teachinglearning environments. In J. M. Spector & T. M. Anderson (Eds.), *Integrated and holistic perspectives on learning, instruction, and technology: Understanding complexity* (pp. 159-174). Dordrecht: Kluwer Academic Publishers.

Alessi, S. (2000). Building versus using simulations. In J. M. Spector & T. M. Anderson (Eds.), *Integrated and holistic perspectives on learning, instruction, and technology* (pp. 175-196). Dordrecht: Kluwer Academic Publishers.

Davidsen, P. I. (1996). Educational features of the system dynamics approach to modeling and simulation. *burnal of Structural Learning, 12*(4), 269-290.

Davidsen, P. I., & Spector, J. M. (1997). Creating engaging courseware using system dynamics. *Computers in Human Behavior, 13*(2), 127-155.

Fleming, N. (2001). *Teaching and learning styles: VARK strategies*. New Zealand: Fleming.

Spector, J. M. & Anderson, T. M. (2000) (Eds.). *Integrated and holistic perspectives on learning, instruction, and technology: Understanding complexity*. Dordrecht: Kluwer Academic Publishers.

Spector, J. M. (2001). Tools and principles for the design of collaborative learning environments for complex domains. *Journal of Structural Learning and Intelligent Systems, 14*(4), 483-510.

Spector, J. M., Christensen, D. L., Sioutine, A. V., & McCormack, D. (2001). Models and simulations for learning in complex domains: Using causal loop diagrams for assessment and evaluation. *Computers in Human Behavior Special Issue: Computer Supported Collaborative Learning, 17*(5-6), 517-545.

Sterman, J. D. (1994). Learning in and about complex systems. *System Dynamics Review, 10*(2-3), 291-330.

Digital literacy: A new terminology framework and its application to the design of meaningful technology-based learning environments

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Abstract: Digital literacy is more then just using software. It includes reading instructions from graphical interfaces (photo-visual literacy), utilizing digital reproduction in learning (reproduction literacy), constructing knowledge from non-linear navigation (lateral literacy), and evaluating information (information literacy). These literacies serve as a measure of the learners' work quality in digital environments. The present paper proposes a terminology framework for digital literacy. Discussion of every literacy type is accompanied by results from a study that examined the ability of learners to effectively utilize digital literacy in educational contexts.

Introduction

The fast developments in digital technologies during the last decades confront members of the technological society with situations that require the utilization of an ever growing assortment of cognitive skills, termed 'digital skills'. Examples that are commonly given to these skills include the ability to access or retrieve data, to use computer programs, and to operate digital appliances. Using digital skills require the users to own a relatively new kind of literacy, termed **'digital literacy'** (Lanham, 1995; Pool, 1997; Inoue, Naito and Koshizuka, 1997). However, digital literacy is much more then just the physical proficiency in operating computer programs, as many studies describe. It is a special kind of mindset; a special kind of thinking. For example: using a computer program involves the user's ability to communicate by deciphering, or 'reading' messages embedded in its interface. It also involves retrieving data from the Web, which requires the user's knowledge, not only of how to use search engines, but mainly of how to evaluate the retrieved data and distinguish between its relevance and non-relevance. It also requires a smart use of the hypermedia technology that involves lateral-associative thinking, which is very different from the traditional, linear reading of a book. The digital reproduction (copy and paste) capability of computers face learners with new horizons and offers a new meaning to creativity and ingenuity. All the above require the utilization of a new, very elaborate and flexible way of thinking, that is typical of digitally literate learners.

This paper proposes a terminology framework, and describes the major dimensions of digital literacy. It presents some research findings on the utilization of these types of literacy among youth and adult learners.

Methodology

In order to investgate the various aspects of digital literacy, three groups of participants were selected. The three groups were:

- 10 high-school students (age 14-15)
- 10 college students (age 24-28)
- 10 adults (age 30-40)

All participants were given assignments that required performing the ability to use different kinds of digital literacy: each assignment designed to address a different literacy. Details on each assignment are given below. The participants worked on the assignments individually. Each age-group worked separately, but at the same time. The assignments required the participants to perform work with computer programs. The participants were observed as they worked on the assignments, and notes were taken regarding the nature of their work while performing the tasks. The outcomes of the assignments, as well as the documentation of the processes of each participant's work, were used to assess and comment on their digital literacy. At the moment, the research findings are not yet completely analyzed, and, therefore, only the clearest and most prominent results are presented. For the sake of coherence, in the paper, every dimension of digital literacy is presented separately, and then discussed with respect to the relevant research findings, that are used to elaborate on its educational significance and utilization .

Photo-Visual literacy - Learning to read from pictures

Writing is a means of communication using symbols. It has evolved through history from a pictorial alphabet, that used meaningful symbols to represent words or letters, and therefore required a low level of cognitive mediation, to an abstract alphabet that uses "meaningless" symbols (letters) and therefore requires a higher level of cognitive mediation. The evolution of computer interfaces show a eciprocal trend, evolving from non-interactive, text-based, hard-to learn batch interfaces, into intuitive picture-based, easy-to learn Graphic User Interfaces (Nielsen, 1993). The first interfaces (either in CP/M or in DOS operating systems) were operated by text-based commands and required a very high cognitive mediation on the user's side (e.g. memorizing commands and understanding commands' syntax). In the 90's, under Windows environments, interfaces evolved into the icon graphic-based, highly-interactive Graphic User Interfaces, that are highly-intuitive and easy to learn. They appeal to the user's intuition and do not require a high cognitive mediation (Shneiderman, 1998). The evolution of interfaces marks three major trends: (1) an increase in the level of visualisation, (2) an increase in the level of interactivity, and (3) a decrease in the level of cognitive mediation required to reach proficiency in the use of the interface. Since computer interfaces communicate between the user and the program as they contain the information necessary to operate the program, using an interface should be regarded as a reading skill (Mullet and Sano, 1995). Therefore, the evolution of interfaces can be regarded as an evolution of a new kind of writing, from abstract text-based to concrete icon-based communication. We suggest that in order to perform well with this new means of communication, one must have a good command of a unique form of digital literacy – the **'photo-visual literacy'** - that the graphic interfaces have brought about: a literacy that requires the ability to use visuals (icons) as messages or "text", as described by Snyder (1999).

In order to examine how different users cope with different types of interfaces, we ran a usability test of two programs that share the same major objective (to design a stage), but are designed under a completely different approach: One (*Stage Struck*) has a pure graphical interface: almost no menus and no 'formal', pre-defined target. It is the user's responsibility to find out how and what should be done in the program. The other program (*The Opening Night*) has a very structured and quite 'expected' design (though it is also graphic). It is menu-driven; menus are textual; the user's task is well explained and determined in a text form.

The present research results show that the Adults group performed better with the more traditional interface of *Openning Night*, whereas the youngest participants performed better with the highly intuitive and graphic interface of *Stage Struck*. In addition, the research participants included three dyslexic persons, who were not fluent readers of a regular text. It was interesting to find that they scored among the highest with the graphic interface of *Stage Struck*, but were very unsuccessful with the traditional, more text -based interface of *The Openning Night*.

Our research has pointed to another aspect of photo visual literacy that involves the way young children learn how to read a new language. During interviews with the research participants, we came across, and documented two cases of 4-5 year old children (Chilian and Israeli) who learned to read and speak some basics of a foreign language (English) from 'living books' types of programs such as *Just Grandma and Me* (http://www.thereviewzone.com/grandmame.html). In these programs, the text is highlighted phrase by phrase, simultaneously with the narration. From discussions with the children, and then with their parents, we discovered that these children were able to pick up the words, and to formulate preliminary spoken sentences that are beyond the sentences read to them in the program. In doing so, they were tracking the highlighted words , and combined the visual shape of each word with its narration. This case seems to suggest another kind of digital literacy, that enables learning new languages through perceiving words as 'pictures', rather then a combination of letters, and by synthesizing audiovisual stimuli (Beavis, 1999).

Reproduction literacy: The copy and paste culture - a new interpretation of creativity and ingenuity

The invention of the press by Gutenberg (1455) marked the first big leap in the ability of humans to copy, reproduce and distribute information in a large scale. The second big leap was made possible by the digital reproduction capabilities (e.g. the Copy and Paste feature) of computers, that enabled people to reproduce or edit digital texts or visuals, (Benjamin, 1994). The unlimited possibilities to reproduce and distribute digital information led to new interpretations of originality, creativity and ingenuity of artwork as well as of academic text. These interpretations ask questions such as "How far can one copy or edit artwork or text, so that it is still considered an original work and not plagiarism?" "What are the limits of creativity? When does it become a technical act of reproduction?" A classical case that pushed the limits of meaning ful art in the reproduction era was the case of Drako Maver (1998) (http://www.kapelica.org/maver/main.htm). Maver was a non-existent person who was invented as an Internet artist, and whose works were a collage of pictures of corpses copied from the Web and edited. This faked artist was invented and introduced by a group of Italian students as part of a large-scale effort to challenge the limits of art in the reproduction era. So successful was this effort that Maver even won some prestigous awards for his pioneering Internet art works... (of course, the referees were not aware of his non existent nature). Can these works be considered art, real, original, and creative? Coping with this challenge requires a special kind of digital literacy on the side of the digitally-literate user. We tentatively term this literacy '**Reproduction Literacy**'.

In the present study, we investigated people's attitute towards reproduction literacy in two ways: (1) by presenting them with the the Maver case and asking whether they would consider it art work and (2) by giving them a digital essay, asking them to edit it (rearrange words; add/delete text), so that it can be used in a completely different context Results clearly show the attitude differences between younger and older people The recognition of Maver's work as a legitimate authentic artwork decreased from 75% among the youngest group (high-school students) to 39% among the college students, and to only 13% by the adult group. The opposite was found for the second task, that required participants to reuse text in order to create something original. Here, the adult group performed the best (43% of them succeeded in fulfilling the task). Success dropped to 35% with the college students, and to only 19% with the high-school students. This finding, of decreasing success from older to younger learners, conforms with reports of Labbo, Reinking and McKenna (1998), that described problems of treating digital text by young students compared with that of adults.

Lateral literacy: Hypermedia and thinking

Besides improving people's performance with computer programs, the hypermedia technology introduced computer users with new dimensions of thinking and new challenges of digital literacy, that are necessary in order to make an educated use of this elaborate technology. In the past, the limited non-hypermedia-based computer environments enhanced a more linear thinking that was dictated by the the non-flexible operating systems, and the fact that users were used to books, and expected to work with computer-based environments in the same way thay read through books. From an educational perspective, the major importance of the hypermedia-based environments is not so much the multi-tasking work they allow the user, but the ability to use these environments for navigating laterally, in a non-linear way, through knowledge domains. This capability enhances a lateral, multi-dimentional thinking, and has led to the evolution of a new kind of digital literacy – '**lateral literacy**'. Rouet and Levonen (1996) discussed the impact of the hypermedia technology on learning. They suggested that this technology helps learners to move away from linear thinking into a rich-associative lateral thinking. According to them, in order to perform demanding multi-level tasks, learners must be able to think laterally and synthesize knowledge from pieces of information that are collected in different, sometimes independent, domains of knowledge. Spiro, Feltovitch, Jacobson, and Coulson. (1991) discussed the role of hypermedia in forming a multi-dimentional knowledge, based on flexible cognition. Some authors (e.g. Salomon, 1996) raised doubts as to the ability of learners to form meanungful knowledge by surfing in hypermedia environments as the Internet.

In order to examine the level of lateral literacy among learners, the participants of our research were asked to perform a similar task: To plan a trip in a foreign country by using information from the Internet. This task requires the learners to utilize lateral literacy in order to combine independent pieces of information (collected by laterally surfing in the Internet), in order to construct knowledge (the trip). Although analysis of results is not yet completed, findingss seem to point to the high ability of the youngest participants (high-school students) to perform the task. The weakest performers were the adults, who tended to stick to linear surfing, that is, they made very limited use of the hypermedia technology, which led to a very poor outcome (a plan of a trip to a foreign country). These findings probably reflect the extensive exposure of young people to hypermedia environments. It may suggest that the exposure of learners to rigid, linear learning methods harm their cognitive flexibility, and affect their ability to cope with ill-structured problems (Spiro et al., 1991). On the other hand, the research findings may indicate that the extensive exposure of young students to the lateral, non-linear surfing on the Web, improved their ability to utilize multi-level constructivistic cognitive skills.

Information literacy: Trust nobody

Today, with the exponential growth of available information, the consumers' ability to evaluate and assess information has become a key issue in training people to become educated consumers of information (Kerka, 1999; Salomon, 2000). Information can be be classified into the following general groups: (1) primary objective information (e.g., all kinds of census data, migration routes of birds, distribution of volcanoes, satellite images, and weather information). It is usually easy to assess the validity of this information; it is original and relatively unbiased. (2) primary subjective information (e.g., much of the news in newspapers and diaries). These are usually biased to some extent, and it is usually hard to assess the quality and validity of this type of information because the average consumer is not fully aware of the fact that the term 'truth' is very subjective, and that even 'objective' information (what people call 'fact') can be easily treated in a biased way to produce a very subjective piece of information. (3) synthetical information (e.g. journalist articles, scientific hypotheses and models). This type of information is usually professional, more mature in its nature, and usually attracts relatively educated, sometimes professional, consumers, who are capable of assessing the quality of information properly.

We suggest that the ability of information consumers to make educated, smart, infomation assessments requires a special kind of literacy, termed here '**Information Literacy**'. This literacy acts as a filter: it identifies false, irrelevant, or biased information, and avoids its penetration into the learner's cognition (Minkel, 2000). It is true that information literacy is not unique to the digital age only. It was always a crucial trait of successful scholars, even before the information revolution of the digital age. But in the digital age, with the unlimited exposure of humans to digital information, this has become a crucial prerequisite that enables learners to make an educated use of digital information. Without a good command of information literacy, how can one decide which, of the endless pieces of contradicting information found on the Web, to believe? Which of the news on the Web to trust? Which political opinion posted on the Web to adopt?

In the present research we examined information literacy. All participants were asked to access seven different Internet sites that contain Middle East news (the Internet site of a main-stream Israeli newspaper; a terrorist organization information Internet site; a site of an Israeli government news agency; two private, politically-oriented news sites; an Arab country news site, and a site of a European news agency). Participants were given several events (news) that were reported in all of the examined sites. They were asked to assess and rate the quality and objectivity of the news. Analysis of results is yet incomplete, but one trend is evident: The younger the participants, the lower their information literacy. In other words, the oldest participants showed a significantly higher ability (49%) to apply critical thinking to information, compared to the youngest participants (15%). These findings, especially in the light of the fact that youngsters are among the most extensive consumers of digital information (in the Internet or in other forms of digital information and communication), illustrate the critical importance of emphasizing the inclusion of teaching information literacy in education systems. The low 49% for adults is also very worrying. It doubly suggests that information literacy be taught in schools.

Conclusions

This paper presents various aspects of digital literacy that are usually neglected in educational research concerning the impact of digital information on our society in general, and our education systems in particular. It proposes a terminology framework for digital literacy, i.e. photo-visual literacy, lateral literacy, reproduction literacy, and information literacy. The following (preliminary) research results were found for each type of literacy:

- The youngest participants (14-15 years old) were the best utilizers of photo-visual literacy; they were capable of working very well with graphic interfaces while the older participants were better with more traditional, menu-driven, or text-based interfaces.
- The dyslexic participants performed better with graphic interfaces, then with traditional, more text-based ones.
- The older participants were the most reproduction-literate learners; they were best in rearranging or re-using prior information into new forms of knowledge. On the other hand,

the youngest (14-15 years old) participants were more flexible in their perception of the originality and ingenuity of works made using digital reproduction methods (albiet a sophisticated 'copy and paste').

- The youngest participants (high-school students) showed the highest level of lateral literacy, which seemed to decrease with the older age groups. This finding is probably strongly related to the extensive exposure of youngsters to the hypermedia environments of the Internet.
- The oldest participants in the research (>30 years old) had the highest level of information literacy, whereas the younger participants were not overly capable of making good evaluations and assessments of information. This finding illustrates the importance of emphasizing teaching critical information literacy in educational systems, especially in schools.

In general, two, different, modes of approaching digital literacy were evident among the research participants: The **technological mode** (using modern graphic interfaces; surfing the Web in non-linear ways), and the **pedagogical mode** (creating meaningful digit al reproductions of knowledge; critically evaluating information). The younger participants were better performing technological tasks whereas the older participants performed better in pedagogical tasks.

More research and data analysis are required in order to examine the validity and aplicability of our findings in wider populations.

References

Beavis, C. (1999). English and computer games. Paper presented at the *Biennial Conference of the International Federation for the Teaching of English*(Warwick, UK, July 7-10, 1999)

Benjamin W. (1994). *The Work of Art in the Age of Technical Reproduction* (Hebrew translation from German). Tel Aviv: Teamin publishers.

Kerka, S. (1999). Consumer education for the information age. *Practice Application Brief*, 4, 12-15

Inoue, H., Naito, E., and Koshizuka, M. (1997). Mediacy: What it is? Where to go? *International Information & Library Review*, 29 (3-4), 403-413.

Labbo, L. D., Reinking, D., and McKenna, M.C. (1998). Technology and literacy Education in the next century: exploring the connection between work and schooling. *Peabody Journal of Education*, 73 (3-4), 273-289.

Lenham, R. (1995). Digital literacy. *Scientific American*, 273 (3), 253-255.

Minkel, W. (2000). No, it's not all true! *Library Journal*, 33-34, Supp. Sum 2000, 35-43.

Mullet, K. and Sano, D. (1995). *Designing Visual Interfaces*. Engelwood Cliff, N.J.: Prentice Hall.

Pool, C.R. (1997). A New Digital Literacy: A Conversation with Paul Gilster. *Educational Leadership*, 55 (3), 6-11.

Nielsen, J. (1993). *Usability Engineering*. San Diego: Morgan Kaufman.

Rouet, J.F. and Levonen, J.J. (1996). Studying and learning with hypertext: Empyrical studies and their implications. In J.F. Rouet, J.J. Levonen., A. Dillon, and R.J. Spiro, (Eds.), *Hypertext and* Cognition (pp 9-23). N.Y.: Lawrence Erlbaum Associates.

Salomon, G. (1996). Learning is wonderful: What computers really offer in education. In S. Kerr (Ed*). Technology and Future of Education.* NSSE Yearbook (pp. 111-130), Chicago: University of Chicago Press.

Salomon, G. (2000*). Technology and Education in the Information Age* (in Hebrew). Tel Aviv: Haifa University/Zemora-Bitan Publishers.

Schneiderman, B. (1998). *Designing the User Interface.* Reading, Ma.: Addison-Wesley.

Spiro, R.J., Feltovitch, P.L., Jacobson, M.J., and Coulson, R.L. (1991). Cognitive flexibility, constructivism and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. *Educational Technology, 31(5)*, 24-33.

Snyder, I. (1999). Renegotiating the visual and the verbal communication. *Prospect,* 1 (3), 13-23.

EvalOnline: A Formative and Summative Evaluation System for Online and Technology-Enhanced Courses

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Abstract: Now that online distance education has outgrown its infancy, increasing attention is being paid to evaluating online course offerings. A stable, easy-to-use web-based course evaluation system is a necessary part of any distance education evaluation effort. This presentation describes the design, development, implementation and revision of a worldwide-web-based system for creating and administering student evaluations of online distance education courses and on-campus courses utilizing Internet technology. The system was developed after assessing instructor needs for such a system and reviewing the existing and potential options for meeting those needs. The system was designed to provide for both traditional summative (end-of-term) evaluation and mid-semester formative evaluation.

Introduction

With the incredible growth of online distance education over the past decade, with over 1.5 million students earning college credit online in the 1997-1998 school year, according to a National Center for Education Statistics (NCES) study, and 82% of the institutions in the NCES study planning to start or increase their online offerings, and the need for faculty and administrators to evaluate these new courses and degree programs, it is essential that tools designed expressly for collecting student feedback to this new type of college course are created. This presentation describes how the instructional support office staff at a large midwestern state university's School of Education designed and developed (with faculty input) an online course evaluation system called EvalOnline. The system can viewed online at http://ic.educ.indiana.edu.

Overview of the Project

In our presentation, we will:

- Share the results of our faculty needs analysis regarding their requirements for an online course evaluation system.
- Provide a technical overview of the system, and the related decisions made.
- Describe how the system is currently being used.
- Describe our plans for further development of the system.

Needs Analysis

The EvalOnline system was created in response to feedback from our faculty and associate instructor clients about their dissatisfaction with the university's existing online course evaluation system and how it failed to meet their needs as distance educators. In a series of informal discussions and during one-to-one consultations with them, we discovered the following instructor needs:

- Accessibility and Ease of Use for Students
- Ease of Use for Instructors
- Compatibility with Existing School Requirements
- Flexibility
- Relational Database Capabilities

Technical Overview

In the initial stage of the development of EvalOnline system, the design team researched the benefits and disadvantages of using a Microsoft Windows-based server compared with the Linux/Unix-based server alternative. Once the platform was chosen, the design team started work on the database infrastructure and the web interface with which the users would interact. Instructors and students were both given the same web address to access the system (http://ic.educ.indiana.edu). On that page, they saw buttons for Students, Faculty and Administrators. Students clicked on the Students button, and then were shown a page that allowed them to login, using the password given to them by their instructor. The next page shown to them was the course evaluation, which incorporated both Likert Scale (Strongly Disagree to Strongly Agree) and open-ended questions (more question types will be added soon). They chose their responses and then clicked the Submit button, which added their course evaluation information to the system. For instructors, the system allowed for a wider variety of activities: they could create or edit their account, create or edit a course evaluation, or view the results of their course evaluations. Administrators (departmental secretaries, primarily) could view course evaluations of their instructors.

Current Use

During the Spring 2001 semester, the first semester of wide (post-pilot) availability, 50% of the instructors teaching onlne courses for the School of Education utilized the EvalOnline service to create and deliver their end-of-term course evaluations. The rest of the online instructors either used the previously existing university testing/grading system or did not administer a course evaluation to their students. We hope to increase this percentage by describing and demonstrating the use of the system to the rest of the instructors. We also expect that the faster system response time allowed by the new 900mhz Pentium III server and the greater ease-of-use due to interface and documentation refinements will increase instructor acceptance of the system. As the School's distance education program continues to grow, adding additional courses and programs, we expect use of the system to continue to rise. We have also had several on-campus instructors utilize the system and we expect this type of use to rise as well.

Future Development

In the near future, we plan to survey a sample of the students and instructors who utilized EvalOnline during Fall 2001 and Spring 2002, to get their feedback regarding the system's strengths and weaknesses. After analyzing the responses, we plan to initiate a new round of revisions and refinements to the program. We are also planning extensive changes to the administrative interface, to allow administrators to save and print more advanced reports, and to make general administrative features easier and more time-efficient

References

National Center for Education Statistics (1998). *Distance Education at Postsecondary Education Institutions 1997-98.* (On-line). Available: http://nces.ed.gov/pubs2000/2000013.pdf

On-line Net.art Gallery and Educational Resource

With the guidance of Professor Mark Amerika, a group of students within the CU Boulder Fine Arts Department have completed an on-line art gallery entitled Histories of Internet Art: Fictions and Factions. This gallery features Internationally acclaimed works of Internet art, hot new works by up and coming net artists, as well as the best student efforts coming out of the CU Boulder Techne Lab. Nearly all of these pieces are complemented by student written reviews, which serve to help clarify many of the new concepts presented by contemporary artists. In conjunction with the visiting artist program at CU, prominent net.artists have been invited to CU to be interviewed and lead workshops with students who are participating in this program. Interview text and clips as well as art generated from these sessions are also presented in this gallery. In addition, there is an area for researched net theory and links to other collections of net.art.

My proposal is to present this gallery to the participants of the ED-Media Conference and give a short lecture and demonstration of what can be found within this gallery and how it can serve as an essential tool for University art departments that are interested in exploring this new art form. Art departments across the country will likely be including this site in their digital arts research list. Although official press releases have only begun to be circulated, there has already been international attention from The Whitney Biennial, Alt-X, Naural.it, and others.

One of the most significant aspects of this gallery is that it is student created and maintained and will continue to grow and offer important original content. Of much interest to the art community and art enthusiasts in general is the filtration of the artwork and the resource created by bringing these works to a central location. The interviews are also extremely popular as they are original content that can only be found on this site. As an educational resource, students can view and explore this artwork as well as study some of the essential theory that has influenced this art movement. The reviews are also helpful in determining which pieces are important topics of research and many suggestions and points of view are offered as to the significance of these works. Faculty and staff in academic art departments who are interested in starting or enhancing a digital arts program can look to this as a resource and a link to pertinent information.

Although net.art is still fairly new in the art scene, it has made its way into mainstream acceptance and there are on-line galleries now being offered by the Whitney, The Tate, SFMOMA, and many other prestigious institutions. Net.art may be the only art movement that has gained this much acceptance in such a short time ever before in the history of art, much being owed to the accessibility of the medium in which it resides. Because this medium is such an open and leveling platform, the history of Internet art is being written and argued by prominent artists, critics, and art historians simultaneously while the movement is gaining popularity. It has been accepted that anyone can publish their findings and opinions on the Internet and although this creates a means of having a voice for all individuals, the question arises as to who will actually look at what has been published. This has created a new form of economy: the attention economy. The attention economy is already a formidable force and may yet become one of the most influential economies yet. As any advertiser well knows, the attention economy has a direct bearing on its monetary counterpart as it is only by gaining the attention and trust of a consumer that a product can sell. Everything on the Internet is clamoring for the attention of the surfing audience, and there is a great need for a trusted filtration mechanism to highlight some of the more important information. The Histories of Internet art gallery hopes to become a popular filter and an important hub for linking to the best that the International community of net.artists has to offer. In also having a section for student works, it is possible for students to gain the attention from the art community while attending school. This type of design can also serve as a working template for other student-run on-line galleries.

Many argue that Internet art is only a combination of audio, video, and text based art forms. There is a new aesthetic that is emerging from the blend of these mediums combined with interactivity and the network space. It is possible to use the rest of the Internet as a dynamic entity within this new form of art. Interactive elements blur the divisions between artist, viewer, critic, theorist, and historian. Commercial development of web based tools and software is fueling this new form of visual creative expression, and it is important to demonstrate that there are alternative ways of viewing the Internet as a medium. The Internet can be seen as a digital canvas that has tremendous accessibility potential. It does away with issues pertaining to physical space, transportation, collections, and formation of an established canon by the powers that be. There has been much theorizing as to how this affects present culture and how it will influence art movements in the future. It is of great importance to illuminate and explore these implications as they cannot help but influence all forms of art. Even the most traditional artisans are turning to digital aids to more efficiently produce and manipulate their work. Not only does this create new possibilities in imaging but also a new aesthetic sensibility has emerged as a bi-product. It is critical that this is not overlooked.

In the short span of the lecture I wish to present, I plan to raise some of these issues in relation to the on-line gallery that we have created here at the University of Colorado at Boulder. Histories of Internet Art: Fictions and Factions gallery (http://blurr2.colorado.edu/~hiaff) is being developed as part of the TECHNE practice-based research initiative with the support of the University of Colorado at Boulder Department of Fine Art, the blurr_ lab, and ATLAS (a campus-wide technology initiative). From its initial inception, it has brought together talent from the college of Fine arts, Journalism, and Engineering. It is my hope and intention that other disciplines within academia will become interested in participating in and embracing this method of on-line presentation and this new field of creative expression and communication. It is also my hope that I can generate interest and stir excitement in this new form of fine art. Thank you for your consideration.

Technology in a Constructicvist Classroom

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Introduction

> Here is Edward Bear, coming downstairs now, bump, bump, bump, on the back of his head behind Christopher Robin. It is, as far as he knows, the only way of coming downstairs, but sometimes he feels there really is another way, if only he could stop bumping for a moment and think of it.
> Milne, 1996

The quote from Milne speaks to the way many teachers function in the K12 arena. There is so much to do and so little time to do it in, they continue to do work in the same way it has been done for decades. Teachers generally know there may be better methods available, but do not have the time to investigate what they are. As assessments and data-driven instruction become increasingly important, teachers must stop "bumping" down the stairs in order to become more efficient, effective users of the equipment provided for them. Integrating technology into a Constructivist learning environment is one way that is currently being advocated as a method that will move more students toward functioning in the real world.

The technological changes that have swept through our society have left educational systems largely unchanged. Over the past 20 years, an immense division appeared between the process of teaching and learning in schools and the ways we obtain knowledge. This division has been made more obvious by the fact that the process of teaching has not changed substantially over the past 100 years. The result is an estrangement of children in schools from society as a whole. Educators now question how we can best educate students raised in a world of instant information, where interactive technologies have led them to believe they can act on the world with the press of a button. What is needed is a guiding philosophy for educational curriculum and effective uses of technology. It has been proposed that this philosophy could be Constructivism (von Glaserfeld, 1989).

Technology and Constructivism

Constructivism's central idea is that human learning is constructed, and that learners build new knowledge on the footing of previous learning. In a Constructivist atmosphere, the learner constructs knowledge through discovery and exploration in order to solve real world problems with peers. According to Bruner, Constructivism is a teacher-facilitated process that places students at the center of active learning, rather than in a passive role. Instead of simply absorbing ideas spoken by teachers, or somehow trying to internalize thoughts through endless, repeated rote practice, constructivism suggests children actually invent their own ideas. They assimilate new information and modify their understanding in light of new data. In the process, their ideas gain in complexity and power, and with appropriate support, children can develop insight into their own thinking processes. Advocates of constructivist teaching say its practice is vital if America hopes to cultivate and maintain a work force capable of competing globally in the 21st century.

Schools have always mirrored the values of our society, however the technological changes that have swept through society have left the educational system virtually unchanged. It is frightening to note that as our children are growing up, they may not be receiving the instruction and knowledge necessary to function in a technological world. The task of the educational system should be to embrace the future and empower children to learn with the tools available to them. Trying to think up clever ways to use computers in a traditional classroom setting will not do the job. If we assign technology to a secondary role, which does not fully utilize its potential strengths, we are failing to use it to its fullest potential.

By using technology as part of a constructivist philosophy in the classroom, we can give our children a powerful set of tools. Technology should be thought of as an integral component of any curriculum. Computers in a constructivist classroom can be used as a writing tool, to complete spreadsheets, to compile databases, for concept mapping, to create multimedia, to author Internet projects, to complete research, and mathematical problem-solver. Computers also make it possible to exchange information between classrooms and access online information.

"The introduction of computers into the classroom changes the teachers' role, leading to decreased teacher-directed activities and a shift from didactic approaches to a constructivist approach" (Schofield & Verban 1988). Research has shown that teaching in classrooms with computers involved more: a) project work, b) extensive projects, c) motivation for the writing process, d) group work and cooperative learning, e) interdisciplinary activities, f) opportunities for students to make choices and g) a different philosophy of teaching (Dwyer, et al., 1990). A classroom with a technology rich environment has also been shown to involve less structure and less teacher presentation (Schofield & Verban, 1988). The trick to teaching is to entice and motivate the students' excitement and interest in the topic, and then to give them the proper tools to reflect, explore, compare, and contrast. Current interactive multimedia technologies have the potential to represent ideas in almost any form so students view the resources, creating their own meanings and understandings of the information they encounter.

Increasingly, researchers and educators are linking Constructivism and learning with technology. This is not surprising since many see a strong support for the principles of Constructivist philosophy in computer-based learning environments. Computer-based Constructivist projects can take many forms, both online and off. They do, however, all have one thing in common; they are based on a problem-solving format. CSILE, CoVis, Computer Clubhouse, JASPER, and Web Quests are all examples of such formats.

Using a Building Block model (Dodge, 2000; March, 1995; March & Reed, 1999) integrated technology projects can be created that will allow students to gather information, use critical thinking skills and communicate. A constructivist technology-integrated lesson plan should be designed to bridge the transition between teacher-led instruction and self-directed learning by students. The hope is that through scaffolding, both teachers and students will gain experience in a learning-centered approach. One way these projects can be created has four steps: a) determine outcomes, b) draft the project framework, c) develop the evaluation tool, and d) design the task.

Summary

The goal for education should not be simply to access information, but to understand and use it to solve real world problems. Technology offers educators the opportunity to move away from instructional strategies that focus on presenting abstract information to a passive learner, to an active process where meaning is developed based on experience. This way of teaching and learning supports the Constructivist point of view where the learner is building an internal representation of knowledge and a personal interpretation of experiences. Technology also offers students the opportunity to communicate and collaborate with millions of worldwide users on the Internet.

Technology has effectively revolutionized American society. An unexpected by product of this revolution has been the emergence of a generation of children weaned on multidimensional, interactive media sources, a generation whose understanding and expectations of the world differ profoundly from that of the generations preceding them. We need to give these children the education necessary to succeed in a technological future. We need to build on children's native learning abilities and technological competence with an instructional model that allows learners to be actively involved and engaged in a real-life arena, which includes technology.

References

Dodge, B. J. (10/07/00). *Building blocks of a WebQuest.* [On-line] Available: http://edweb.sdsu.edu/people/bdodge/Professional.htm

Dwyer, D.C., Ringstaff, C., & Sandholtz, J. (1990 April) *The evolution of teacher's instructional beliefs and practices in high-access-to-technology classrooms. (Paper presented at the Annual Meeting of the American Educational Research Association, Boston.)*

March, T. & Reed, J. (1999). *Filamentality.* [On-line] Available: http://www.kn.pacbell.com/wired/fil/

March, T. (1995). *Working the web for education.* [On-line] Available: http://www.ozline.com/learning/theory.html

Milne, A. A. (1996). *Tales of Winnie-the-Pooh.* USA: Penguin.

Schofield, J. & Verban, D. (1988). Computer usage in teaching mathematics: Issues which need answers. In D. Grouws and T. Cooney (Eds.). *The Teaching of Mathematics: A Research Agenda,* (Vol. 1). Hillsdale, NJ: Erlbaum.

von Glasersfeld, E. (1989). Constructivism in education. In T. Husen & N. Postlewaite (Eds.), *International Encyclopedia of Education* (pp.162-163). Oxford, England: Pergamon Press.

A Game Editor for Virtual-Prismaker Learning Environment to Improve Teaching and Learning in Classroom

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Abstract: This paper describes a personal game editor developed to improve teaching and learning strategies in classroom trough a learning environment called Virtual-Prismaker. Most educational games are closed in the sense that the teacher is not permitted to introduce new activities. In the context of Virtual-Prismaker project we have faced the need to open the game's educational possibilities by enabling to incorporate the educator's experiences and needs, and by enforcing the motivation children find in playing computer games.

1. Introduction

When preparing activities that are to be carried out in classroom, the teacher tries to maximize the use of available resources. Prismaker is a construction game composed of reduced number of kinds of available pieces. The main construction block is a semicube. Apart from these basic construction blocks, there are a series of additional pieces: wheels, axis, small cylinders and logos. In our context, logos are very useful and greatly improve the construction game's cognitive capacities. Indeed, logos are used to assign blocks a meaning. Teachers are able to create a greater number of different games for distinct school matters by using this highly interesting feature. Information technologies provide new tools for the creation of contents that adapt to children characteristics, to their learning capacities and to their special needs. Our research team is involved in the development of an interactive learning environment based on the physical educational game Prismaker^{tm} [Prismaker, 2001]. The game is called Virtual-Prismaker [Gonzalez et al., 2001; Lopez et al., 2001]. Introducing new technologies in classroom does not mean substituting the teacher's work. It rather allows creating new games according to the students needs. This is the cue we are approaching in this paper.

2. A Game Editor to Improve Teaching and Learning Strategies

Computer games designed for education in classroom should allow the teacher to create and to modify the existent playing possibilities to adapt the material to the learning necessities of the different students. Thus, the central idea of our project is to offer the possibility to personalize games. Observing similar games that exist in the marketplace, we have noticed that their playing possibilities are totally closed. Our solution is to offer teachers an open game. For the currently available types of games, the teacher is in charge of creating those activities he considers to be convenient, as well as their characteristics. Here is where the teacher's educational role begins. Our virtual game editor tool is not sought to substitute the teacher's labor, but to offer him to be a decisive part in a new teaching means.

A characteristic incorporated to the game is the division in difficulty levels. This also bears a motivation aspect for the player as he is challenged to complete all the levels. The difficulty levels are based on the age of the player and the teaching matters (mathematics, history, language, etc). The student has to overcome, according to his age, the different difficulty levels to complete each matter. It is the teacher's job to associate any playing activity to a certain level.

In our solution the main raw material needed to create activities are images. We have also created a letter/word editor that allows us to create simple images containing letters, numbers and words in a quick and easy way.

3. The Game Editor Capacities

3.1. Meaning related games

These kinds of games have been incorporated as they throw two desirable characteristics for learning. The first characteristic is its memory training capacity. And, respect to the concept of association, it offers a great potential applied to any matter. Some examples are offered now. In a Foreign Language course it is possible to give the native word and the foreign word for it. An example in Geography is to show the name (or the map) of a state and the name (or a representative monument) of its capital. There is no limitation to the teacher's imagination. Thus, it is feasible to create identical couples, to create couples with the same concept or even to create couples with some preset relationship. This way, children learn to relate concepts. The association possibilities are infinite. For example we can enumerate the following ones: learning words in several languages, relating two numbers associated somehow, comparing an image to a written expression, associating the same images.

3.2. Order related games

This second kind of games is based on composing an original image where the important thing is the order of the parts that compose the global image. The student is given the original image and the disordered pieces. Considering the fact that the important thing is the order, we have added to this type of game the possibility to create a sequence of images. We can create this way, for example, an alphabet, a sequence of images that describe a story, etc. Another possibility is to create a sequence of images where the order is the important thing. The editor offers a multiple image viewer for this case. Once we have the images, the creation of an activity game of this type is very simple. We can create image sequences such as an alphabet, a story where each drawing represents a part to the story, etc. Series or patterns are allowed too. When a pattern is being created the teacher decides the elements the pattern will consist of, along with the number of times the pattern must be repeated. A mathematical sequence could be created defining the initial value, the expression to calculate the next element and the minimum number of elements to play successfully that game.

3.3. Meaning plus order related game

Meaning plus order has been used in a game based on mathematics, so that children are engaged to learn about the basic operators in a simple way. In this kind of game, the student is offered a disordered mathematical expression, where each piece contains an image of an operand or an operator. The student's mission is to place the pieces so that the expression is correct. Therefore, both the order of the pieces and the result calculated to evaluate the expression has to be correct. Each piece will be an integer number or one of the following operators: sum, subtraction, division, multiplication, right parenthesis or left parenthesis.

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References

[Gonzalez et al., 2001] Gonzalez, P., Montero, F., Lopez, V., and Fernandez-Caballero, A. (2001). A virtual learning environment for short age children, In *Proceedings IEEE International Conference on Advanced Learning Technologies, ICALT 2001*, pp. 283-284.

[Lopez et al., 2001] Lopez, V., Fernandez-Caballero, A., Gonzalez, P., Montero, F., and Molina, J.P. (2001). Collision handling and shadow casting in Virtual-Prismaker, In *Proceedings of the IASTED International Conference on Visualization, Imaging and Image Processing, VIIP2001*, pp. 113-116.

[Prismaker, 2001] www.prismaker.com

PDA Strategies for Preservice Teacher Technology Training

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Abstract: Making technology integration relevant by eliminating the access barrier for preservice teachers is a problem that may be solved for educators of preservice teachers by the utilization of PDA (Personal Digital Assistant) devices. For approximately $250, students can be equipped with the PDA, keyboard, and software necessary to read, write, collect data, and create presentations. This paper outlines the perceptions of the preservice teachers in their beginning technology class that utilized PDAs to support their learning experiences and discusses the appropriate use of PDAs to integrate technology into classroom activity structures.

Introduction

Surveys regarding the current state of technology use in classrooms indicate that, although more students have access to computers than ever before, either in the classroom or at home, 78% of classroom teachers still view lack of access to computers in the classroom as a barrier to their efforts to integrate technology into their daily teaching practices (U.S. Department of Education, 2000). In a comprehensive survey that reviewed teacher use and teacher-directed use of computers in classrooms around the United States, Becker, Ravitz, and Wong (1999) found that "regular use of computers with students is highly dependent on access to computers" and that frequent use of computers occurred more frequently with 5-8 computers in the classroom rather than with 15-30 computers in a lab (executive summary statement on website).

The challenge, then, to educators responsible for providing preservice and inservice teachers with the skills necessary to infuse technology into their daily teaching practices is to provide teachers with options to overcome the access barrier as well as inform them of emerging technologies and practices that strengthen and support their inclusion of technology into daily classroom routines and practices.

Meeting this challenge may have received a helping "hand" with the recent drop in prices of the Personal Digital Assistant (PDA), a handheld device that allows a portable and relatively inexpensive means of gathering, recording, and organizing information into meaningful forms of communication. For approximately $250 per student, the teacher is able to provide a student with a PDA, black and white camera, and a keyboard that will enable the student to take notes, jot down ideas, record thoughts, memories, words, and responses to readings/experiences, collect pictures for creative projects, as well as support time management skills needed for the successful student.

The research described here provided preservice teachers currently participating in the beginning technology course, Teaching with Technology, with an opportunity to explore the application of handhelds to elementary classroom instruction, and then investigated their perceptions as to the factors perceived as most valuable in influencing teachers to use this emerging technology as a part of their students' everyday learning activities.

The Study: The Participants and Data Generation/Analysis

Investigating the perceptions of preservice teachers as to the factors that will influence teachers to use handhelds as part of everyday learning and teaching activities that integrate technology into the instruction required two components. First, the study required the selection of a purposive sample of participants with knowledge and understanding of the capabilities and functionality of the handheld, as well as participants knowledgeable about the use of technology seamlessly applied to instructional design. The participants in this study were chosen from among the preservice teachers currently enrolled in a university technology integration class, Teaching with Technology, that is one of three courses that comprise the first block of the Elementary Preservice Teacher Certification Program. These participants also expressed an interest in learning to use emerging technologies as a part of daily classroom instruction, and had constant access to computers as they were currently working in a technology-rich environment as a part of the technology course. These parameters were established so that the perceptions of informants with similar technology training backgrounds and technology support could be explored. The sampling was designed to include a broad variety of informant backgrounds based on life experiences, age, unique observation field situations, and a variety of teaching expertise (beginners vs. novice preservice teachers).

Secondly, the research required a study design that placed the voices of the participants and the telling of their perceptions at the center of the inquiry, one of the assumptions key to constructing research in the constructivist paradigm. Naturalistic Inquiry, the strategy chosen for this study, provided the researcher with appropriate methods necessary to explore preservice teachers' perceptions of technology-based activities deemed valuable to their teaching practices. Defined as a collection of methods with "the commitment to studying human action in some setting that is not contrived, manipulated, or artificially fashioned by the inquirer" (Schwandt, 1997, p. 102), Naturalistic Inquiry relies upon a study design which allows the findings to "emerge" from the data as the value systems of the researcher and participants "interact in unpredictable ways to influence the outcome" (Lincoln & Guba, 1985, p. 41).

The constructivist design occurred in two stages. During the first stage, participants were given the opportunity to explore, handle, and acquire competency with the use of handhelds, as well as probe the application of handhelds within the instructional design process. To do this, the participants attended two workshops. The first workshop instructed participants in the basic use of handhelds; the second workshop instructed participants in the integration of handhelds into the instructional design process. Between the workshops, the participants were given a handheld and a keyboard and asked to use the handhelds on a daily basis by taking notes, using the calendar feature, maintaining an address book, and beaming documents between study participants. Participants provided the researcher with weekly reflective journals that documented their learning experiences during this first stage.

After the second workshop, participants participated in a series of unstructured, open-ended interviews initiated with a single broad-focused question: *What are the factors you perceive as most influencing elementary teachers use of emerging technology, such as the handheld, as a part of students' everyday learning activities, as well as a part of the teacher's everyday teaching activities?* The interviews were tape-recorded, transcribed, and member-checked through follow-up interviews with the informants. Other data in the form of related documents, such as e-mail conversations with participants, reflexive journals of researcher and participants, examples of lesson plans and student activities created during the process, were collected and analyzed. A peer-debriefing group met weekly for the purpose of reviewing the analysis of documents and interpretation of resulting interview data.

Data analysis in a study that uses naturalistic inquiry methods is inseparable from data generation and collection; thus the process of data analysis began with the first contact between researcher and participant. Data generated from each contact with participants, through interview, observation, or the creation or review of documents, helped to form several tentative findings, which led the researcher to probe some areas of discussion more deeply or change strategies for observation and data generation. Adjusting data generation procedures continued as additional data were generated and tested against the evolving themes. The process of generating data, unitizing data, and developing categories and themes from the data continued until reaching thematic saturation, or the point at which no more new categories and themes made themselves apparent (Erlandson et al., 1993).

The Findings

These findings are preliminary as the final interviews are still being member-checked, but two main themes (subject to refinement as the data collection/analysis continues) have emerged:

Theme 1: Participants perceived handhelds as an invaluable tool for collaborative learning environments and a catalyst for development of learning communities. Participants overwhelmingly expressed satisfaction with the capability of handhelds to collect data/resources and ease with which that information could be shared with others, either through traditional printing methods or beaming files to others to use. Participants perceived this ease of distribution of data and the process of collaborative sharing as promoting the development of a learning community that supported their learning needs.

Theme 2: Participants perceived handhelds as an invaluable instructional tool because it provided technology that was easy to use, supported the learning needs of students often supported by technology, and was portable and accessible. Participants valued the handheld as an instructional tool for students because the skill level required to use the tools was minimal, could be acquired with minimum classroom time, and, student work could never be "lost" due to the student carelessly closing an application without saving. In addition, with the view that, as students, they personally used technology mostly for taking class notes, writing short paragraphs for various purposes, and keeping up with the assignments, participants viewed the capability of the handheld to provide word processing, editing, and beaming functions as supporting the majority of their learning needs that they were currently supporting with desktop computers. And, finally, the fact that this capability could be taken anywhere and used anytime was perceived as providing users with a portability that could not be provided by laptops or desktop computers.

Conclusion

Although the purpose of this inquiry was not to provide findings that are representative of all preservice teachers, but to explore the perceptions of these 12 participants as they reflected upon the value of handhelds in the learning environment, these findings may suggest possible consideration to the various contexts of using emerging technologies as enhancements for learning environments. Strategies for using handhelds as a part of a successful learning environment may include integrating handhelds into instructional designs that require the following:

- Collaborative learning processes or the development of a learning community,
- Writing Process or intensive development of writing pieces, or
- Portable tools for remote data collection.

References

Becker, J. J., Ravitz, J. L., & Wong, Y. T. (1999). *Teacher and teacher-directed student use of computers and software.* Center for Research on Information Technology and Organizations, University of California, Irvine, and the University of Minnesota. Available: http://www.crito.uci.edu/tlc/findings/computeruse/html/startpage.htm [2001, December 11].

Erlandson, D. A., Harris, E. L., Skipper, B. L., & Allen, S. D. (1993). *Doing naturalistic inquiry.* Newbury Park, CA: SAGE Publications, Inc.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Newbury Park, CA: SAGE Publications, Inc.

Schwandt, T. A. (1997). *Qualitative inquiry: A dictionary of terms.* Thousand Oaks, CA: SAGE Publications, Inc.

U.S. Department of Education. (2000). *Teachers' tools for the 21st century: A report of teachers' use of technology* (NCES 2000-102). Washington, D.C.: National Center for Educational Statistics.

User Studies: Developing Learning Strategy Tool Software for Children

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Abstract: This paper is a report of user studies for developing learning strategy tool software for children. The prototype software demonstrated is designed for children with learning and behavioral disabilities. The tools consist of easy-to-use templates for creating organizational, memory, and learning approach guides for use in classrooms and at home. User studies that were conducted with software prototypes included two rounds of expert review, usability testing in a lab setting with teachers and parents, a focus group with parents and educators, and "think-aloud" observations of children using a sample of the tools. Results were used in improving the software, preparing the teacher orientation module, and designing online supports for users. The most useful dimensions of evaluation were found to be direct observation of children using the software and messages contributed by a high school student with learning disabilities to the Online Focus Group.

Service to children with behavioral and learning disorders is a high priority in the U.S. (Elam, Rose, & Gallup, 1998; Kay, 1999). Currently, federal mandates require that such children be served in the "least restrictive environment" by providing appropriate supports and effective strategies to ensure success (IDEA97). Common problems faced by these students in regular classrooms are difficulties maintaining attention, organizing work, managing time and materials, and responding with accuracy (Lewis & Doorlag, 1999). With these deficiencies students are at-risk for increased behavioral problems, failure, and ultimately, removal from these classrooms. Research shows, however, that strategy instruction in these skills can help students become successful learners and managers of their own behavior (Swanson & Hoskyn, 1998).

Electronic Performance Support for Children with Learning and Behavior Problems

Computer-based training and support mechanisms are an innovative approach for helping children gain control over personal behaviors. While electronic performance support systems have been used in education and industry to support adults in learning new skills "at the right place, right time, right form" (Laffey, 1995), work is scant in applying these principles to the development of software tools for children. If the goal of EPSS software is appropriate for adults—to provide whatever is necessary to ensure performance and learning at the moment of need in a seamless activity—then it offers the same potential for helping children improve performance in their learning environments. If effective, EPSS support tools for children improve their independent functioning, reduce teacher time re-focusing their mistakes and energies, and offer lifelong skills for success.

This paper reports the design process followed by the developers in creating a new set of EPSS tools to help young children learn and use these school survival strategies. These unique materials include four components: (1) strategy software tools for children, (2) an information resource database for teachers, (3) a web-based orientation module for teachers, and (4) online resources and discussion lists to support teachers and parents (refer to conceptual framework in Figure 1) (Fitzgerald & Koury, 2001-2002). During the development period, a variety of user studies were conducted with children, parents and educators to ensure that the materials represent best practices in the field. This paper summarizes the user studies and initial findings and highlights important issues in software design for children.

Related Work: Previous Applications with EPSS Tools with Children

Computer-based training and support mechanisms are an innovative approach for helping children gain control over personal behaviors. Although there are limited data on the use of computer-based instruction to support behavior change in children to date, research results are promising. Fitzgerald and Werner (1996) reported success with a computerized verbal mediation essay as a cognitive retraining procedure to assist a student with significant behavioral disorders in changing his behavior; the computerized essay provided consistent practice and focused the child's attention and thoughts on behavioral choices and consequences. In another case study, the same researchers reported a procedure in which software templates were developed for a student to create self-monitoring materials.

Following these early studies, the developers created a series of EPSS tools for children that supported children in using self-management skills in classrooms (Fitzgerald & Semrau, 1998-2000). The children's software programs, *First Step KidTools* for ages 7-10, and *Second Step KidTools* for ages 11-14, provide a series of progressively complex templates to be used as tools. In using the tools, children identify behaviors for self-improvement, identify specific self-control strategies they want to use, prepare self-talk statements to guide their use of the strategies, and create/print-out materials to support their plans. Both software programs consist of tool templates that are kid-friendly with colorful graphics, text-with-audio directions, multiple examples, simple formats, and automatic record-keeping capabilities. To use the tools, the child simply clicks on "hot words" on the template form to enter personalized content and then print out the completed form for use in the classroom or home.

Qualitative methodologies were used to gather multiple data on the usefulness of the approach and important design features in the software. Several important design decisions were made based on these studies that have been applied to the production of the new strategy software: (1) include the option of spoken text for poor readers; (2) use children as on-screen guides through the tools; (3) use children's voices for narration; (4) provide access to help screens that can be accessed while using the tools; (5) provide multiple options to re-start or make changes; and (6) put the child in charge of creating his/her tools using natural language. Pilot testing with *KidTools* in two states demonstrated that children were able to independently use the tools and were motivated by the computerized tool format. Teachers reported improved motivation and self-control in classrooms. The findings from *KidTools* are extended to the production of *KidSkills* with its new focus on learning strategies. The previous work ensures appropriate literacy and ease-of-navigation features are included in the *KidSkills* design (Fitzgerald, Watson, Lynch & Semrau, 1999).

Conceptual Framework for the Design of *KidSkills*

Recognizing the importance of ecological variables surrounding an innovation systems (Peled, Peled, & Alexander, 1994), multiple products are being developed in a systems approach. The primary components of this framework are illustrated in Figure 1: development of the EPSS software, development of a resource information database for educators and parents, development of an orientation module, and use of online focus groups and a web-based hotline to share information, provide support, and disseminate materials during implementation.

KidSkills, the children's software, offers strategies based on cognitive-behavioral approaches that help youngsters change *cognitions* (thoughts, beliefs, self-talk, cues) and *behaviors* (actions) within a problem-solving framework to gain successful outcomes. These approaches have increased in popularity during the last two decades as researchers have documented their effectiveness (Gresham, 1985) and curriculum developers have designed and disseminated teachable programs for implementation in schools (Anderson, 1981; Nichols, 1999). To date, there have been no known precursors to this work that combines electronic performance support tools along with strategy training for teaching cognitive-behavioral strategies to young children.

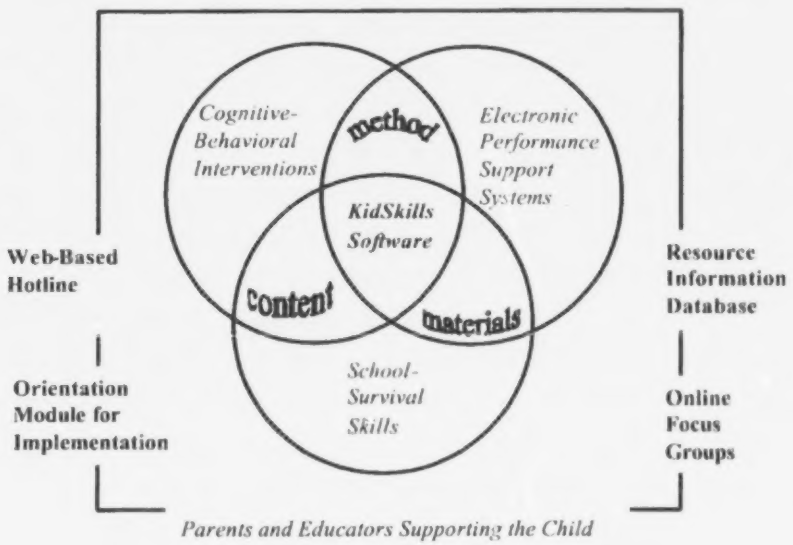
Cognitive-Behavioral Interventions
method
Electronic Performance Support Systems
KidSkills Software
Web-Based Hotline
Resource Information Database
content
materials
School-Survival Skills
Orientation Module for Implementation
Online Focus Groups
Parents and Educators Supporting the Child

Fig. 1 Conceptual Framework for Development of *KidSkills*

The *KidSkills* Prototype

There are two levels of *KidSkills*. *First Step KidSkills* is designed for ages 7-10 and *Second Step KidSkills* for ages 11-14. There are 18 tools in *First Step KidSkills* organized in the categories of: Getting Organized, Learning New Stuff, Doing Homework, and Doing Projects. There are 30 tools in *Second Step KidSkills* organized in the categories of: Getting Organized, Learning New Stuff, Organizing Information, Preparing for Tests, Doing Homework, and Doing Projects. Information on these strategies is provided in a resource information database program, *Skill Resources*, to provide educators and parents resources to assist children during implementation. A teacher orientation module is currently being developed, including a PowerPoint presentation, demonstration videos, and a web-based hotline for assistance.

The software contains colorful graphics, text-with-audio directions, and simple formats. Graphic characters serve as "guides" to the different tools and provide audio directions in children's voices. The text and audio in *KidSkills* allow for children to enter text in their own words. The audio directions supplement the simplified text instructions and can be turned on or off. To use the tools, the child simply clicks on "hot words" on the template form to enter his or her content and then prints the completed form for use in the classroom or home. Children have instant access to examples with directions and flexible ways to re-start when desired. The program automatically enters the child's name, date, and establishes an audit trail for record-keeping purposes. These audit trails are instrumental in tracking the development of children's thinking and skill decisions.

Figure 2 displays the main menu screen for *Second Step KidSkills*. Children select tools from categories by clicking on the hot areas on the screen or by using the pull-down menu. Figure 3 shows an example of a completed *Second Step* tool. In this example, the KWL (Knows…Wants to know…Learned) tool provides a learning strategy to help the learner focus on important information when learning new material and integrate

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new information with his/her current information. This helps the learner re-structure knowledge. The child would enter the following information: the ***class***, ***topic***, ***source*** of information, what the child ***knows***, ***wants to learn***, and ***what was learned***. The tool could be used prior to studying to guide learning, or as a follow-up to review information.

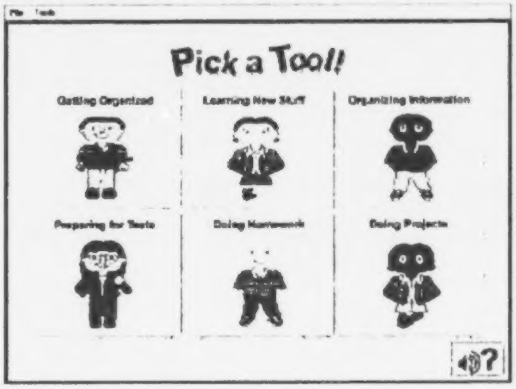

Figure 2. Main Menu from *Second Step KidSkills*

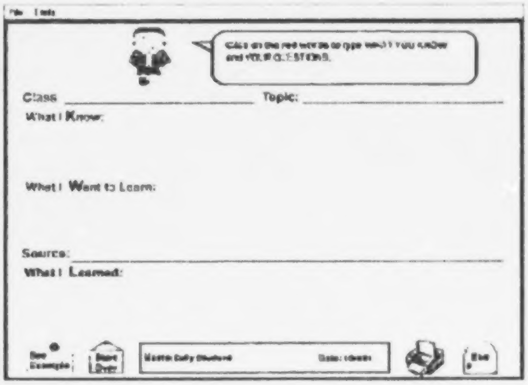

Figure 3. Sample **KWL** Tool

User Studies in the Developmental Process

The software development process is recursive, going through several phases of development→ testing→ revision based on procedures recommended by designers of children's software (Druin, 1999) and evaluators of interactive learning systems (Reeves & Hedberg, 2002). The first step of formative evaluation, design testing, includes three processes: 1) review of content and interface design by experts in learning strategies and children's software design, 2) observations of adults working with the prototypes, and 3) focus group meetings with parents and educators to discuss the tools and consumer training needs. The second step of formative evaluation, usability testing, includes three processes: 4) observations of children using a sample of the tools while collecting "think-aloud" transcripts, 5) examination of tool artifacts, and 6) expert reviews of the completed software. These six developmental steps lead to a full beta testing of the software, training, and support modules.

Expert Review of Paper Prototypes

Paper copies of all the tools were reviewed by eight content experts, including teachers, administrators, university personnel and a parent of a learning disabled child. Each reviewer used a structured questionnaire to provide feedback on screen design, content of the tools, terminology for children, and other literacy features. Some of the reviewers had prior experience using the *KidTools* program and were able to give suggestions for operability. Based on these reviews, some of structural elements and terminology of the tools were changed to make them more understandable by children with learning disabilities; some tools were re-conceptualized; color coding was added to guide entries; and two new tools were created.

Design Testing in a Lab Setting

An open lab time was scheduled at a statewide special education conference for educatora and parents to "play" with the *KidSkills* prototype. During this time, two graduate research assistants staffed the lab and observed 46 adults using the software, watching for difficulties or unusual routines. Field notes were made to record comments of participants, and feedback forms were collected. Overall ratings were 8 to 9 on a 9-point Likert scale (9 being the highest). Positive comments were that the program would be fun and easy to use, the strategies would be useful for students with learning disabilities, the audio directions were helpful, and they appreciated the interactivity and multisensory approaches. Some potential problems identified were difficulty in using pull-down menus for children, desire for more graphics and larger hot spots, use of tab key to save text entries, desire for spell checker and thesaurus, and navigation back and forth between screens. Problems that were identified for implementation included teacher training, scheduling use within the school day, access to computers at home and school, and need for quick instructional resource.

Online Focus Group with Consumer Group Members

An online focus group was held with members of the target consumer groups, including one parent, three classroom teachers, three teacher-trainers, and a high school student with learning disabilities. Project staff also participated in the discussions. Four open-ended questions were used to engage participants: (1) acceptance and use of the software, (2) potential implementation problems, (3) recommendations for training and support, and (4) other suggestions. Discussion threads emerged within these broad areas. The messages were coded for themes using the qualitative analysis program, *NVivo*. With this text analysis program, information can be linked and examined across multiple sources, leading to an integration of the results (Richards, 1999). Some of the concerns that were raised were earmarked for observation of tool usage with children, particularly use of the tab key, size of text entry fields, quality of audio narration, and navigation problems. Discussion of implementation issues were helpful in designing the orientation module and planning the web hotline.

Think-Aloud Observations of Children Using Working Prototypes

Twelve children with mild-moderate disabilities were selected to participate in usability testing. These students all had learning disabilities or behavioral disorders, grades levels 2-7, ages 8-14, and received academic programming in resource or inclusive classrooms. The selected children used the software in a one-on-one setting with project staff. After an initial training period with one of software tools, children were asked to "think aloud" as they worked with the software to produce materials using three different tools (Smith & Wedman, 1988; Someren, Barnard, & Jacobijin, 1994). An observer audiotaped the sessions and made field notes in order to record the children's reactions to the interface and the overall operability of the software using observation and interview guidelines. These results were analyzed using *NVivo*.

Examination of Artifacts Created by Children Using Working Prototypes

The artifacts produced by the children were examined to answer any questions raised during earlier stages of review or suggestions made about the tools during the Online Focus Group. The software contains a complete audit trail that records out to files all tool choices and entries made during usage.

Expert Reviews of Completed Software

The completed software tool programs will be sent to a panel of experts in July, 2002. The reviewers will have background in special education (cognitive-behavioral interventions and learning strategies) and two of the reviewers will have expertise in human-interface design of software (EPSS architecture and design for children). A systematic interface design will be conducted using an assessment guidelines based on procedures for user interface studies (Schneiderman, 1998). The guidelines include overall reactions, screens, sound, graphics, content, terminology, and operability. Reviewers will submit a written report with recommendations.

Putting the Pieces Together

Although each formative evaluation procedure yielded valuable information and useful suggestions, we found summation and integration of the information to be most critical. As discussed by Maslowski & Visschler, all the possible dimensions of formative and summative evaluation are rarely conducted due to financial and time constraints (1999). Their suggestion is to evaluate the dimensions where designers face questions for the greatest benefit. It is easy to respond to each procedure with revisions and further testing, as recommended in the recursive testing process, yet this approach can lead one down false paths based on partial, rather than complete, findings. For example, adults viewed the tools and raised concerns about navigation and the use of the tab key, yet observers of children found that with very little guidance, children quickly learned to navigate and enter information into tools. Adults questioned the clarity of the children's voices for narration, yet observers reported that children found the voices appealing. Adults who tested the software found it easy to use, yet our high school student strongly recommended a hotline for teachers to answer computer-use questions.

It was clear that conflicting feedback was provided by different "voices" of expertise. The most useful dimensions to us were the direct observations of children using the tools and the messages to the Online Focus Group provided by our high school student with learning disabilities. He grasped how the tools could be used in classroom settings and the abilities and limitations of teachers in supporting roles. Above all, we learned to integrate the voices of children during the design process (Druin, 1999).

References

Anderson, J. (1981). *Thinking, changing, rearranging*. Eugene, OR: Timberline Press.

Druin, A. (1999). *The design of children's technology*. San Francisco, CA: Morgan Kaufmann Publishers.

Elam, S., Rose, L., & Gallup, A. (1998). 28th annual Phi Delta Kappa/Gallup poll of the public's attitudes toward the public schools. *Kappan, 80*(1), 41-59.

Fitzgerald, G., & Koury, K. (2001-2002). The KidTools Support System. Project #H327A000005. U.S. Department of Education: Office of Special Education Program.

Fitzgerald, G., & Semrau, L. (1998-2000). Virtual Resource Center in Behavioral Disorders Project #H029K70089: United States Department of Education: Office of Special Education Program.

Fitzgerald, G., Watson, P., Lynch, J., & Semrau, L. (1999). EPSS in the classroom: Self-management tools for kids. *Proceedings of World Conference on Educational Multimedia, Hypermedia, and Telecommunications* (pp. 1225-1226). Charlottesville, VA: AACE.

Fitzgerald, G., & Werner, J. (1996). The use of the computer to support cognitive-behavioral interventions for students with behavioral disorders. *Journal of Computing in Childhood Education, 7*, 127-148.

Gresham, F. (1985). Utility of cognitive-behavioral procedures for social skills training with children: A critical review. *Journal of Abnormal Child Psychology, 13*, 411-423.

Kay, P. (1999). *Prevention strategies that work: What administrators can do to promote positive student behavior* . Burlington, VT: University of Vermont.

Laffey, J. (1995). Dynamism in electronic performance support systems. *Performance Improvement Quarterly, 8*(1), 31-46.

Lewis, R.B., & Doorlag, D.L. (1999). *Teaching special students in general education classrooms.* (5th ed.), Upper Saddle River, NJ: Merrill.

Maslowski, R. & Visscher, A. (1999). Formative evaluation in educational computing research and development. *Journal of Research on Computing in Education, 32*, 239-55.

Nichols, P. (1999). *Clear Thinking- Talking Back to Whispering Shadows: A Psychoeducational Program for Parents, Teens, and Young Adults*. Iowa City, IA: River Lights Publishers.

Peled, Z., Peled, E., & Alexander, G. (1994). An ecological approach for information technology: Intervention, evaluation, and software adoption policies. In E. Baker & H. O'Neil (Eds.), *Technology Assessment* . Hillsdale, NJ: Lawrence Erlbaum.

Reeves, T., & Hedburg, J. (2002 forthcoming). Interactive learning systems evaluation. Educational Technology Press.

Richards, L. (1999). *Using NVivo in qualitative research*. Melbourne, Australia: Qualitative Solutions/ Research Pty. Ltd.

Shneiderman, B. (1998). *Designing the user interface: Strategies for effective human-computer interaction* (3rd ed.). Reading, MS: Addison-Wesley.

Smith, P., & Wedman, J. (1988). Read-think-aloud protocols: A new data source for formative evaluation. *Performance Improvement Quarterly, 1*(2), 13-22.

Swanson, H., & Hoskyn, M. (1998). Experimental intervention research on students with learning disabilities: A meta-analysis of treatment outcomes. *Review of Educational Research, 68, 277-321.*

An Innovative Solution To Improve Web Database Integration: IVQS A Client-Server Iconic Visual Query System

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1. Introduction

Inquiring databases through the Web, in terms of visual interface, is currently an active area of research [15,16]. The main problem is to provide a user-friendly interface to query remote database. Most systems provide three kind of querying: text search engines, form-based interfaces and natural interfaces. An alternative way to query is based on icons. Starting from previous works [1,2,4,5,13], a client-server Iconic Visual Query System (IVQS), called IVQS Server, has been developed. This system allows the user to query remote and different multimedia RDBMS through the Web using an iconic interface. The system offers two kind of iconic querying: *query icon*, where an icon represents a query, and *entity icon*, where an icon represents an entity (a table in a relational Database). An iconic representation of a query can make easier for the end-user or the inexpert user to query a remote database without knowing the internal structure of the database or compiling exhausting forms. Our system has been used in education fields obtaining good results. IVQS Server has been developed as an applet Java on client side and a Java application on server side, so it's completely platform independent and it doesn't need any installation on client side.

2. System Overview

The IVQS Server prototype is a Visual Query System developed at ENEA's Usability Lab to access and query remote databases through the Web. The system allows to create and execute queries to remote databases and to have a multimedia results visualisation. The system has an architecture client-server where the client is a Java Applet and the server side is a Java application, both executable directly through a Java-enabled Web Browser (without needing any installation). The system provides two kind of iconic querying (fig.1):

- *Query icon*. Each icon represents a query. More icons can be grouped inside a folder so that the icons are structured in a tree. The user can execute the query double clicking on the icon.
- *Entity icon*. Each icon represents an entity (a table in a relational Database). Between two or more entities a query can be associated. Dragging an icon entity and dropping it on to another one, the associated query, if exists, is executed. For example, if there are the entities (tables) DEPARTMENT and EMPLOYEE, it can be associated a query that is the join on the common field DEPARTMENT_ID.

An Icon Editor has been integrated both to create and to associate an icon to a query or to an entity. In this way the user can create his own icon or import an existing image specifying an URL. The system provides a multi-user environment with user identification/password authentication. Each user can have, in a list of his own favourite queries in a specific area. Two kind of user are handled:

- Expert User (*Super User*). This kind of user can manage the system to create and modify queries, entities and can set up the result display layouts. The user has a good knowledge of relational databases and of their structure. The user can create queries visually selecting databases, tables, attributes and conditions.
  The system can execute queries to the most known relational databases such as Oracle 8.x, 9.x, MS SQL Server, MS Access, Informix, Sybase and ODBC/JDBC-compliant data sources). In particular, choosing two or more different database, he's able to build a query involving tables from different remote RDBMS. The user can use the system by himself or as an administrator for a set of end users.

- End User (*User*). This kind of user uses a structure already set up by a super user. The user deals with predefined queries and entities. Typically he's neither a computer nor a database expert; the user can use the system without knowing the internal structure of the databases. The user can have his own set of favourite queries.

Every data related to the user is stored, by means of IVQS server side, in the system database.

IVQS Server provides two kind of result display: table and form. In the form result display it's possible to customise the visualisation layout in terms of object position, font type, size, style and colour. Objects can be text labels, images, Web resource links (web pages, e-mail address, executable files) as URLs. In the latter case the user can open the resource that will be handled by the browser. Multimedia objects, such as movies or sounds, are placed in a specific area Media Area.

Typical uses of IVQS Server:

- IVQSS as a visual database interface for the end user, who can access a set of remote databases in a quick and easy way using predefined queries pre-built by the administrator.
- IVQSS as a tool for long distance learning, both for the administrator who can manage the students database and for the students as an interface to access structured information collected by multimedia cards. In particular with IVQSS applications in natural science and materials have been implemented.

3.IVQS SERVER Architecture

The system architecture has three modules: IVQS Server, IVQS applet, the client, that is stored in the Server and the IVQS Web Site. When the client Web browser sends the request, the Web Server sends back the applet, which starts being executed on the client. The applet, because of its security limitations [14,19,20], can open socket connections only to the originating Server. We need a server side application, which can access remote database and talks with the applet. We used a Java application at server side, it can access various kinds of RDBMS (Oracle, MS Access, Informix, etc.). In this way the applet communicates with the application server to send query and to get back results in XML format.

After the first generation of IVQS [22] has been implemented the IVQS Server release with the following functionalities: User management, User data management, Query management, Query Optimisation, Asynchronous Query, Query Repository, Query Statistics, Query&E-mail Services and Dynamic Web Page Services.

4.Experimental Results

IVQS Server has been used on a set of existent databases, each one very different from the other in terms both of information and target users. Here is the list of the databases where IVQS Server has been applied:

1. FAD Database (Long distance learning), ENEA web site for long distance learning on the Internet.
2. G7 Global Inventory Project (GIP). An Internet inventory of G7 IT projects. The target users are Internet ones.
3. Prosoma (PLUS), EU Web site, a multimedia database containing the most relevant project results in Europe.

The target users are researchers, enterprises, technology operators and the EU.

In all these experiences, IVQS Server has been tested by the users to measure its Usability [5]. The results obtained, in terms of user satisfaction and user efficiency [10], showed that a query iconic representation allows a better perception in user's mind making it easier to memorise [6,7,8].

5.Conclusions and future work

The increasing number of Web users is looking for convenient ways to search information on the Net and to collect and query data from different sources through the Web [2,12,16,18]. It's necessary to develop new alternative tools for such tasks. It has been introduced IVQS, a Visual Query System to query remote database through the Web using an iconic interface, developed and tested at ENEA Usability Lab in collaboration with University of Rome "La Sapienza". The iconic interface that is alternative to the form-based web pages which are the most common interface nowadays. The system has proved that an iconic interface is really easier to use for large end-user groups. As future features it's planned to produces an increasing on multimedia web services provided.

References

1. M.L.Bargellini, F.Fontana, F.M.Ferrara. *VENUS: una esperienza europea per la realizzazione di un'interfaccia visuale alle banche dati. Technical report*, ENEA 1998.
2. F.Capobianco, M.Mosconi, L.Pagnin. *Looking for convenient alternatives to forms for querying remote databases on the Web: a new iconic interface for progressive queries.* Dipartimento di Informatica e sistemistica - Università di Pavia, 1996.
3. F.M.Ferrara. *VENUS: Visual Enquiry User-oriented system. Technical Annex.* GE01-01-0002 , ENEA 1991.
4. F.Fontana, M.L.Bargellini, C.Bucci, F.Ferrara, P.A.Sottile, G.Scavino, R.Mancini, S.Levialdi. *Venus Project, Experimentation at ENEA's pilot site,* ENEA 1995.
5. International Standards Organization DIS 9241-11, *Ergonomic requirements for office work with visual display terminals (VDTs), Part 11: Guidance on usability.*
6. C.Jung. *The Man and his symbols.* Cortina editore, 1983
7. R.R.Korfhage, M.A. Korfhage. *The Nature of Visual Languages.* Proc. of 1984 IEEE Workshop on Visual Languages, Hiroshima, Japan, pp. 177-183
8. S.Levialdi, T.Catarci, S.Chang, M.F.Costabile, S. Levialdi, G. Santucci. *A Graphical Framework for Multiparadigmatic Visual Access to Databases.* Reprit, IFE Transaction on Knowledge and Data Engineerig, Volume 8 Number 3,28-42,1996.
9. C.Lu. *The Apple Macintosh Book.* Microsoft Press, 1984
10. M.MacLeod, R.Bowden, N.Bevan, I.Curson. *The MUSiC performance measurement method.*
11. J.Martin. *Managing the Database Environment.* 1983
12. A.Massari, S.Pavani, L.Saladini. *QBI: An Iconic Query System for Inexpert Users.* Dip. Informatica e Sistemistica, Università di Roma "La Sapienza", 1996
13. K. Mullet, D. Sano. *Designing Visual Interfaces*, SunSoft Press.1995
14. P.Naughton. *The Java Handbook.* McGraw-Hill, 1996
15. T. Nguyen, V. Srinivasan. *Accessing Relational Databases from the World Wide Web.* SIGMOD Conf. 1996.
16. C.Pancake, M.Newsome, J.Hanus. *Simplifying web access to remote scientific databases.* Oregon State University, 1997
17. B.Shneiderman. *Designing the User Interface.* Addison Wesley, 1994
18. B.Shneiderman, E.Tanin, R.Beigel. *Incremental Data Structures and Algorithms for Dynamic Query Interfaces.* University of Maryland, 1996
19. G.L.Steele Jr.. *Java and the Evolution of Web Software.* ICSE, 1997
20. A.S.Tanenbaum. *Computer Networks.* Prentice Hall,1996
21. H.Thimbleby. *User Interface Design.* Addison-Wesley.1991
22. F.Fontana, M. Moscarini, M. Valeri. Looking for alternative ways to query database through the Web: an iconic approach with IVQS. ENEA, 2000

CAN DEVELOPMENTAL STUDIES LEARNERS SUCCEED IN DISTANCE LEARNING?

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Abstract

This action research program involved implementation of distance education-based developmental studies programs for mathematics using PLATO via the Internet at 8 participating institutions. Twelve characteristics were found to be in common over the most successful of the programs. We present the twelve characteristics and summarize overall effectiveness of the programs.

The Internet and distance learning hold untapped potential to change the culture, curriculum, and course of educational institutions around the world. But, most distance eductation models assume highly skilled and self-motivated learners: exactly the opposite of the typical developmental studies learner. The League for Innovation in the Community College and PLATO® Learning, Inc. initiated an action research project exploring the questions and challenges of implementing successful distance learning developmental math programs for community colleges across the country.

College Participants

Selection of participants from League colleges and League Alliance members was based on specific commitment criteria. Each participating college was asked to designate two faculty members and commit training and service time to research and program development. The research consortium initially included nine colleges; however, eight fully implemented PLATO On the Internet[i] (POI) as part of their developmental mathematics program: [ii]

Central Florida Community College, Ocala, FL
Delta College, University Center, MI
Kapiolani Community College, Honolulu, HI
Kirkwood Community College, Cedar Rapids, IA
Moraine Valley Community College, Palos Hills, IL
Miami-Dade Community College, Miami, FL
Santa Fe Community College, Gainesville, FL
Sinclair Community College, Dayton, OH

PLATO on the Internet Courseware

PLATO on the Internet (POI) courseware is a modular, self-paced, computer-based learning system that offers students interactive learning opportunities in mathematics, reading, English, and core work skills with over 2,000 hours of instructional content available. As a comprehensive academic and applied skills courseware system, PLATO uses computer-adaptive integrated learning processes for student assessment, prescriptive placement, interactive instruction, and evaluative testing and feedback.

Project Goals

The purpose of this project was to explore critical success factors for computer-based distance learning in developmental math programs during a summer trial implementation session and a full fall semester term. College participants, League research team members, and PLATO service teams outlined four areas of investigation:

- Development of effective, individualized, open entry/open exit programs for developmental students via distance education
- Cultivation of learners' motivation through the use of technology in developmental studies programs using distance education

- Exploration of successful developmental student profiles using distance learning technology
- Effective combinations of campus-based support service and distance learning delivery systems as models of success for developmental learners

Formative Conclusions

The study identified these critical success factors:

- Easy Access to Internet and Easy Navigational Courseware.
- Technical Support.
- Alignment of Online Courseware and Course Objectives.
- Individualized Instructional Format.
- Student Recruitment and Counseling.
- Orientation.
- Student Connections
- Faculty Development.
- High Standards of Quality and Content Development.
- College Leadership and Program Support.

Project Outcomes, at end of the study

Total Participants (n =)	**Course Completers (at the close of the project)**	**In-Progress**	**Anticipated Success Rate**
185	**89 (48%)**	**27 (14%)**	**116 (62%)**

Reference

Perez, S. and Foshay, R. (*2001*). *Adding Up the Distance: Critical Success Factors for Internet-Based Learning in Developmental Mathematics.* Mission Viejo, CA: The League for Innovation in the Community College.

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[i] This product has been superceded by the PLATO Web Learning Network.

[ii] Eastfield College (Dallas County Community College District, Dallas, TX) initially planned on being a member of the consortium, but college and departmental obstacles prevented implementation of the PLATO on the Internet® curriculum.

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The comparison of two electronic portfolio programs: The University of Porto, Porto Portugal and The University of Florida, Gainesville Florida

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Abstract. The Electronic Portfolio initiative in the College of Education at the University of Florida represented two years of our best efforts at matching the current research on portfolios to a systemic project for all future teachers. It was therefore surprising for one of the authors, while on a Fulbright to the University of Porto in Portugal, to find an independently developed electronic portfolio project that had so many things in common with the project we developed at the University of Florida. In this session, rather than describing the projects in detail, pointing out similarities and differences, we have decided to try to isolate the factors that caused our surprise.

The Electronic Portfolio initiative in the College of Education at the University of Florida represented two years of our best efforts at matching the current research on portfolios to a systemic project for all future teachers. It was therefore surprising for one of the authors, while on a Fulbright to the University of Porto in Portugal, to find an independently developed electronic portfolio project that had so many things in common with the project we developed at the University of Florida. In this session, rather than describing the projects in detail, pointing out similarities and differences, we have decided to try to isolate the factors that caused our surprise. After all, it isn't everyday that two independent teams of research-aware educators come to the same conclusions about the way any educational project should be run! Seriously, we believe a brief investigation of the issues facing electronic portfolio implementers may prove informative. We have worked and conferred with several groups who are either actively working with electronic portfolios or working on developing an electronic portfolio initiative. We have also spoken with professors who have lost faith in portfolios as a meaningful educational experience. Some or our anecdotal experiences, which we maintain are insights, frame the views that follow.

Mention the word *portfolio* to a room full of educators and many will complete the phrase with the word *assessment*. Portfolio assessment - the words seem to be inextricably linked. Yet a vast amount of research related to portfolio initiatives (Lyons, 1998, Paulson & Paulson, 1990, Wolf, 1991) is skeptical about applying any standardized or generic assessment procedures to the evaluation of a student's portfolio. This is due in part to the fact that unlike an assignment, a portfolio can be thought of as belonging to the student and maturing over time. Electronic portfolios can be maintained and updated dynamically over time and there are many reasons to promote portfolio development that transcends individual courses or even school years. By encouraging students to continue the revision of the work they have done, and in particular to revise their rationale for their work (as in the case of an evolving philosophy statement, for example) professors directly apply research findings on reflective practice. Indeed, if portfolios are viewed from the perspective promoted in much of the portfolio research, they provide an extremely rich environment for reflective practice. In addition, portfolios can be used to make connections between disciplines and between student experiences and generally accepted accomplished practices. In these cases, connections are being encouraged in a way that helps a student link specific scenarios or experiences to more global practices. Since portfolio building is the construction of a virtual representation of one's ideas and experience, connections between a student's work and the larger educational themes s/he is studying make sense. We would

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argue that working from experience to more general theories is more effective than studying theories waiting for an exemplar, and portfolios encourage the former.

Similarly, we feel strongly that predefined rubrics and checklists limit the power of personal portfolios. If a student is going to reexamine positions or ideas s/he promoted in the past in a meaningful way, can that evaluation be scripted? Can it be scheduled? How does one evaluate an individual student's portfolio in a generic way? Despite the strong connection between a portfolio and reflective practice, most systemic initiatives require a clearly defined, almost formulaic way of communicating the assessment process. Consequently, many professors begin to create checklists, or two dimensional checklists and rubrics. Unfortunately, description becomes prescription (Clark, 1979) and soon students begin to loose ownership of the portfolio, then they loose interest, and ultimately, the portfolio becomes a typical assignment. If portfolio development is to be a personal experience, it must be evaluated on a personal level, if it is to be evaluated at all. Providing rubrics, in addition to removing student level choices about portfolio makeup, can easily lower the bar with respect to quality of the finished product. According to Spiro (1991), "instead of retrieving from memory a previously packaged 'prescription' for how to think and act, one must bring together from various sources, an appropriate ensemble of information suited to the particular understanding or problem solving needs of the situation at hand."

On the other hand, in order for a system level portfolio initiative to work effectively, faculty have to understand what is expected of students. More than that, faculty should be instrumental in envisioning what students will produce. In most universities it is difficult to coordinate a system wide effort with subjective evaluation procedures. Although it is possible, it requires setting up subsystems to handle a process which may include time consuming interviews and quality communication between staff members. It is much easier to publish guidelines, or rubrics, or checklists than it is to evaluate in context, on a personal level. Consequently, most systemic portfolio initiatives either bow to the difficulties and simplify the assessment process, or set up straightforward procedures from the outset. Of course, this "conspiracy of convenience"or reductive bias (Spiro, 1994) is related to larger issues involving any movement towards experiential or problem-based learning (Schon, 1983). According to Ramsden, "if enhancing the quality of student learning is the primary goal, it is imperative to prevent the task of collecting and demonstrating from overwhelming the process of reflection and change." Ramsden goes on to say:

> There is now a widespread view in academic development circles, derived directly from the student learning research, that we should concentrate on learning, on what the learner does and why the learner thinks he or she is doing it, rather than what the teacher does (Shuell, 1986; Biggs, 1990,1993). And, if teaching is about helping to make learning possible, assessment becomes defined as being about understanding students and what they have learnt. Effective assessment helps students develop the skills of self-assessment....Luckily, if we get the improvement part right, the accountability part is generally sure to follow. Good evidence of improvement is automatic evidence of accountability (Ramsden, 1994).

In this light, we can see that in order to develop a truly student centered program, professors (or project directors) must focus on improvement in student performance and link accountability to related indicators. In other words, professors must trust themselves and their students to do quality work. It is the acceptance of this fact that is somewhat rare, and it is this we found in the portfolio project in Porto. There was general agreement about the idea of nurturing quality over time and avoiding rigid guidelines "handed down" to students. We both agreed that our problems had to do with the difficulties and potential of a single, particular student at a specific time, to say the things, to discover the things, to communicate the things, to build consensus about the things that allow and empower that particular student to understand.

It is often difficult for professors and faculties to operationalize this student-centered approach even though most philosophically embrace it. But using a student-centered approach to portfolios has several consequences that directly affect learning and ultimately, program. For example, in both Florida and Porto, rather than portfolio entries being selected by the teacher, students select their own entries and are then asked to provide a rationale for their choices that explains why they selected the work to be included. As it happens, students have difficulty providing this rationale (professors from other universities have also noted this difficulty). As a result of the students' difficulty, in Florida faculty dialogues took place, which led to discussions about course adjustments. Also student interviews were modified to focus on rationale statements, thus providing the student with a forum to delineate his or her thinking. We embraced and promoted what Ehrmann and Lewis (1997) called DIATing (Doing It Again Thoughtfully). Significantly, during the design phase of the portfolio initiative in Florida, a large percentage of faculty held to the belief that professors rather than students should specify what appears in the portfolio. If that view had carried the design, student weaknesses would have not been identified, and steps to address the weaknesses, that is, modifications to the program, would have never been made.

Our experiences in Florida and the supportive comments made by professors in Porto and elsewhere have strengthened our commitment to student-centered education based on the development of an electronic portfolio. We consider the portfolio to be a perfect vehicle to promote the transition from teacher directed to learner-centered education.

References

Clark, C. (1979). Five Faces of Research on Teaching. Occasional Paper No. 24. (ERIC Document Reproduction Service ED 180972).

Ehrmann, S.J. (1997). *Asking the Right Question: What does research tell us about technology and higher learning?*, Annenberg/CPB, found at: http://www.learner.org/edtech/rscheval/rightquestion.html

Lyons, N. (1998). Reflection on Teaching: Can it be Developmental? A Portfolio Perspective. *Teacher Education Quarterly*, 25(1), 115-128.

Paulson, F.L. & Paulson, P.R. (1994). *Assessing Portfolios using the Constructivist Paradigm.* American Educational Research Association. New Orleans, LA.

Ramsden, P., (1994). Using research on student learning to enhance educational quality, in Gibbs, G. (ed.) *Improving Student Learning - Theory and Practice.* Oxford: Oxford Centre for Staff Development (1994), internet: http://www.lgu.ac.uk/deliberations/ocsd-pubs/isltp-ramsden.html

Schon, D. A. (1983). *The reflective practitioner.* New York: Basic Books.

Spiro, R. J., Feltovich, P. J. Jacobson, M.I. and Coulson, R.L., (1991). "Cognitive Flexibility, Constructivism, and Hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains", *Educational Technology,* May 1991, pp. 24-33.

Wolf, K. (1991). Teaching Portfolios: Synthesis of Research and Annotated Bibliography. (ERIC Document Reproduction Service ED 343890).

Designing tools and contents for project based learning with net-based curriculum

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Abstract: This paper reviews some of the key issues of what we believe should be the corner stone of a project-based learning approach with ICT and net-based multimedia learning resources. It refers to the LAVA Learning project where pedagogic, learning resources and computer-based tools have been developed to support a complete learning environment. The project ended up creating a new project tool for this approach, and learning material and specialized content were made available to users of this tool. Content of all media types was provided a primary focus on text and video material. Curriculum from different content providers was linked together to constitute a source of learning materials.

Introduction

In Norwegian public schools there is a considerable focus on project based learning as it is required by the Norwegian National School plan, L97, see (L97). The schools were also to start using information and communication technology (ICT) in all subjects. At that time the teacher experience was low in both areas, especially ICT. Internet was there, but net-based learning resources lacked and so did broadband networks.

The LAVA[1] Learning research project was launched trying to design a prototype learning suite consisting of what could be the next generation net-based curriculum and the next generation learning technology on the premises of the pedagogy of project based learning. The research team has been given a total funding of nearly 3 million US$ over a three year period to determine critical factors in the nexus of these three areas.

At the start, we found considerable prior work in pedagogy in the literature, some on appropriate content, and a large body of work in technology and tools for ICT use in schools (with links to pedagogy). Much of the work targets mathematics and science. However we didn't find any projects where the three areas of research were conducted synchronously.

Our focus, and the purpose of this paper, is the combined development of pedagogy, net-based curriculum for project work, and computer technology to support this pedagogical approach in the humanities and social sciences at a school level. The objective of the work has been to create a learning environment that stimulates the pupils towards explorative discussions in a given topic. We therefore have chosen to use the physical arena of collaboration that exists in the schools instead of creating a virtual community on the net. We have also decided to let the pupils in groups of 4 share the main computer in the project work to stimulate discussion and cooperative creation of the learning projects.

This paper presents some of the major decisions made and results of the work done in the project LAVA Learning's second field trial (of three). We start with the pedagogical approach to project based learning and its impact on content. We then point out the requirements for suitable ICT tools that we found to be a consequence of the approach. Commonly used software tools were evaluated but found to fall short or our requirements leading us to develop our own net-centric multimedia production tool called "Slime".

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[1] LAVA is a Norwegian acronym for "delivery of video over ATM networks", a collection of projects with a technology viewpoint on video. The ATM is left now focusing on learning as one application of high quality video streaming.

Project work as a pedagogical approach

As already indicated the pedagogic focus in Norwegian schools has turned towards more use of project-based learning and use of ICT in all subjects. As discussed by Roschelle et.al. in (Roshelle 00), learning is a complex task. Pedagogic approaches, curriculum and its use, the teacher's experience, the social and physical environment and several other factors affect how children learn. Changing one factor, like infusing PC's into the classroom, will not by itself dramatically change learning. Getting the most from the use of computers should also involve changes in the rest of the learning environment, especially the teaching methods used and the curriculum. In the endeavor to improve learning conditions, one should also pay attention to results from recent cognitive research, for instance in (Bransford 99). It has been shown that the four fundamental characteristics—active engagement, participation in groups, frequent interaction and feedback, and connections to real-world contexts enhances the learning processes significantly.

In project work learning takes place during the creative process of producing a project report and during the discussions among the pupils when they are engaged in doing so. The pupils formulate a problem statement to be investigated, and find and compile information that can be used to elaborate and answer the principle questions raised by the topic of concern. Learning facts and relations between concepts takes place as the pupils pose questions, confirm or reject each other's suggestions and explain their position. The teacher, the content available to the students, and the tools used to compile and document students' efforts, must all contribute to keeping the right focus on the pupil's discussions. When focus is lost, learning will be less effective and subsidiary or irrelevant threads evolve.

The pedagogical researchers involved in LAVA Learning have been pro-active in designing a learning scenario that incorporates the use of net-based curriculum and computer based project tools in a natural way. The scenario based upon was the following:

1. Go through the start page designed by the project (see below) and follow all linked material that you find interesting.
2. Discuss the subjects of the start page and decide upon a main problem to be investigated (had to be accepted by the teacher).
3. Brainstorm the actual subject identifying possible sources of information.
4. Iteratively build an electronic project report using a combination of net-based and self-produced content.
5. Finalize the project as a class presentation.
6. Present the project to the teacher and the rest of the pupils in the class.

To give the pupils a good start of the project, we have had numerous discussions of how the start page should be, and which role it should play. It ended with a web-site providing an introductory preamble to the theme of the project with some provoking elements like "why don't Norwegians eat dogs?"

Figure 1 shows the start page of 2001. Each of the pictures in the collage is a link and leads to a short video, audio file or text. Links are provided at the bottom of the screen to material prepared by content

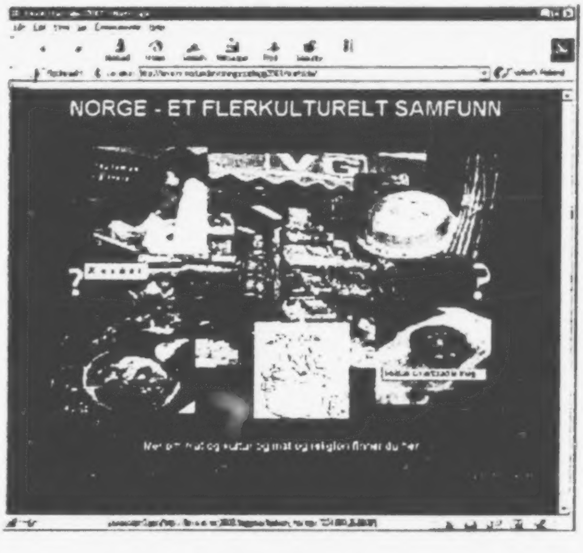

Figure 1: The start page of the project work can be seen at http://lava.nr.no/undervisningsopplegg2001/startside/

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providers participating in the project (described in the next section).

Net-based content

Pupils normally define the problem areas of their work in groups, not necessarily focused on traditional subject boundaries. We observed that they (11 – 15 years) often had problems finding good and relevant content. Their sources were often very ad-hoc, and much of what exists is in English and often written for adults, see (Ludvigsen 01). It also appears to us that the material often supports the pupils' problem areas very poorly. We found a need for more material that is more available to the pupils in language, in actual themes and so on., without being a study book on the net.

Norwegian schools are using the Internet intensively in project work. They combine this with printed materials like study books, lexical books etc. Printed materials are usually very fact oriented and often appear to give answers to all relevant questions. Our opinion is that existing syllabus books often discourages rather than encourages discussion among the students and close subjects.

The Internet on the other hand is completely open. Here you find lots of mainly textual material, but the relevance, organization and language is often in a form not suited for children and project work. There are some exceptions, but in the amount of relevant material in Norwegian was found to be limited.

We therefore asked our content providers to try to develop the next generation net-based curriculum as open learning sources but well coordinated and targeted on "Norway as a multi cultural society" with main focus on food and culture – food and religion. The material was developed according to the following guidelines:

- We would have rich media content — text, pictures, audio, video and web pages.
- The content should be directed towards stimulate curiosity and discussion and not an accumulation of facts.
- Texts should be concise, structured to appeal to intuition, and should not follow a book like structure.
- Content from each of the three content providers (The National Library in Norway, The Norwegian Broadcasting Corporation and Aschehoug, a large Norwegian publisher) should be structured to support the materials provided by the others within the selected subject and should be mutually linked.
- All content should be available in a web-browser.
- In addition to the content providers services, audio, video and pictures should be available for editing and manipulation by the students.

Project tools

In project work, the pupils are producers. Learning takes place as an integrated and iterative process of a number of tasks; Searching (Internet, books aso.), collecting, editing, creating and merging. This normally requires several computer tools to support the students' various work processes.

In the first field trial (of three) in LAVA Learning see (Ludvigsen 01), we used a tool called Syncrolink, see (Syncrolink), in combination with the MS Frontpage html editor and MS Internet Explorer. Syncrolink is a tool that allows the user to annotate videos with hyperlinks to web pages. In the trials, the pupils used Syncrolink to see the video, remove the parts they didn't think was relevant and add links to web pages they had created or that was found on the Internet. Their work process evolved to: Find the interesting places to put links in the video (using Syncrolink), create or find web-pages that cover the issues being discussed (using Internet Explorer or FrontPage), store these webpages and finally connect the links using Syncrolink.

The problem with this mode of work appeared to be that the students lost track of their contexts and hence that the different parts of what they produced did not harmonize very well.

Another problem that was observed in this first trial was that the children lacked a placeholder for interesting material they came across on the Internet. Adding the URL's to the Favorites list in the browser only solved the problem on a specific machine. In cases where the pupils used different computers for content collection, they had problems transferring correct URL's. Solving the problem involved writing down the URL or using a third tool to type it in, and store this on a networked disk.

In studying the pupil's work we were convinced! Tools can never be neutral in this context. Inappropriate tools will easily distract the pupils' attention. Our opinion is that supporting a good working process is the best way the tool can contribute to good learning processes.

As for MS Frontpage, results (we took lots of video of the pupils during the project work) show that the pupils spent lots of time discussing the appearance of their web pages rather than discussing the content and subject matter.

In collecting preferable properties for a project tool we also wanted the ability to handle all media types in a transparent manner being it net-based or locally produced. Within the actual subject of the pupils project work, the Norwegian Broadcasting Corporation and the National Library had lots of relevant video material that they wanted to make available over the Internet. They wanted to experiment with new net-based services targeted for schools. TV is quite a different medium from video on the web, and TV programs are self-contained and have a longer duration than acceptable as part of a multimedia presentation. We needed to provide mechanisms for the children to include only those parts of the video that were relevant to their field of inquiry.

Experience from early trials of the LAVA project, showed that when students edited a selected video from 30 to about 5 minutes, the exercise gave them a much deeper grasp of the subject matter in the video. In later trials we wanted to preserve this ability.

Permissions to do this editing of copyrighted material were needed and given by the content owners. We wanted to test our earlier observations that the editing process led to better understanding of the video content. To avoid copying and changing the original video material, and avoiding having to copy and handle large video files, the video editing needed to be carried out on streamed video with caching capabilities.

We started looking for a convenient project tool with a clear focus on the need for support of the pupils work processes. Having evaluated easily available tools like MS PowerPoint with MS Media, Macromedia Dreamweaver, Real and others, we found that none provided good support for our requirements. Having the resources of developing our own tool, we decided to create what became the Slime tool shown in figure 2 and 3.

The main approach behind Slime was to provide a set of canvases or *scenes* where all media types could be collected and edited. Since the scenes needed to handle both static and time-varying media types, we decided to tag all media types with time tags. This meant that in playback mode, a text, a web-page and a picture would all be assigned a time slot when each object was displayed on the canvas, and a time where it each object would disappear.

In Slime content objects are displayed in parallel or in sequence or overlapping in time during playback of edited material. The contents of a "scene" can be played as a synchronized whole. When all media objects in a scene have been played, the tool jumps to the next "scene".

To navigate between the scenes of a project, users can use both the *scene graph*, the navigation box to the lower left, and the overall timeline shown on top of the tool. The scene graph is a graphical display of the object names and structure of scenes.

Students can easily switch the search modus of the tool by clicking on the switch button. The search mode allows the user to search the Internet using a standard web-browser, or collect local files or search in given content providers' databases for annotated material. Interesting materials found can be collected and included in a given scene. Material collated in this fashion can be thereafter edited and synchronized with the other content objects.

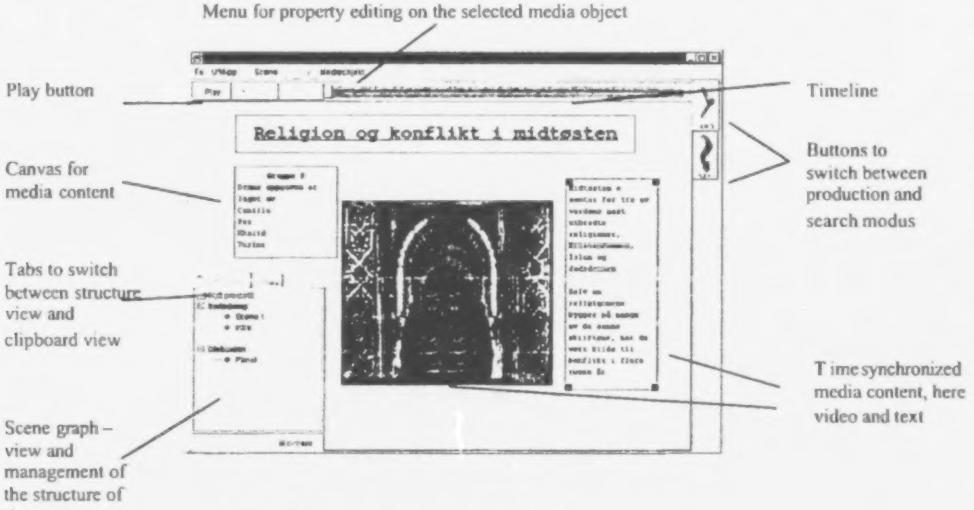
Menu for property editing on the selected media object
Play button
Play
Timeline
Religion og konflikt i midtøsten
Canvas for media content
Buttons to switch between production and search modus
Tabs to switch between structure view and clipboard view
Time synchronized media content, here video and text
Scene graph – view and management of the structure of the scenes

Figure 2: The Slime tool in production modus

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A special object model underlying the Slime tool that makes it possible for content providers to control content distribution and use after it has left the server. These security, IPR and copyright issues are beyond the scope of this paper, but are documented in (Diesen 00).

The snapshots in figures 2 and 3 indicate some of the functionality of the Slime tool. For a more detailed description, please see (Slime).

Results and discussion

To document the school trials, researchers have been in the classrooms, and about 40 hours of video of pupils working together using the Slime tool are available. The pedagogic results will be comprehensively documented in papers by other researchers in the LAVA Learning project, and will be available on http://www.nr.no/lava/lava-le/ as they are published. We will focus here on some of the content and tool issues.

We found that the Slime tool was able to support the entire project oriented learning process of the pupils. Many of the pupils started their production by creating a structure of empty scenes. This worked as a way of storing their common understanding of what their project would result in. Project structure was frequently revisited and discussed during the project work. This showed us that this kind of mutable structuring element provided good work support. It generated considerable discussion about the organization of their material for example by serving as a focal point to identify what was lacking and so on.

Despite the excellent support of student work-processes, we clearly saw that Slime is a poorer presentation tool than PowerPoint. We had observed problems with timing of the display of text boxes. This indicates the need for a "proceed" button or a revision in our approach to the time model.

What we also found was that material made available directly into the project tool worked well and was used to some extent, but the video material not was sufficiently annotated. The pupils had to go through what they assumed to be relevant in order to evaluate it, and the annotations did not give a sufficiently accurate description of video content. Lots of pupils ended up omitting the use of video, or just using privately produced video. In the next field trial (the third and last of LAVA Learning), we will have to annotate the videos with a higher granularity. This will ensure that search results will turn up only the relevant parts of a video.

We also observed a problem with content resources in general. The problem focus of the different project groups of students was very broad. Teachers will either have to restrict focus, or huge amounts of content must be made available. Students found lots of material on the Internet on relatively ad hoc web sites, and the content was used relatively uncritically with regard to the sources. It is obvious to us that there is a pressing need for more content, and an educational emphasis in critical evaluation of sources available on the Web is very important

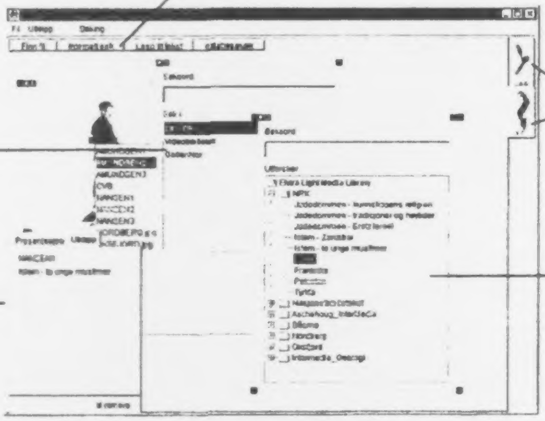
Buttons for searching for media data from file, internet and the databases of the content providers
List of available databases with ability to search across all of them for a specific item
Buttons to switch between production and search modus
Clipboard, a placeholder for content that the user will transport to a scene
Lists of database content with search window, here a list from a video database

Figure 3: The Slime tool in search modus

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Conclusions

We feel that we have managed to combine research in the three areas of pedagogy, content production and technology to create a good working learning environment using a project based learning approach. The main emphasis is on the pedagogy, which defined the framework for a project tool that would support effective learning. The issue was to keep student focus on the subject matter of the project and not on the underlying technology.

Our observations from field studies indicate that a specially designed project tool like Slime enables students to keep their focus on the subject matter to a much greater extent than the traditional off the shelf tools. Integration of search and production facilities turned out to be important to the learning process.

The content providers of LAVA Learning gave access to their raw material, which enabled us to link it directly into the project tool of the pupils. This turned out to be successful, but the amount of available and structured content for educational needs will need to be provided to keep up with demand for electronically available material. It is of great importance to get reliable sources of material available on the Internet for the children working with an approach like project based learning.

Do children learn better in this way? This really is a question with no simple answer. What we have seen is that motivation increases a lot. Some children would hardly leave school. On the other hand, we believe that a good learning result requires well functioning project groups and a good teacher. The teacher needs to help the groups in finding good problems to work with and in testing the relevance and quality of the material they use.

Acknowledgements

LAVA Learning is a project with many contributors from different fields. The learning arena and the Slime software is developed with the combined effort of many school teachers, college teachers, content providers and researchers. We would like to specially acknowledge the contribution from second professor Sten Ludvigsen from InterMedia, University of Oslo, who has lead the pedagogical research and helped us extensively. The same is the case for the researchers Dag Diesen and Asbjørn Oskal from NORUT-IT in Tromsø, Norway, who have been developing Slime with us, and Ph.D. student Anders Kluge at the University of Oslo. Without you, this project wouldn't have been possible. Our thanks also go to the Norwegian Research Council (NFR) that provided funding for the project.

References

(L97)	L97, the Norwegian teaching plans for the 10-years school: Læreplanverket for den 10-årige grunnskolen, available from http://skolenettet3.ls.no/L97_eng/Curriculum (in English)
(Roshelle 00)	Roschelle J.M., Pea R.D., Hoadley C.M., Goradin D.N., Means B.M.: Changing How and What Children Learn in School with Computer-Based Technologies, The Future of Children – Children and Computer Technology Vol 10, No 2, Fall/Winter 2000, pp 76 – 101
(Bransford 99)	Bransford J.D., Brown A.L. and Cocking R.R.: How People Learn: Brain, Mind, Experience and School, Washington, DC: National Academy Press, 1999
(Ludvigsen 01)	Ludvigsen S., Kluge A., Rasmussen I., Solheim I. and Foyn B.: Multimedia og læring – Erfaringer fra LAVA Læring første feltforsøk våren 2000, NR report 976, September 2001, available from http://www.nr.no using the search facility. (in Norwegian)
(Syncrolink)	Syncrolink – software that lets you put hyperlinks on a video connecting video and web in a synchronized manner, see http://www.syncrolink.com
(Diesen 00)	Diesen D. and Oskal A.: Using object oriented information distribution to present and protect information, Advances in infrastructure for Electronic Business, Science, and Education on the Internet, L'Aquila, Italia, 6. - 12. August 2001
(Slime)	Description of Slime can be found in: http://www.nr.no/lava/lava-le/slime/

E-ACCESSIBILITY: UNITED STATES AND INTERNATIONAL

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Abstract

This presentation provides guidance on the issue of universal web accessibility for individuals with physical challenges who need accommodations to fully participate in the electronic world. Four categories of information facilitate understanding the complexity of the issues. These categories are:

- U.S. legal mandates;
- International accessibility policy and legislation;
- Resources and information; and
- Web site accessibility validation.

These four are explored in depth and provide the tools for meeting today's challenges. As the Web evolves, new accessibility issues will emerge. Once you think you have it figured out, it will change, requiring continual self-study to keep abreast of the how these changes effect your situation. Helpful resources can be accessed from the following site: Http://www.e-linkagesglobal.com

Introduction.

This presentation provides guidance on the issue of universal web accessibility. Lack of information concerning web accessibility not only contributes to the digital divide, but can lead to serious legal problems as well. Lawsuits can arise because of U.S. legislation that required all web sites receiving federal funds to meet accessibility directives by the spring of 2001. The goal of this paper is to provide clarification of the accessibility statutes and offer resources and information to assist in successfully developing accessible web sites.

The circular process of comparing and contrasting information from the Internet, expert testimony and personal expertise were the primary components fueling the engine of this qualitative inquiry. It goes without saying that constant and rapid change makes it extremely difficult to study any phenomenon on the Internet.

Many web developers are ignoring the accessibility issue or just do not know how to make their sites universally accessible. They are bewildered in the face of the vast amount of information available on applying accessibility techniques to the design of their web sites.

Four categories of information facilitate understanding the complexity of the issues. These categories are:

- U.S. legal mandates;
- International accessibility policy and legislation;
- Resources and information; and
- Web site accessibility validation

These four areas provide the tools for meeting today's challenges. As the Web evolves, new accessibility issues will emerge. Once you think you have it figured out, it will change, requiring continual self-study to keep abreast of the how these changes effect your situation.

The Legal Mandates for Accessible Internet Sites

The Americans and Disability Act (ADA), which was signed in 1990, prohibits discrimination "on the basis of disability in employment, programs and services provided by state and local governments, goods and services provided by private companies and in commercial facilities." However, the ADA doesn't just apply to the physical world. Waddell

(1998) points out that according to the Justice Department, the ADA also applies to cyberspace. In an opinion letter dated September 9, 1996, The Justice Department stressed that covered entities under the ADA are required to provide effective communication, regardless of whether they generally communicate through print media, audio media or computerized media such as the Internet. Covered entities that use the Internet for communications regarding their programs, goods or services must be prepared to offer those communications through accessible means as well.

Section 508 of the Rehabilitation Act Amendments of 1999 (http://www.access-board.gov/sec508/nprm.htm) provided the basis for the Electronic and Information Technology Accessibility Standards, enacted August 7, 1998. "Effective (two) years after the date of enactment, any individual with a disability may file a complaint alleging that a federal agency fails to comply with section 508 in providing accessible electronic and information technology."

Carnevale (1999) notes: "As colleges and universities expand their distance-education programs, they are finding that they must include the virtual equivalent of ramps when building their website. Higher education institutions know they're obligated. "It's not that web site creators are ignoring the accessibility issue," says Jane Jarrows, president of Disability Access and Information. "It is that they don't always realize how important accessibility is." While the U.S. Department of Education's Office for Civil Rights (OCR) has specific guidelines for compliance on traditional campuses, the agency has not yet issued accessibility rules for online education.

United States Legal Cases Related to Education

According to Waddell:

> Not surprisingly, web accessibility issues are now being faced by educational institutions. Library reference services are being transformed by the efficiency of Internet access to information systems and search engines. Professors are teaching long distance learning courses over the Internet and even if a student is physically in class, homework assignments and resources are being posted on class homepages. Yet, even if a library terminal has assistive computer technology installed for students with disabilities, Internet research by students with disabilities is not possible with inaccessible web page design.

A blind student from Long Beach California filed a complaint to the Office of Civil Rights (OCR). The university provided OCR with a voluntary resolution plan, which resolved the issues raised in this case. The plan included the following commitments:

1.) Develop and implement a systematic method for ensuring that the issue of accessibility to persons with disabilities, particularly blind persons, is taken into account when colleges purchase computer software and hardware.

2.) Develop and implement a systematic method for informing campus employees who design/select web pages for use by students to make sure the web pages are in accordance with principles known to maximize accessibility to users with disabilities, including visual impairments

Waddell, 1998, provides more information about this case by citing Brummel's 1994 white paper, " The Information Infrastructure: Reaching Society's Goals Report of the Information Infrastructure Task Force Committee on Applications and Technology Published by: U.S. Department of Commerce."

"...(T)he issue is not whether the student with the disability is merely provided access, but the issue is rather the extent to which the communication is actually as effective as that provided to others. Title II (of the Americans with Disabilities Act of 1990) also strongly affirms the important role that computer technology is expected to play as an auxiliary aid by which communication is made effective for persons with disabilities" (Pages 1-2, 1996 Letter; 28 C.F.R. 35.160(a)) (Waddell, 1998 citing Brummel, 1994).

In further clarifying what is meant by "effective communication," OCR has held that the three basic components of effective communication are "timeliness of delivery, accuracy of the translation and provision in a manner and medium appropriate to the significance of the message and the abilities of the individual with the disability" (Page 1, 1997 Letter) (Waddell, 1998, citing Brummel, 1994).

On June 25, 2001, the accessibility requirements for U.S. electronic and information technology took effect under Section 508. This law mandates that this technology be accessible according to standards developed by the Access Board, which are now part of the federal government's procurement regulations.

Section 508 and its enforcement provisions apply to products procured by U.S. federal agencies after June 25, 2001. This law relies heavily on the procurement process to make sure there is compliance with the new standards. Compliance with the standards is required unless it would pose an "undue burden"—as defined in the standards—or if no complying product is commercially available. The law permits individuals with disabilities to file a complaint with the appropriate federal agency concerning access to products procured after the effective date.

International Accessibility Policy and Legislation

Accessibility issues are considered to be one of the "target areas for equal participation" at an international level. Late in 1993—at the infancy of the World Wide Web—the United Nations General Assembly adopted the Standard Rules on the Equalization of Opportunities of Persons with Disabilities [1]. Rule 5 of the Standard Rules addresses accessibility in terms of the physical environment and with reference to information and communications services. Among other points, Rule 5 recommends: "States ... develop strategies to make information services and documentation accessible for different groups of persons with disabilities."

Although not a legally binding instrument, the Standard Rules represent a strong moral and political commitment of governments to take action to attain equalization of opportunities for persons with disabilities. The rules serve as an instrument for policy making and as a basis for technical and economic cooperation. In the past few years, a special rapporteur appointed by the U.N. Secretary General to monitor the implementation of the Standard Rules has encouraged governments to consider accessibility of information and communications services within their country's social development policies.

The unique governance structure of the Internet makes it difficult, if not impossible, for a country to impose accessibility legislation on its own citizens. For example, it is not easy for one government to impose penalties for poor accessibility in a web site of one of its own citizens if the web site is hosted in another country. Governments have used either policy or limited legislation in an effort to ensure that public information is an accessible public good.

Policies that encourage accessibility—stating its benefits to the producers and consumers of information—are used by most of the early adopters of the importance of information accessibility. These policy/guidelines can only implement minor penalties such as the notoriety of non-conformance. Australia, Canada and Portugal have issued policy statements, and have mostly limited policy application to their own federal governments.

A good example of a clear and concise policy statement comes from the "Guide to the Internet" of the Government of Canada. It states:

> "Since the end user cannot count on either standard technology or helping devices to ensure access to information on the [World Wide] Web, the onus is on the web page developer to deliver the message in a way that allows everyone to benefit.
>
> "It is every Canadian's right to receive Government information or service in a form that can be used, and it is Government of Canada's obligation to provide it."

Only the U.S. has, so far, turned information accessibility into legislation. It does so using both “push” and “pull” regulations. "Push" regulations—such as Section 255 of the Telecommunications Act of 1996—require industry to consider accessibility. This type of regulation is, however, only effective in production of accessible products such as kneeling buses and accessible teller machines. It is difficult to regulate delivery of online information using “push” regulation because World Wide Web information is available globally, and there are many countries that do not consider information accessibility an issue.

Section 508 of the Rehabilitation Act is an example of "pull" legislation because it requires that the government purchase accessible products, but does not require that industry produce them. This provides a market *pull* to industry. Obviously, industry prefers pull regulations to push regulations. In practice, Section 508 may also be more effective because suppliers stand to lose major federal contracts if they are perceived not to adopt corporate accessibility policies. By imposing accessibility regulation on its own ranks, the U.S. federal government is hoping that corporations will adopt accessibility policies as a matter of example and as a sign of good corporate citizenship.

The European Union seems convinced that “pull” regulation and standardizing on WAI is their best option. In its Europe Action Plan, the E.U. provides a special section titled “e-accessibility: Participation for all in the knowledge-based economy.” This action plan optimistically targets the year 2002 as the deadline for all member countries to make their federal websites follow the WAI Content Accessibility Guidelines.

In Canada, federal websites have mostly complied with the Treasury Board Secretariat's Common Look and Feel (CLF) Guidelines. The successful implementation probably makes Canada's web sites the most accessible among industrialized nations. But the Treasury Board is not satisfied. The CLF Guidelines are currently being used in the formulation of legislation similar to Section 508, and with a compliance date of December 31, 2002. The difference between U.S. regulations and the Canadian and E.U. regulations is that Canada and the E.U. are adopting the W3C Web Accessibility Initiative as a reference material to keep with new technologies and developments. This move will likely be the same approach as other countries determine how, if ever, they formulate information accessibility policy.

Unfortunately, many countries may never have to deal with web accessibility for mostly economic reasons. One reason is that country priorities for information and communication services will naturally begin with the telecommunications infrastructure and the cost/benefit analysis of various platforms. For example, the e-Mexico project concentrates on making telecommunications facilities available to the rural areas, and the term *accessibility* is used to refer to the access of these facilities.

Another reason web accessibility might not be adopted is that in countries where labor costs are low, care giving for persons with disabilities is the norm, and independent living is not common. Caregivers can be asked to provide other services such as reading books and online information.

Verification of Web Site as Universally Accessible and Related Services

Web pages need to be validated to ensure they meet the minimum requirements for universal accessibility. There are two major validation services—available free online—which evaluate web pages and help identify potential accessibility problems to correct. The first is Bobby, which is part of the Center for Applied Special Technology (CAST), a non-profit organization, whose mission is to expand opportunities for individuals with disabilities through the development of innovative technology. The Bobby validation system is simple to use to validate a web site. The web site URL is submitted by entering the information onto the web page and then clicking a submit button. Http://www.Cast.org/

The process for obtaining the report is easy. Copy and paste the URL to insert into the verification program. Copying and pasting keeps from making a typing error. Tip: If a Windows-based computer is used, select/highlight the URL and use "Ctrl" and "C" keys to copy the URL and then "Ctrl" and "V" keys to paste the URL to the address box. Then submit.

Web sites should have at least a *Priority One Accessible* rating. When users get feedback from the site, they will be able to see the entire page. Tiny question marks by the images means for users to check their information manually—this will not stop those from getting validated. If major problems are experienced, a question mark appears by each image.

W3C Validation. The second major validation site is W3C's HTML validation service, a free service that checks documents like HTML and XHTML for conformance to W3C recommendations and other standards. http://validator.w3.org/

Approval Icon. The NCAM accessibility icon was selected from 17 symbols as a Web Access Symbol for people with disabilities. Web masters can use this to denote their site contains accessibility features for disabled users. The symbol should always be accompanied by its description—a globe, marked with a grid, tilts at an angle; a keyhole is cut into its surface—and alt-text tag,. This image was created by Stromship Studios of Boston. There is no charge to use this symbol, and it may be used in electronic or printed form. It can be copied from the NCAM web site and pasted it into a document. http://ncam.wgbh.org/accessncam.html

Conclusions

"The difficulties of studying the Internet can only be described in the present moment due to the constant state of change on the Internet" (Rizia, 1999). The future will hold many exciting technological innovations, making computers adapt to individuals rather than the reverse. Technology that allows access to computer resources for a person with disabilities is known as adaptive technology. These "electronic curb-cuts" are a combination of hardware and software. The challenge is making adaptive technology part of any base configuration and making all components work in a seamless fashion. This will increase the access to computers and applications without making major modifications.

When designing for the Internet, a global approach needs to be considered. As of now, the U.S. is the only country that mandates accessibility for anyone doing business with the government. Of course, that includes most higher education institutions. Meeting accessibility guidelines for most situations means adding descriptive tags to any image and text links for audio or video files. Anyone, anywhere can use the Bobby site to check for these simple things. Having accessibility sites makes good economic sense as the number of individuals with disabilities on the Net—who could emerge as consumers of vast numbers of products—continues to increase.

Resources and Information

Helpful resources can be accessed from the following site: Http://www.e-linkagesglobal.com

References

K. Barlett (personal communication, June 14, 1999).

M. Bayne (personal communication, June 10, 1999).

F. Rizia (personal communication, June 10, 1999).

Carnevale, D. (1999, October 29). *Colleges strive to give disabled students access to on-line courses. The Chronicle of Higher Education.* Retrieved March 7, 2002: Http://chronicle.com/free/v46/i10/10a06901.htm

Dahm, T. (2001). *Five steps to accessible web sites.* Retrieved from the World Wide Web March 7, 2002: http://techupdate.zdnet.com/techupdate/stories/main/0,14179,2781418,00.html

McDunn, R. (2002). *Web content accessibility tips and tricks.* Retrieved from the World Wide Web March 7, 2002: http://www-group.slac.stanford.edu/wim/accessibility/default.htm

Rowland, C. (2000). *Accessibility of the Internet in Postsecondary Education: Meeting the Challenge.* Retrieved from the World Wide Web March 7, 2002. http://www.webaim.org/articles/meetchallenge

Valdes, L. (2000). *Accessibility on the Internet.* Retrieved from the World Wide Web March 7, 2002: http://www.un.org/esa/socdev/enable/disacc00.htm

Vanderheiden, G., & Tobias, J. (2000). *Universal design of consumer products: Current industry practice and perceptions.* Retrieved from the World Wide Web March 7, 2002: http://trace.wisc.edu/docs/ud_consumer_products_hfes2000/

Waddell, C., & Thomason, K. (1998). *Is your site ADA-compliant...or a lawsuit-in-waiting?* Retrieved from the World Wide Web March 7, 2002: http://www.icdri.org/is_%20yoursite_ada_compliant.htm

Waddell, C. (1998). *Applying the ADA to the Internet: A web accessibility standard.* Retrieved from the World Wide Web March 7, 2002: http://consumerlawpage.com/article/ada.shtml

Waddell, C. (1999). *Electronic curbcuts: Universal access for everyone.* Retrieved from the World Wide Web March 7, 2002: http://www.cisp.org/imp/december_99/12_99waddell.htm

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Implementing a Quality Management System in E-education

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Abstract: Quality is an elusive and ill defined concept. We have become accustomed to associating quality with fancy features, high prices, zero defects and conformance to specifications. How do we interpret Quality in the field of higher education in general, and E-education in particular? In the field of higher education, we speak of "best practices", "quality learning interventions", "design standards", "quality instructional design", "quality services and products" etc. Although there is a fair amount of literature on quality management in higher education, there appears to be little which applies the principles of Quality Assurance and Quality Management in the field of E-education. This paper describes the implementation of a formal Quality Management System in E-education at a tertiary institution in South Africa.

Background

The Council for Higher Education (CHE) in South Africa is a statutory body established by the Higher Education Act of 1997 to advise the Minister of Education on all matters pertaining to higher education. The CHE is responsible for establishing a quality assurance system for higher education through the Higher Education Quality Committee (HEQC), which was constituted in March 2001.

There is a real need for ETD (Education, Training and Development) practitioners to research the implementation of QA systems and to contribute to the work of the HEQC. The founding document of the HEQC states that "The HEQC is committed to a quality driven higher education system that contributes to socio-economic development, social justice and innovative scholarship in South Africa" (CHE, 2000, p.5).

Context

The Department of Telematic Learning and Education Innovation (TLEI) is a service department, which was established at the University of Pretoria, South Africa, in 1997. We provide support to academic staff members who wish to embrace innovative learning models, including computer-assisted assessment, multimedia, web-supported learning, interactive television and various other delivery alternatives and combinations. We provide faculty and student training in online learning, as well as technical support.

Research Brief

This project focuses on the quality of the products and services offered by the E-education division of the Department of TLEI. The research brief of this study is to implement a Quality Management System (QMS), which will formalise processes, procedures and measurement instruments.

A Quality Management System (QMS) is a way of formally ensuring that an organisation is consistently in control of the product or service which it provides to its customers. The British

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Standards Institute (BSI) defines a QMS as "the organisational structure, responsibilities, procedures, processes and resources for implementing quality management" (Boyd, 2001). Documenting a quality system demonstrates how each of the aspects interacts to ensure success in improving the efficiency, performance and cost effectiveness of the organisation. A QMS should not be perceived as separate from the way 'things are done around here', but a way of evolving better and better business practices and a part of normal everyday routines.

Although a conscious decision not to seek certification to ISO9000 standards has been made at present, it is useful to review the provisions of ISO9000 both in application to education, and to software systems development, so that the system is suitable for refinement and auditing to ISO9000 standards in the future, if required.

For the purposes of the QMS, we define our "customers" to be lecturers and students, and we describe our "products" as learning experiences.

Quality Management System – progress so far

We began by documenting our intuitive ideas for monitoring and evaluating the learning experiences we design and develop. Our Instructional Design "toolkit" consists of design standards for multimedia, video and web-based products, QA checklists used to evaluate prototypes, guidelines for screen design and other technical functions, as well as client service satisfaction surveys.

Our Project Timeline reflects the traditional ADDIE instructional design model, namely Analysis, Design, Development, Implementation and Evaluation. Following these five stages, we have defined our overall processes to be: A: Initiate E-education projects; B: Manage E-education projects; C: Design and Develop Instructional Materials; D: Implement learning experiences (p roducts); E: Evaluate learning experiences (products). These five processes are broken down into a total of 17 procedures, each represented by a box in the project timeline.

We conducted introductory QA training workshops, which were attended by all staff members in E-education. Process diagrams indicating the suppliers, customers and their requirements at each stage have been used to gain insight into the five processes and how they may be measured effectively. The importance of measurements in completing the feedback loop is vital, and these are yet to be defined.

We have formulated a Quality Policy, which is an essential component of a QMS. The policy reflects our commitment to fitness for purpose, client satisfaction, cost effectiveness and continuous improvement of all our processes and functions. The formal QMS will reside on the departmental intranet, in order to facilitate access to and control of documentation.

Conclusion

This is a work-in-progress project, which contributes to the field of Quality Assurance in Higher Education, and E-education in particular. It will provide input to the HEQC in South Africa, in their brief to establish a framework for Quality Assurance in Higher Education. It will provide insight into the practical dilemmas of implementing a formal Quality Management System in E-education at a tertiary institution.

References

Boyd, L.G. (2001). Proposal for the Implementation of a Quality Management System in the Department of Education Innovation at the University of Pretoria. Unpublished document.

Council for Higher Education (CHE). (2000). Higher Education Quality Committee Founding Document. Council for Higher Education, Pretoria.

Participatory Design, Problem Solving and Community Involvement in Two Different Learning Communities

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Abstract

A collaborative software development project designed to maximize the skill sets and interests of school children and teachers, educational software technologist and researchers, and college undergraduates is presented. The work brings together elementary school children with college seniors and technology consultants to implement a problem-solving methodology within a collaborative environment to design, develop and implement a multimedia software application that enhances the spatial orientation abilities of children and puts the programming, interface design and multimedia systems capabilities of college students into action. This effort in project-based learning offers young students the opportunity to learn mapping skills, problem-solving techniques, and participatory design methods while planning and conducting virtual tours of their city.

References:

Deek, F.P., An Integrated Environment for Problem Solving and Program Development, Unpublished Ph.D. Dissertation, New Jersey Institute of Technology, 1997.

Deek F.P. and Friedman R. (2001). Computing and Composition: Common Skills, Common Process, *Journal of Computer Science Education - ISTE SIGCS*, vol. 15, no. 2.
Available at: http://www.iste.org/sigcs/jcseonline/2001/12/index.html

Druin, A. (1999). Cooperative inquiry: Developing new technologies for children with children. *Proceedings of CHI'99*, ACM Press, 592-599.

Filho, W. (2001). Requirements for an Educational Software Development Process, *Proceedings of the 6th annual conference on Innovation and technology in computer science education*, ACM Press, June, 65-68.

Shank, R. & Cleary, C. (1995). *Engines For Education*, Hillsdale, NJ: Lawrence Erlbaum.

Sobel, David (1998). *Map Making With Children.* Portsmouth, NH: Heineman.

Introduction

Familiarity with geography, the science of space and place on the Earth's surface, helps people visualize and understand their home and orients their relationships vis-à-vis other cultures and environments. Maps help to show children where they are, where they've been and where they can go, while creating a sense of belonging to a community, a history and a path to the future. The urban environment, in particular, is populated with many young students who do not often perceive their world beyond the boundaries of their immediate neighborhood.

We describe here a software development collaboration project designed to maximize the skill sets and interests of elementary school children and teachers, educational software technologist and researchers, and college undergraduates. Through the implementation of project-based learning, problem-solving and, participatory design methodologies, and community involvement, software containing interactive video, calculation programs and spatial orientation tools offers 4th- through 6th-grade students in Newark, New Jersey the opportunity to learn mapping skills while planning and conducting virtual tours of their city.

Cognitive Development, Spatial Orientation and Technology

Learning theorists have articulated unique developmental predispositions for different kinds of learning. David Sobel (1998) states that between ages five and seven, children start to move away from home and parents and explore the natural world. From ages seven to eleven, children are predisposed to merging with nature and making geographic sense of the world around them. Although computers cannot replace the human contact and feedback that only a teacher can provide, they are tools that can be used to significantly enhance students' educational experiences at a time when children have a propensity to explore. Through the process of participatory design (Druin, 1999), 10-year old students have an equal, if not greater stake in the development, testing, refinement and use of the software as compared to the college students who are interacting with the youngsters at each stage and step of the software development process.

Software companies have developed a wide range of software applications geared to geographic inquiry and map making. The current strategies used in mapping software programs permit students to be active mapmakers. Neighborhood Map Machine, Trudy's Time and Place, Carmen Sandiego, Where Are We, Map Makers Tool Kit, Geo Safari – all introduce geography skills to students grade 4-8, geared to providing geographic discovery and knowledge. What these programs cannot offer, however, is any significant or concrete local context for the user. Moreover, educational software applications generally do not satisfactorily support the urban environment. Their symbols are suburban in orientation, and many of their activities use rural landscapes as a backdrop to learn navigating skills. However, children often do not have an opportunity to explore their neighborhoods. Urban lifestyles sometimes include dangers in neighborhoods and deplorable conditions of many buildings, causing parents to be reluctant to have their children explore on their own.

We've developed a partnership among students and faculty at the New Jersey Institute of Technology, Little Bytes, a technology-integrated curriculum development firm, and St. Philip's Academy, an independent elementary school in Newark, to serve as the foundation for a comprehensive multiyear program in multimedia learning systems that brings college seniors studying software engineering and multimedia design together with elementary school students and teachers in an effort to provide community-based educational software that introduces children to the landmarks and cultural facilities of Newark through the collaborative development of mapping skills instructional software. A major goal of the program is to build on the participatory design model of software design, articulated most clearly for application in an educational environment by Druin (1999), and a problem-solving methodology that has been successfully implemented at NJIT and in four Newark public high schools (Deek, 1997; Deek & Friedman 2001). We are testing the hypothesis that integrating these two models will promote positive change in the academic climate of classrooms by incorporating teachers, students and skilled college-level software engineers to create educational multimedia applications that accommodate the specific needs of the younger students, provide teachers with design-level access to appropriate instructional materials and educational technologies, and give youngsters hands-on experience in the design, development, testing and use of computer software tools.

Our project began with Little Bytes, a client of NJIT's business incubator providing the content specifications to begin building the software application. The NJIT/Little Bytes collaboration has opened the door to increased involvement with community-based and civic organizations such as the Newark Museum, Newark Bears baseball team, New Jersey Performing Arts Center, the Newark Housing Authority and the Newark Department of Engineering, all of whom have contributed to the development of a mapping skills software application that is focused on Newark's neighborhoods and landmarks. Having already placed several college students, earning service learning credits, at St. Philip's Academy, where Little Bytes serves as educational technology consultant, we were well positioned to expand our involvement to include a small class of seniors to focus on a specific outcome.

Project Implementation

During the spring 2002 semester, NJIT seniors majoring in multimedia information technology, information systems and computer science, were more enthusiastic to be involved in this innovative project. The college students' educational experience is project-based, as it moved them out of the lecture hall and into the community and the computer lab as they worked with learning systems researchers, 4th-6th grade students and educational technology consultants to implement a software design that was created collaboratively among St. Philip's Academy 4th grade school students, their teacher and Little Bytes. The software's three major components begins with a series of fun tutorials facilitated by an animated character, during which the user learns basic geography skills; putting those skills to use as they conduct four searches throughout different locations in Newark, and finally being able to design virtual tours of the city by building efficient routes between landmarks that are in video format.

The protocols of the project are oriented to maximize a problem-solving methodology found effective in computing, mathematics and composition courses at the pre-college and college levels (Deek & Friedman, 2001), combined with Druin's approach to software engineering (Druin, 1999). Children's interaction with technology expands beyond their end-user status and into the conceptual design, development, usability testing and debugging phases as well. By involving the children, we supply an alternative method of software design, development and evaluation, one that is accessible to our end users, the elementary school students. Through the use of visually oriented software design and increased opportunities to team children, teachers and software engineering students, educational researchers and software designers in the development of new applications, software evaluation becomes the province of all the participants.

Application development through participatory design has three main goals: to develop integrated learning environments that support visual and verbal literacy; to encourage student centered learning; and, to develop methodologies that offer a better understanding of what children want and need when using technology. The program provides a combined laboratory and classroom environment in which participants design, develop, test and refine software tools intended to inculcate spatial awareness and mapping skills while also attaining positive results with students.

Problem-Solving

Through participatory design, there are extended interactive discussions among teachers, students and software engineers during each phase of software development. We began with a meeting of all the people involved: the 4th graders, their teacher and principal; the college students and their instructor, two representatives of a community based youth group, Do Something Newark; and two educational technology consultants from Little Bytes. After explaining to the youngsters briefly what we had in mind, the children were asked to describe and draw a picture of a character that would act as their guide through the computer game. The college students formed several groups: graphical user interface designers, database and systems programmers, videographers and 3D designers, and each began to storyboard specific components of the intended product.

There are three major components. Section 1, Navigator, consists of 11 skill building interactive exercises that teach basic map reading skills. Here, an animated character that acts as a guide, Mapper, is introduced. Section 2, Mad Mysteries, presents three scenarios in which students find answers to clues offered in each to solve mysteries that take place in Newark. They are awarded certificates of proficiency that allow them to move on to the final component, Section 3, Create a Tour. The children are given a problem to solve: how to structure a tour of Newark for four different groups of tourists, all with different time constraints as well as interests. The skills garnered in Section 1 and tested in Section 2, are applied in Section 3. After two weeks of preliminary design, the college students settled on Macromedia Flash as the animation and movie creation software best suited for sections 1 and 2, and Adobe Digital Video Suite served as the main technology behind section 3.

Employing a consistent methodology that is common to all the participants and able to be documented added to the sense of partnership among the participants as they shared ways to solve problems specific to the areas that each encounter. Bringing theory into practice, as Filho (2001) suggests, demands that a process architecture be used when students are engaged in complex software engineering projects such as the project describe here. We used SOLVEIT, which is such an architecture, and has been successfully employed in high school and college settings. (Deek & Friedman, 2001) The SOLVEIT environment is collection of tools supporting a six-step process for problem solving and software design and implementation. These steps are: formulating the problem, planning, designing, and translating the solution, and finally, testing and delivering the product. The combination of a participatory design approach and SOLVEIT as a software engineering methodology produced a highly accessible interactive software application. NJIT students used applications such as Flash, 3D StudioMax, Adobe Digital Video Suite, as well as C++, Java and Access to provide the younger students with a game-like learning environment. This combination of methodologies and tools not only broadens all the students' educational experience, but also provides a more meaningful context within which to integrate the knowledge and skills they have garnered.

Student Response

While the college students were initially hesitant to break free of their traditional classroom environment, they were quick to appreciate the benefits of working within the structure provided by SOLVEIT as well as those that problem-based learning experiences offer, particularly when the solution to a problem takes the form of interactive software, and the design and development of that software is based in the methodology of participatory design. Ritika, who was responsible for the scaling activity in the Navigator group, used Flash 5

> because the class had agreed on doing most of the project with it. Also, it was something new to me, and I wanted to learn it. I tried to think of the kids' demands first when I was making this, so I tried to make it as fun as possible. I put in animations, and will put in sounds, which I think they will enjoy. From the last meeting with the kids, I could tell they wanted something very challenging with degrees of difficulty, but I am not sure how to incorporate that into my part of the game. (Instructor's notes)

Marc was part of the audio/video team responsible for the planning, shooting, editing, and integration of video footage and voice-overs. In a mid-semester report he noted,

> The recent visit by the St. Philip's students to our NJIT lab led to the continued development of software segments that have thus far been pieced together. The students' ideas reflect their upbeat attitude toward the city of Newark and their role in the project. An example of their input during this meeting was the idea to change the background color at the welcome screen from a black night to a more optimistic daytime. Jerri, Ursula [of Little Bytes] and AJ [Zenkert, the 4th grade teacher] have all been a big help. Ursula is good at clearing up confusing development issues between Jerri and our NJIT class. I look forward to our future collaborations. (Instructor's notes)

Rajesh, who in addition to the credits is responsible for several of the Navigator components, used Macromedia Flash, Adobe Illustrator, Microsoft Paint, and Microsoft Image Composer as development tools.

> These were chosen for their development capabilities and ease of use. On average, in addition to class time, I spent about 5 hours a week on the project. Initial progress was slow because of the learning and investigating time involved in starting the project. Meeting with Jerri, Ursula, AJ, and the St.Philip's kids proved that the users need a fun, challenging, and educational application. (Instructor's notes)

Gosia & Tim began their work by developing the introduction sequence for the software.

> We used traditional storyboarding and drawing techniques to develop the intro Space animation. We tried to make an entertaining and fun animation that hoped to show the kids from St. Philip's their perspective by traveling from space, down through the solar system, into New Jersey. Music was added to give a little flavor to the work using a hardware synthesizer, along with other software. Working in the studio environment with all the very diverse people was unarguably the best experience I have had since being at NJIT. (Instructor's notes)

Nainsi and Parag found that,

> This class has given a wonderful opportunity very close to the real world without entering a REAL world. Our project was mainly created by Flash; I have learned lot about Macromedia Flash and its implementing capabilities. Drawing with details and putting every piece together is sometimes tedious. But overall it is fun. Our discussions among ourselves, Jerri and the kids have shaped our requirements tightly. I really like the involvement of kids in our project, as I find them smart is noticing things and accurate in demanding what exactly they will like to see. What I don't like sometimes is not having a set rule, not knowing what actually is needed until it is done halfway or all the way. But I guess that is part of learning, and I don't have many complaints about that. (Instructor's notes)

St. Philip's Academy students and teachers have also benefited from this project in many different ways. The current Social Studies curriculum does not contain many lessons about mapping and map usage. Quality supplemental mapping skills material are not easy to find, particularly material that involves the type of mapping that is most pertinent to urban students' world: the city. When students understand how to use maps and concepts of scale and distance, they have skill sets that can be applied in subject areas such as history, politics, wars, migration, and immigration.

For the students, the opportunity to participate in the development of software is invaluable. Being a part of a team, whether it is a sports team or a debate team, teaches children about working together, solving problems, listening to others' ideas, and communicating. Throughout this process, the students have had to use and improve all of these skills. What they did not realize was that they learned and reinforced many mapping skills without ever sitting through a traditional classroom lesson. The students were very eager and excited to be a part of the project, and they worked very hard to be helpful, honest and creative in the process. They began to understand that they could not have everything they wanted in the software, but that it did not hurt to offer ideas and attempt to help, with the hopes that their ideas would be used in the final product. The teamwork, brainstorming, and creative thinking that the students used during this process provided a wonderful challenge and learning experience for them.

During a recent usability testing session, 14 4th graders reviewed several components of the Navigator section, including a parade that asks them to measure distance and height, and assess whether a float will be able to pass under a bridge, a "walk in the park," which tests students' ability to orient themselves to shifting directions, and a "legend" exercise that asks students to identify icons and move them in their appropriate places on a map. Feedback was obtained concerning levels of difficulty, "coolness," as well as descriptions of what the students learned. These results have direct bearing on the nature of the modifications the college students will do over the summer, but also suggest that we are on the right path, not only in terms of integrating software into the 4th grade curriculum, but also that involving the children in the design and development of the software has proven beneficial to the younger participants of the project. The majority of children found the software to be "cool," the instructions clear and the navigation easy. There was a nearly unanimous call for the components to be more challenging, but at the same time, more children found the software to be fun than boring. When asked, "What did you learn while playing this activity?" ten of the 14 respondents answered, "How to measure," while the remaining four replied, "Nothing." When asked, "If you could change this activity in any way, what would you change?" about half answered, "Make it easy," two said, "Make it more challenging," and four did not respond. Generally, the students liked the interactivity and that the activities require concentration.

Conclusion and Future Work

Development and utilization of customized educational software empowers the teacher and takes advantage of rapidly emerging multimedia technologies. We expand our scope and vision by bringing together the classroom teacher, students, the business community, civic institutions with the universities to create technology integrated products designed to promote student-centered learning which serves the

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community and ensures educational success of the child. The first version of City Mapping is designed primarily for 4th graders. It is our plan to produce a module for 5th and 6th graders as well during the fall 2002 semester. At the time, we will also expand our technology integration into the elementary school curriculum by implementing an international media sharing collaboration among students in Indonesia, Poland and Newark, with NJIT students building the infrastructure that will allow the exchange and collaborative development of music, art and narrative via the Internet.

Supporting the Application of Design Patterns in Web-Course Design

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Abstract: Many instructors are expected to design and create web courses. The design of web courses can be a difficult task for educators who lack experience in interaction and instructional design. Design patterns have emerged as a way to capture design experience and present design solutions to novice designers. Design patterns are a widely accepted method of providing design support to software engineers, and they have been proposed to support designers of web-based courses. However, end-users' abilities to use design patterns are unclear especially since web-course design and computer programming are different activities. We present a methodology for supporting novices' use of patterns during web-based instructional design. This methodology consists of a pattern language for web-based instruction and a design environment that scaffolds the process of finding, selecting, and applying patterns to design problems.

1. Introduction

Design patterns provide a way to capture and present solutions to design problems and to facilitate communication among the many members of a design team. The use of patterns for design originated in the field of architecture during the late 1970s as a way to describe solutions to reoccurring problems encountered in architectural design (Alexander et al., 1977). The goal was to support both architects and the general public in designing quality towns, neighborhoods, and homes. Building upon this work, the concept moved into the software engineering discipline as a way to document design experience for less experienced software developers (Beck & Cunningham, 1987; Gamma et al., 1995). These patterns have since been used as an educational tool to teach computer science curriculum (Gelfand et al., 1998). Design pattern usage has also become a relatively new idea in the field of human-computer-interaction and educational technology to support designers in interaction and instructional design (Borchers, 2001; Frizell, 2001; Rossi et al., 1996).

The popularity of design patterns can be attributed to their ability to capture design experience and their concrete nature. Patterns are more flexible than static templates and more concrete than abstract guidelines. This suggests that end-users can better apply them to their design problems. Although the literature on design patterns makes claims to their effectiveness in helping novice designers, there is not a lot of empirical evidence with end-users utilizing patterns in actual design projects. The current research is from the area of software engineering, whose design solutions are often in the form of classes (in the object oriented paradigm) and describe how the classes relate to and communicate with each other and objects to solve a problem. The original architectural design patterns are somewhat different from software engineering patterns with the latter being more concerned with implementation than design. Just as the goal of the architectural patterns is to help architects build structures that possess a certain quality for their inhabitants, the goal of WBI patterns is to assist educators in designing web-based courses that are instructionally effective for students. Web-based instructional (WBI) design patterns are more closely related to architectural design patterns because the focus is more on the user's experience with the final product. Patterns can be a powerful resource tool for designers within these domains, but our working hypothesis is that novice designers need additional support in the process of selecting and applying patterns to their design problems.

This paper presents our approach for scaffolding the pattern user's design tasks. In Section 2, we take a closer look at design patterns and current research results. Section 3 discusses design environments that have been proposed to support design pattern usage. In Section 4, we present our methodology for providing support for the application of patterns in web-course design and the resulting design environment. Section 5 concludes with a brief overview of our research objectives and future research directions.

2. Design Patterns

A design pattern captures a solution to a problem and presents it in such a way that the solution can be adapted and used repeatedly. Patterns go beyond simply presenting a solution; they also tell the user *why* the solution is needed and the context in which the solution can be applied. This information is presented in a format usually organized into several sections including the *pattern name,* which describes the design problem and provides a way to communicate about the pattern, the *problem*, which describes the design issues the pattern addresses, the *context*, which explains when to apply the pattern, the *solution*, which tells the user how to solve the problem, and the *forces,* which describe the trade-offs of applying the solution. Patterns usually exist within a language with other patterns addressing design problems in that same domain. A pattern language is a collection of patterns that are connected, thus allowing the designer to see how all the patterns within the language work together.

Our research is concerned with design patterns for WBI design. The need for design support has become a major issue in the design of web courses. The poor design of the instructional materials in web courses is one of the key problems with learning from the web (Bork & Britton, 1999; Kessler et al., 1999). Design patterns provide a mechanism for capturing pedagogical strategies and good design practices in a way that can assist educators in designing instructionally sound web courses. WBI design patterns vary in content from dealing with navigation design issues to addressing problems with student learning activities (Frizell, 2001; Rossi, 1996; Anthony, 1995). As in other areas of pattern usage, the goal is to support less experienced designers. Figure 1 gives an abbreviated example of a design pattern that has been proposed for web-course design (Frizell, 2001). This pattern addresses the isolation problem some web-based students have, and the solution describes to the designer a method for alleviating the problem.

There have been some preliminary studies on the effectiveness of pattern usage during the design process (Prechelt, 1997; Schmidt, 1995; Beck, 1987). Although this evidence has been in the realm of software engineering, preliminary results from these studies do show that patterns may prove beneficial to the design process. The benefits of design patterns may be greatly harnessed by coupling the patterns within an environment that supports the designer in working with the patterns in the language. We believe this to be especially true in a domain such as web-based instruction where the course designer may not have any experience in interaction and instructional design, and also in domains where the pattern language has grown to include a large number of patterns.

Name: Learning Community

Problem:
Some students have a need to feel connected with other students enrolled in the course. How to facilitate a sense of community for on-line students?

Context:
Web-based courses where students are feeling isolated.
Forces:
Students are not all on-line at the same time.
Some students prefer anonymity.
The difficulty of the medium.

Solution:
Provide an environment that encourages students to get to know other students in the course and to communicate with each other. This can be facilitated by having students post information about themselves. You can make the first assignment called 'Introduce Yourself'. It can be in the form of a web page and contain information such as the student's name, email address, interests, and a picture. This information can encourage interaction and dialogue among the students.

Web discussion tools such as bulletin boards can also be added to the course to encourage students to discuss topics. Students can go to the bulletin board to post problems and share ideas. You can also post questions on the bulletin board and require students to respond. This type of student interaction creates a sense of community for students.

Including *Group Projects* as a part of the instructional activities provides another mechanism to encourage a connection among students.
Rationale:
Creates a learning environment that encourages participation and interaction among the students. A course design that provides for a high level of interaction may alleviate some of the issues of learners who feel isolated and non-connected during on-line courses. In distance education courses, an attrition rate of 50% is common. By making students feel like they are part of a community, they may be more likely to participate and complete the course.

Related Patterns: Group Projects

Figure 1: WBI Design Pattern

3. Pattern Support Environments

Within the software engineering community, there has been some research on providing computer support for working with design patterns. Budinsky (1996) presents a design tool to support the implementation of design patterns in object-oriented software. Their tool supports browsing the patterns on-line and automatically generates the code for the pattern's implementation based on information collected from the software designer. The objective was to automate the implementation of design patterns for the software developer. However, with this work they found that the problem that may exist in pattern application is not in the coding or development; it is in the designer understanding his problem and deciding which pattern(s) helps solve it best (Chambers et al., 2000).

Web-course design environments such as Shih (2000) and Thomson (2000) recognize the need for design support for pattern usage, but these environments mostly provide support for the navigational structure of web-based courses. Patterns are used to model optimal paths through the course and a design tool guides the designer in developing courses based on these paths.

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Design environments such as the ones described above are heavily implementation oriented; a support environment for pattern usage in web-course design must also provide support for pattern selection.

4. Supporting the application of patterns in web-course design

Our research with design patterns is two-fold. We are working on a pattern language for web-based instruction to support designers in the creation of web courses and on a design environment to support our language. We focus the remainder of this paper on our methodology for providing this support and the resulting design environment.

Our goal is to provide support for three main activities, *finding* and *selecting* the appropriate patterns, and the *application* of the selected patterns into the course's design.

- Finding Patterns: We utilize a hypertext rendition of our pattern language to support browsing and quickly navigating through the patterns in the language. Patterns are grouped into categories based on the type of problems they address with cross-referencing between related patterns. This allows quick access to the patterns.

- Selecting Patterns: To support course designers in selecting the appropriate pattern(s) to solve their design problems, we provide support for pattern selection in two ways. We provide a menu-based approach, which allows the designer to search for patterns based on their course goal or problem. We also use a decision support system to guide the designer through the process of designing a course using a standard instructional design process combined with the patterns that address problems within each phase.

- Applying Patterns: After the course designer chooses the patterns he wants to use in his course's design, a design specification for the web-course is developed based on these selected patterns. The course design specification acts as a bridge from design to implementation. It gives the instructor an idea of how the course is structured based on his particular design decisions.

A designer that is experienced with working with the pattern language may not only know which patterns to select and how to apply them, but also follows an effective design process that includes the use of patterns as a subtask. It is important that the novice designer learns to not only work with the pattern language, but also gains a better understanding of design in general and design with patterns specifically. The process of finding, selecting, and applying patterns should be scaffolded for the novice designer. One of the characteristics of scaffolding is that support can be faded away over time giving the learner the control to apply their new knowledge and skills (Vygotsky, 1978*)*.

We are developing a design tool named PatternEdge to explore the combination of a pattern language coupled with a method that scaffolds pattern usage for the designer. PatternEdge employs a dynamic web-based interface implemented with PHP and uses a relational database for storing patterns. A rule-based system supports the designer in the selection of patterns taking into consideration the characteristics of the learners and the goals and objectives of the course designer.

The overall approach is depicted in Figure 2. The patterns within the language are annotated for how and when they are best used. The inference engine can then use this information during the pattern selection process. When interacting with the system, the designer is able to browse through the patterns and select and apply them on their own as they would if the patterns were presented without design support. Users also have the option of being able to seek design advice for working with the patterns. The system will collect information about the course to be designed such as learner characteristics and the instructor's goals and objectives. Based on the information known about the course and interaction with the instructor, the tool suggests design solutions (i.e. patterns) to the instructor. The solution given could be a pattern to solve a particular design issue or a collection or subset of design patterns from the language to cover all aspects of a course's design. After the selection of patterns, the tool generates a design specification for the web-based course based on these patterns. We believe this design specification could be integrated into an authoring tool to support the instructor in developing the course based on the design decisions.

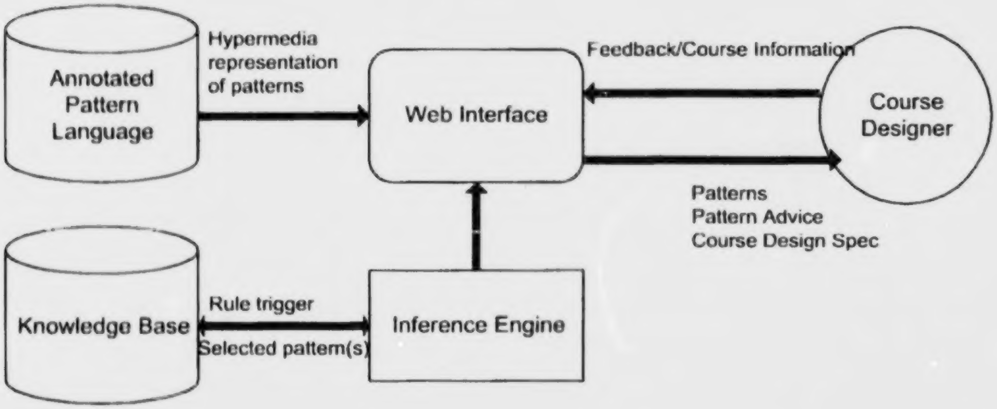
Annotated Pattern Language
Hypermedia representation of patterns
Web Interface
Feedback/Course Information
Course Designer
Patterns
Pattern Advice
Course Design Spec
Knowledge Base
Rule trigger
Selected pattern(s)
Inference Engine

Figure 2: Design Environment

5. Conclusion and Future Work

An objective of our research is to develop an environment that fosters educators in designing instructionally sound web-based courses through the development of a WBI pattern language and a method to support the effective use of this language. We believe end-users can benefit from having a design environment that scaffolds design pattern usage for them. Instead of merely focusing on implementation issues, this environment should provide support for finding and selecting the appropriate patterns. With PatternEdge, we provide this support. Future work includes evaluations with users to assess the effectiveness of the design environment in supporting pattern usage.

6. References

Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdhl-King, I. and Angel, S. (1977). *A Pattern Language.* Oxford University Press, New York.

Anthony, D. (1995). Patterns for Classroom Education. *Pattern Languages of Program Conference.*

Beck, K. and Cunningham, W. (1987). Using Patterns languages for Object-Oriented Programs. *OOPSLA Workshop on Specification and Design for Object-Oriented Programming.*

Borchers, J. (2001). *A Pattern Approach to Interaction Design.* John Wiley & Sons.

Bork, A. and Britton, D.R. (1998). The Web is Not Yet Suitable for Learning. *Computer*, 31(6), (pp. 115-116).

Budinsky, F.J., Finnie, M.A. Vlissides, J.M., and Yu, P.S. (1996). Automatic code generation from design patterns. *IBM Systems Journal*, 35(2).

Chambers, C., Harrison, B., and Vlissides, J. (2000). A Debate on Language and Tool Support for Design Patterns. *Pattern Languages of Program Conference*, Boston, MA.

Frizell, S. (2001). A Pattern-based Design Methodology for Web-based Instruction (Thesis Research Proposal). Auburn University.

Gamma, E., Helm, R., Johnson, R. and Vlissides, J. (1995). *Design Patterns: Elements of Reusable Object-Oriented Software*. Addison-Wesley.

Gelfand, N., Goodrich, M., and Tamassia, R. (1998). Teaching Data Structure Design Patterns. *SIGCSE*, ACM Press.

Kessler, G.C., Rosenblad, K., and Shepard S.D. (1999). The Web Can Be Suitable for Learning. *Computer* 32(2), (pp. 114-115).

Prechelt, L., Unger, B., and Schmidt, D. (1997). Replication of the first controlled experiment on the usefulness of design patterns: Detailed description and evaluation (Technical Report Wucs-97-34). Washington University.

Rossi, G., Schwabe, D., and Garrido, A. (1996). Towards a Pattern Language for Hypermedia Applications. *Proceedings of the Third Annual Conference on Pattern Languages of Programs*.

Schmidt, D.C. (1995). Experience Using Design Patterns to Develop Reusable Object-Oriented Communication Software. *Communications of the ACM, Special Issue on Object-Oriented Experiences*, 38(10).

Shih, T., Chang, S. and Arndt, T. (2000). Database Support of Web Course Development with Design Patterns. *First International Conference on Web Information Systems Engineering (WISE'00)*, IEEE.

Thomas, J. (2000). Applying Patterns to Hypermedia Instructional Design (APHID). PhD Thesis, Department of Computer Science, University of Saskatchewan, Saskatoon, UK.

Vygotsky, L.S. (1978). *Mind in Society*. Harvard Press.

Clio's Assistants
A Tool Suite for Exploring Student Web Usage

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Abstract: Since the inception of the World Wide Web, faculty members have been developing online course materials. However, there is little careful analysis of how students use these Webs. In particular, do more successful and less successful students use course webs and associated materials differently? Are usage patterns similar to those of printed resources, or do students explore materials differently on the Web? To answer questions like these, educators and researchers need tools that allow them to closely examine student use of Web materials. Building upon user tracking tools that gather information on student usage, including the time each reader arrives at and spends on each page, the use of multiple windows, and the links followed from page to page, we implemented *Clio's Assistants* a customizable suite of tools that permit exploration of student Web usage patterns both graphically and textually. The graphical tools include simple bar charts, customizable directed graphs, and "replays" of student sessions. Textual tools include simple statistical summaries, human-readable log files, database queries, and an advanced pattern matching language. Through these tools, one can identify and explore patterns of Web usage.

1 Introduction

Although a number of tools are used to create educational computing resources, the World Wide Web (Berners-Lee et al. 1994) is perhaps the most popular mechanism for creating computerized educational resources. The Web provides many advantages, including easy design of documents, "universal" access (most Web pages can be accessed from anywhere on the Internet), and the ability to incorporate local and remote documents in a course Web.

Students use course Webs in a variety of ways. For example, some students explore course webs using only one window while others open multiples windows (e.g., one to hold the current problem being studied, another to hold reference materials, and a third to hold current news). Similarly, some students will visit each link on a page while others will be very careful in their selection of links. Are there patterns that successful students seem more likely to use? Do students' usage patterns evolve over time? And, perhaps most importantly, can less successful students benefit from using the patterns of more successful patterns?

Scholars cannot answer any of these questions until there are ways to identify and explore these usage patterns. The goal of Project Clio is to provide tools that allow analysts to identify and experiment with usage patterns. Clio works in three phrases: gathering (Clio's Watchers), synthesis (Clio's Accountants), and analysis (Clio's Assistants). Clio's Watchers are a collection of tools that gather information while a student is browsing the Web. By using the Web Raveler architecture (Kensler and Rebelsky 2000), Clio's Watchers are able to gather information on student usage whether students are on a local or remote site. Because the data gathered by Clio's Watchers are repetitious and make some information (such as time on page) implicit, Clio's Accountants convert the raw data into more useful data that are then stored in a relational database. Finally, Clio's Assistants provide customizable ways to explore those data. The key aspects of Clio's Watchers are that they gather data for a group of individuals (e.g., all members of a course) and that the gather data for all pages those individuals visit, whether they are local or remote.

Clio's Assistants provide the focus of this paper. In Section 2, we describe the primary assistants. In Section 3, we describe a typical interaction with Clio's Assistants. In Section 4, we compare Clio and Clio's Assistants to other hypertext analysis tools. In Section 5, we revisit the need for Clio and Clio's Assistants. Finally, in Section 6, we consider future directions for Clio.

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2 Clio's Assistants: The Suite of Tools

The Clio's Assistants Tool Suite is a collection of tools, both graphical and textual, that allows analysts to explore the ways in which students use the Web. At the core of this exploration is the notion of classification. Although Clio's Assistants permit analysts to explore usage of individual pages (e.g., How long did the average student spend looking at exercise 3?), most assistants allow analysts to consider groups of pages (e.g., When confronted with an exercise, what kind of page did student X most likely visit before entering an answer? Or From what pages were students more likely to leave the local course Web?). The classification of pages is relatively straightforward: For each class of pages, the analyst enters (1) one or more patterns (e.g., "all pages whose URL begins with http://www.cs.grinnell.edu/~rebelsky/Examples/"), (2) a classification (e.g., "Examples") and (3) a shorthand for the classification (e.g., "E"). Classifications are stored permanently in the system. Links may be classified in two ways: by the internal link type (the REL attribute) or by pairs of patterns. Because links depend closely on the particular pages used (e.g., while a link from sect3.5.html to sect2.4.html in the same directory is probably a "prerequisite information" link, not all links between sections are prerequisite links), internal link types are preferred.

Once analysts have classified pages, they may explore the usage logs with both graphical and textual tools. These tools range from simple summaries (textual and bar charts) to complex representations of the data (e.g., as a directed graph or animation over time). Direct access to the "nearly raw" data is also available. In the following paragraphs, we describe the tools in more detail.

Bar Chart: Simple Graphical Summaries Often the best way to begin exploration of data is with a simple overview of the most "popular" parts of a site. Bar charts concisely represent a large amount of data in a simple and quick way. The Bar Chart tool permits analysts to quickly explore a number of comparative relations. For example, bar charts can be generated for number of visits versus URLs (for a group of students) to get a feel for which pages students visit most often, or time spent versus classification to explore how students are dividing their time. We are currently exploring ways to let analysts explore the data within each bar of the chart. For example, upon finding that students spend a lot of time on example pages, an analyst might then ask to see a bar chart of the more popular URLs for example pages.

Summary Statistics: Simple Textual Summaries While the Bar Chart tool provides a general overview of popularity, the overview is limited to one type of thing (URLs, Classification, etc.). The Summary Statistics tool generates a variety of statistical information about the browsing session of a particular user or multiple users. While we are currently exploring the most appropriate information to provide, it currently provides the mean and median time spent on pages, most visited URL, most visited Web domain, most visited classification, and similar data.

Slideshow: Graphical Replays When exploring the patterns of a single student, it is sometimes most useful to watch exactly what the student did: what pages did she visit and in which order, with which on the screen simultaneously. While it would be best to be able to watch over the students shoulder, the Slideshow tool provides a reasonable substitute in that it "replays" the original Web pages visited by the students chronologically, with multiple simultaneous pages shown in different frames. This display is supplemented with additional information, such as time spent on each page and the referring page. This tool is particularly useful when the content of the page, and not just the classification, is of interest.

Directed Graph: Complex Graphical Summaries The tools described so far provide only basic information about usage. How can an analyst find more complex patterns? The Directed Graph tool provides users with a more sophisticated graphical means of examining a browsing history. A directed graph consists of nodes (dots) and directed edges (arrows) that are used to illustrate Web pages and link between those pages, respectively. Different characteristics of the nodes and edges can be set to correspond to different aspects of the pages and links. For example, different colors might represent different classifications and different node sizes might represent different amounts of time spent on a page. Similarly, the color of a link might represent its classification. Alternately, the color of a node might represent the sequential time at which it was visited (making it easier to consider patterns involving multiple windows; similarly colored nodes are likely onscreen at the same time).

Each of a node's four characteristics can be associated with one of eight attributes of the corresponding Web page. The node characteristics are color, size, horizontal position, and textual label. Page attributes include URL, classification, site, title, sequence number (in terms of pages visited in current window), arrival time, maximum time on page, and total time on page. At present, each link has only one customizable characteristic, its color. The color may represent link type, sequence number, or number of times the link was followed.

Each node of a directed graph represents a distinct (window, URL) pair. The directed graph is displayed in one of two frames, with the second frame being reserved for node information. When a node is clicked on, information such as number of page visits, timestamps and URL all become visible in the second frame. Also located in this frame are controls for zooming in and out on the entire graph.

The directed graph may prove beneficial to those who can most easily see patterns with the aid of visuals. Because many nodes and edges can all be examined quickly, patterns of usage become apparent to the user. Combining the graphical means of pattern exploration with the highly customizable attributes of the graph, the directed graph can be an excellent tool for pattern analysis.

Pattern Matching: Complex Exploration of Log Files Once an analyst has identified a pattern through one of the previous tools (e.g., they may see one student who follows many links, but often backtracks, as if they followed the wrong link) or through speculation (e.g., one might postulate that good students always check prerequisite links; the best students quickly realize that they know the prerequisite material and return to the page), analysts may then wish to explore when and how often that pattern occurs within the browsing history of a single student or the class. The Pattern Matching tool is particularly useful for searching through the logs of all students being tracked and letting the analyst see how many and who are following a certain pattern. For example, consider the following sequence of events:

1. The student went to a 'Search Engine' page.
2. The student went to a 'Search Results' page for less than ten seconds.
3. The student went back to a 'Search Engine' page.

This pattern would most likely indicate a failed search. Because the Pattern Matching tool relies on classifications, failed searches can be found at Yahoo and Lycos, not just Google. The Pattern Matching tool has a small language embedded in it that shortens queries to just a few characters. For example, the pattern above would be written in this language as `'SE/SR{<10}/SE'`. SE here stands for Search Engine, SR for Search Results, the '/' indicates, "and then," and the brackets indicate a time interval. The Pattern Matching language provides a number of other special patterns, including an "or", an "at the same time as" and even a way to classify pages on the fly. The results are returned as time intervals for a particular user, and links are provided to the directed graph, the log file, and the slideshow.

We consider the time-on-page pattern particularly useful as it helps one distinguish between apparently similar by actually dissimilar navigation strategies. Consider the pattern "Problem, Reference Page, Example". A student who follows that pattern may be one who wants to read the reference completely and then view some examples. It could also be one who is simply using the reference page as a quick way to get to an example because there is no link to an example from the problem. How can you tell the difference? If the student spends a lot of time on the reference page, the student is probably reading the page. If the student spends only a short amount of time on the reference page, the student is probably using the page as a quick way to get to an example.

"Nearly Raw Data": Log Files and Database Queries As we worked to develop these tools, we interviewed a number of faculty members and instructional multimedia technology specialists to see what features they might want. A few noted, in effect, "While I'd probably use your tools for my initial exploration, I really want access to the raw data for my final analysis". Viewing the log files is another means of analyzing the information available in our database. The log file can be downloaded in CSV format or viewed online. CSV files can be viewed in many spreadsheet programs. Online viewing allows for the creation of links and the ability to link between the various Clio Analysis tools. One can sort and select the data chronologically or by any other information displayed.

Because the data are stored in a relational database, we also expect to provide a mechanism for direct database queries using SQL. However, that remains a future goal.

3 Extended Example

Let us consider a sample session in which one uses Clio's Assistants to explore students Web use. Professor Peabody is interested in studying where and how his students find their information for a particular assignment. Peabody asked his students to turn on Clio while searching for answers on the Web. (For issues of privacy, he first discusses the uses of Clio with the students and obtains their permission.) Several days later, the professor has his students turn in their solutions to their assignments as well as stop using Clio. He then accesses the analysis tools with his favorite Web browser and begins using Clio's Assistants.

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Peabody begins by viewing the log files of his students. The information presented to him appears as a series of rows with information about each page the students visited. Having received permission to correlate homework scores with student identifiers, Peabody notes that Student 5 did a wonderful job on his homework and he now views the log file just for Student 5. Because Peabody believes that the log file contains the most information, he begins there. A quick scan of the beginning of the file shows that Student 5 spent a lot of time on the reference pages. However, as Peabody jumps to the end of the file, he sees that most of the entries there are for examples. Two questions quickly arise: Did Student 5's exploration change over time and what kinds of pages did Student 5 use most, the early reference pages or the later example pages?

The second question is perhaps the best place to start. Professor Peabody selects the Bar Chart tool and asks for a comparison of number of visits vs. classification. Both examples and reference pages appear quite frequently. However, Professor Peabody is stunned to see that the most-visited classification was "Course Front Door" and the second most-visited classification was "Search Engine". Two new questions arise: Why did Student 5 revisit the course front door again and again? Was he lost in cyberspace? Perhaps more importantly, why did Student 5 use search engines so frequently?

Peabody asks for summary statistics for Student 5 on the front door. He sees that the average time spent on the page is less then twenty seconds and that the most common referring page is "no referrer". What does that mean? It probably means that Student 5 makes it a habit to jump back to the start of the course web when moving on to new information. Perhaps Student 5 likes to ground his exploration from a comfortable place. A quick check of the directed graph shows a pattern that looks very much like what he postulated: lots of long straight trails that begin with the front door. Is this answer conclusive? No, the best way to find out more is to speak with the student, as in the work described in (Jones and Berger 1996).

Now Professor Peabody wonders what the student was searching for outside of the course web. He sets up a pattern to request all sequences of the form "Search Engine, Results Page, Any Other Page". He expects that by scanning the pages received, he will obtain additional information on what kinds of things Student 5 was looking for. He notices two things. First, that many of the search results that Student 5 selected are within his course web. That suggests that the student is just using the search engine to find pages with the course web. Is that an indication that the links on his pages aren't good, or that Student 5 prefers to search rather than to use links? Another reason to talk to the student. The other thing Professor Peabody notices is that many of the other results are all within a certain domain. It's probably worth exploring whether he should make direct links to those pages.

Before going on to other things, Peabody decides to revisit the question of whether students need a search engine to find pages within his course web. He looks through all students for the pattern "Search Engine, Results Page, Page in My Course Web". He finds that Student 5 is the only student who uses that pattern. Now it's time to consider whether or not that's a technique he should suggest to other students.

4 Conclusions

Most discussions of the World Wide Web in education focus on the direct benefits the Web provides for students: Easier access to material, ability to explore material at the speed and in the manner that best suits the student, availability of a greater variety of materials. Project Clio provides a very different benefit: Clio's goal is to help faculty understand, through data analysis, the pattern and personality of students' usage of the World Wide Web. For Clio to fully assist in the analysis of data, Clio must allow the analyst to explore the various patterns of learning that individuals undergo. Such learning patterns include: active and passive approaches to discovery (Dufresne and Turcotte 1997) and different searching methods (Jones and Berger 1996). By providing a suite of tools that take learning styles into account, we are expanding the boundaries of this underdeveloped area of research. We hope that once scholars are able to identify successful patterns, those patterns can be incorporated into Web sites and taught to less successful students.

The greatest strengths of the Clio's Assistants tool suite are: (1) the diversity of tools available; (2) the interconnectedness of the tools, which permits the results of one tool to be used in another; (3) the ability to record information for a number of students on arbitrary sites, (4) the customizability of the tools, particularly the directed graph tool; (5) the support for information not commonly available, such as time on page and the use of multiple windows; and (6) the richness of the pattern matching language.

5 Future Goals

The first goal of the Clio team is to try the tools in a real classroom situation. We are currently negotiating with some faculty to classify their pages and require their students to use Clio. However, such trials require a more robust version of Web Raveler (*currently under development*) and a careful consideration of the impact on students. We expect to gather our first data in Fall 2002 and analyze it in the subsequent semester.

Many of the Clio Assistant tools need to be expanded. For example, the Log File tool should be expanded to allow an analyst to select portions of the log file so as to "dig in" to particular parts or patterns. For example, one might first select just the entries for a particular day, then just a particular classification. At the more advanced end of the spectrum, we are hoping to animate the directed graphs so that one can see the graph expand over time, providing an alternative to the slideshow and giving another node characteristic (that is, when the node appears on the screen). We also expect that an animated directed graph will help reveal important aspects of sessions in which students return to certain pages repeatedly.

We are also considering other appropriate tools. As suggested earlier, we are considering ways to give direct SQL access to the data and looking for interesting queries that one might want to make using SQL. We are also considering whether it might be appropriate to present logs in some form of 3-dimensional "world", in which there would be additional opportunities to represent attributes of pages and links (Kmiec et al. 2002). Since the current tools rely on the intuition of those using the tools to find patterns, we are also looking at ways to use data-mining techniques to automatically find pattems (Pinchback et al. 2002).

Finally, we need to consider some subtle issues in more depth. For example, there is a question as to whether a page can receive multiple classifications. For the purpose of the pattern-matching tool, it makes sense to permit a page to be classified in many ways. However, for the directed graph tool, it seems that only one classification can be used at a time (if an example is red and a page about topic X is green, what color should an example about topic X be?). We expect that these kinds of issues will be revealed and clarified as the Clio Assistants are used by a variety of analysts.

References

Becker, R., McLaughlin, K., and Rebelsky. S. A. (1999). Project Clio: Tools for Tracking Student Use of Course Webs. In B. Collis and R. Oliver (Eds.), *Proceedings of the EdMedia 99 World Conference on Educational Multimedia, Hypermedia, and Telecommunications* (Seattle, Washington, June 19-24, 1999), Charlottesville, VA: Association for the Advancement of Computing in Education, pp. 981-986.

Berners-Lee, T., Cailliau, R., Luotonen, A., Nielsen, H.F., and Secret, A. (1994). The World-Wide Web *Communications of the ACM* August 1994 Vol. 37, No. 8, pp. 76-82.

Dufresne, A. and Turcotte, S. (1997). Cognitive Style and Its Implications for Navigation Strategies. In B. d. Boulay, & R. Mizoguchi (Ed.), *Artificial Intelligence in Education: Knowledge and Media in Learning Systems.* Amsterdam: IOS Press, pp. 287-293. URL: http://www.crim.ca/.ipsi/articles/cognitive.pdf. (Accessed May 30, 2001).

Heck, R., Nanjiani, K., Raulerson, E., and Staicut, I. (2000). Clio: Creating History. Unpublished manuscript, August 2000.

Hong, J. and Landay, J A. (2001) WebQuilt: A Framework for Capturing and Visualizing the Web Experience. In *Proceedings of the 10th World Wide Web Conference* (May 1-5, 2001 Hong Kong). URL: http://www10.org/cdrom/papers/602/index.htm (Accessed May 25, 2001; Last modified 15 March 2001).

Jones, T. & Berger, C. (1996) The Pursuit of Knowledge: Interviews and Log Files in Hypermedia Research. In P. Carlson and F. Makedon (Eds.) *Proceedings of the EdMedia'96 Conference on Educational Multimedia and Hypermedia* (Boston, Massachusetts, June 17-23, 1996). Charlottesville, VA: Association for the Advancement of Computing in Education, pp. 342-7.

Jones, T. & Jones, M. (1997) MacSQEAL: A Tool for Exploration of Hypermedia Log File Sequences. In T. Muldner and T. Reeves (Eds.) *Proceedings of the EdMedia'97 Conference on Educational Multimedia and Hypermedia* (Calgary, Canada, June 14-19, 1997), 1997. Vol. 1. Charlottesville, VA: Association for the Advancement of Computing in Education, pp. 539-44.

Kensler, A. and Rebelsky, S. A. (2000). Web Raveler: An Infrastructure for Transforming Hypermedia. In J. Bourdeau and S. Heller (Eds.) *Proceedings of the EdMedia 2000 World Conference on Educational Multimedia, Hypermedia, and Telecommunications* (June 26-July 1, 2000, Montreal, Quebec, Canada), pp. 479-484. Charlottesville, VA: AACE, 2000.

Kmiec, A., Koomjian, J., Lindsey, D., and Rebelsky, S. A. (2002). Clio's Worlds: Three-Dimensional Visualizations of Student Web Usage. Poster abstract accepted to EdMedia 2002 World Conference on Educational Multimedia and Hypermedia (June 24-29, Denver, Colorado).

Pinchback, M. P., Stoltzfus, R., Tiwari, A., and Rebelsky, S. A. (2002). Clio's Intuition: Using Data Mining to Find Patterns of Student Web Usage. Poster abstract accepted to EdMedia 2002 World Conference on Educational Multimedia and Hypermedia (June 24-29, Denver, Colorado).

Raulerson, E., and Staicut, I. (2000) Clio: A Course Web History Analyzer. Public presentation, Pew Midstates Science and Mathematics Consortium Undergraduate Research Symposium in Mathematics and the Physical Sciences (St. Louis, MO, November 5, 2000).

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Mathematics Teacher Education Online

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Abstract: Despite major differences in course delivery, the critical components of effective online mathematics teacher education may not be different from the critical components of effective face-to-face mathematics teacher education. Research indicates that components of effective mathematics teacher education include (a) aesthetic experiences with mathematics, (b) confronting personal beliefs about mathematics, (c) engaging in practical inquiry, and (d) discussing pedagogical implications in the context of mathematics education literature. This paper describes the case of an online mathematics education course for in-service elementary teachers, and discusses issues of design and effect of online experiences.

Introduction

McGowen & Davis (2001a) suggest that we need an "antidote" to teachers' conceptions of mathematics as learning procedures and getting right answers. Findings show that such conceptions are consistently associated with observed practice of teachers (McGowen & Davis 2001a, 2001b; Stipek et al 2001) and that teachers who hold such conceptions of mathematics have lower teacher self-confidence and enjoy mathematics less than teachers who hold inquiry-oriented conceptions (Stipek et al 2001). Attempts to change teachers' mathematics conceptions and teaching practice through teacher education and professional development programs focusing on inquiry-oriented mathematics instruction "are minimally effective, in part because teachers filter what they learn through their existing beliefs" (Stipek et al 2001, 214). Teachers assimilate new ideas without substantially altering existing beliefs that drive their practice (Cohen & Ball 1990). In terms of affecting classroom practice, the new ideas are either ignored or they are interpreted and distorted through the lens of existing beliefs. In this paper we posit that instruction needs to provide critical experiences that lead teachers to pedagogical thinking and practice that enable them to move towards an inquiry-oriented conception of mathematics.

Critical Experiences

Critical experiences may be defined as those experiences that cause teachers to reflect on their knowledge, experience and beliefs and help them see mathematics and mathematics teaching in a new light. When moments of epiphany occur, mathematics education artifacts – such as past experiences, curriculum documents, classroom situations, ideas from professional development workshops, from education articles, and so forth – can be seen as inkblots in which the image (or idea) appears to shift and teachers see something new, something that was not apparent to them before. As one teacher in one of our studies commented, "I feel like [this experience] has cleaned my spectacles and I am reading the [curriculum] document with new vision". Similar findings are reported in a study by McGowen & Davis (2001b) where one teacher noted that the experiences provided in a course of study "opened my eyes to a new outlook on mathematics" (444).

In our research we have concentrated on aesthetic aspects of critical experiences. Contrary to the usual alignment of "critical" with "rigorously intellectual", participants in our study demonstrate that critical engagement occurs within an aesthetic context (Gadanidis, Hoogland & Hill 2002). This was true for teachers with diverse mathematical backgrounds and attitudes that ranged between positive and negative. It is interesting to note that although aesthetic qualities of critical experiences for mathematics teachers are not explicitly identified in related studies, aesthetic qualities are in some cases implied. For example, McGowen & Davis (2001b) make use of phrases such as "we focused on a […] beautiful experience in establishing connections" (439) and "the atmosphere […] was electric" (440) to describe aspects critical experiences for mathematics teachers.

Research on mathematics teacher development (Cohen & Ball 1990; Gadanidis, Hoogland & Hill 2002; McGowen & Davis 2001a, 2001b; Stipek et al 2001) indicates that the following are integral components of critical experiences:

- Teachers confront their beliefs about mathematics.
- Teachers have aesthetic experiences with mathematics.
- Teachers engage in practical inquiry.
- Teachers consider pedagogical implications in the context of relevant mathematics education literature.

Design and Effect of an Online Course

The discussion of the design and effect of a full-credit additional qualification online mathematics education course for elementary in-service teachers [referred to hereafter as Online Course] is organized around the four components of critical experiences outlined above. It should be noted that although the design of the course incorporated these components, the components were explicitly identified after the course was designed and taught. The original design of the Online Course was based on successful learning experiences for teachers that emerged from face-to-face professional development sessions. In the discussion below we highlight the design similarities between the Online Course and the face-to-face professional development sessions that inspired the design of the course. We hope to illustrate that the components of critical experiences for mathematics do not depend upon a particular environment – be that face-to-face or online. Rather, that critical experiences depend upon the quality and nature of instruction as identified above.

Prior to developing the Online Course the instructor was a mathematics consultant for a large school district, dealing mostly with elementary mathematics program design and teacher development. This experience reinforced research findings that many elementary teachers view mathematics as procedures to be learned for getting right answers (McGowen & Davis 2001a, 2001b; Stipek et al 2001). One of the goals of district-wide professional development was to help teachers become aware of these beliefs and to examine them critically. Bringing teachers face-to-face with their unexamined beliefs about mathematics involved more than simply telling or showing teachers what mathematics is really like or how it may be different from their personal beliefs. Teachers were provided with opportunities to personally experience aesthetically-rich mathematical contexts, which were different than the teachers' historical experiences with mathematics or the experiences they may have been providing for their own students. Likewise, teachers in the Online Course were provided with similarly aesthetic mathematics experiences. Such experiences created a reflective context for examining personal in both the face-to-face and the online environments.

Experiencing aesthetically-rich mathematics does not have to involve complex mathematics, especially for elementary teachers. Some of the mathematics experiences in the Online Course involved teachers in mentally solving arithmetic problems such as 16 x 24 and 156 + 78 + 9 (see Activities 1 & 2 in Figure 1). These activities were chosen based on their positive effect in previous face-to-face workshops conducted for elementary teachers and parents. In such workshops, typically half the people in each group were asked to solve a problem like 16 x 24 or 156 + 78 + 9 in their heads and half the people to use pencil and paper. After a few minutes, people shared and explained the methods they used in their groups. Then the discussion was opened up and people shared and explained other methods. It quickly became apparent that the people who used paper and pencil methods had little to say. One reason for this was that most people used the same procedure. Another reason was that although they were able to describe the procedure they followed, they often were not able to explain why. Some people reverted to statements like "this is how it works – it's just a rule". On the other hand, people who solved the problem in their heads shared a variety of methods and they understood what they were doing and why they were doing it. They displayed pride in their individual approaches to problem solving. There was an excitement about mathematical thinking in the room, with people eager to share their personal methods and quick to express surprise and praise for unique methods that others shared. A palpable energy was created in this exchange.

We suggest that the experience of mentally solving 16 x 24 or 156 + 78 + 9 is aesthetically rich in that the mental processes involved do not demand rule-based procedures. How people solve 16 x 24 depends greatly on how they personally interpret the problem. For example, some people may multiply 16 and 25 and then subtract the extra 16. Others may deconstruct the problem as 10 x24 + 6 x 24. Many other solutions processes are possible – even ones that use algebraic structures like (20 - 4)(20 + 4). Given such problems, people are eager to share their solutions, they express interest and sometimes surprise in the solutions of others, and are motivated to try to come up with different solution processes. Open-ended inquiry, interest, surprise and motivation are characteristics of an aesthetic approach.

Teachers in the Online Course noticed that their mental solution processes were "different than when I did it with paper and pencil because I solved my problem by starting with the bigger numbers first (left to right, not right to left!)". Such experiences appear to have helped teachers move towards questioning traditional views of mathematics and developing a deeper understanding of what constitutes mathematical activity and mathematical understanding in the context of addition and multiplication. "To me, the implications are that doing arithmetic mentally requires real understanding. The traditional way (on paper, doing the "ones" first) is more of a procedure to be memorized that requires little understanding".

In face-to-face professional development, practical inquiry was facilitated through a double-session structure. Between sessions tried out new ideas in their classrooms and shared their experiences and reflections in the second session. Teachers were encouraged to bring to the second session samples of student work. Many of the insights that teachers gained and shared arose from observations of students doing mathematics and thinking mathematically in the context of the new ideas that teachers tried in their classrooms. The Online Course involved teachers in practical inquiry in that teachers were asked to explore the thinking of others, including the thinking of their own students, in mentally solving problems like 16 x 24 and 156 + 78 + 9 (see Activity 3 in Figure 1). They shared and reflected on these observations in online discussions. Many of the teachers tried the problems with their students and discovered that they too used a variety of methods, and usually not standard paper and pencil procedures. This helped teachers realize that their mathematical thinking as adults was similar to that of their students and different from the standard paper and pencil procedures. Teachers were impressed by the creativity of student answers and questioned their reliance on paper and pencil procedures.

Asking teachers in the Online Course to mentally solve problems like 16 x 24 and 156 + 78 + 9 and to share their solution processes also offered opportunity for practical inquiry into the nature of mathematics and doing mathematics. This set the context for discussions of related pedagogy. However, one would expect that practical inquiry would also involve experimenting with teaching practice, which was not a requirement of the Online Course. Unlike the face-to-face professional development described above, the Online Course did not explicitly ask teachers to experiment with new teaching ideas in their own classrooms. This is something that will be reconsidered when redrafting the Online Course.

In face-to-face professional development sessions, ideas from mathematics education literature were shared and discussed. The Online Course gave teachers the opportunity to read such literature. Two articles about children inventing personal algorithms for arithmetic operations (Burns, 1994; Kamii et al, 1993) provided a context for teacher reflections on their thinking when mentally solving problems like 16 x 24 and 156 + 78 + 9 and for considering pedagogical implications. "To guide your thinking" questions (see Figure 1) directed teacher attention to pedagogical issues. In contrast to the face-to-face professional development sessions where ideas verbalized may be forgotten, an advantage of the Online Course was the 'permanent' record of discussions. Many teachers revisited past discussions and created scrapbooks of 'good ideas' by copying sections of online transcripts in word processing documents. As was the case in the study by McGowen & Davis (2001b), teachers made important connections between their experiences and ideas in the articles they read.

> I do agree with Kamii and Burns' points of view. I think that by having the student discover a successful method they will be more likely to internalize and understand the concept. In coming up with their own methods they are doing the thinking the way their mind works. We can see [in our discussion] that everyone processes things differently.

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Discussion

Research indicates that many teachers are unaware that an alternative to a procedural view of mathematics exists (McGowen & Davis 2001b). The interplay between the mathematics experiences, journal readings, online reflections, and discussions created for many of the teachers in the Online Course a critical experience that helped them 'see' mathematics and mathematics teaching in a new light. As one teacher commented,

> After seeing how different people calculate, I better understand this last overall expectation in [the curriculum document]. Hmph! It is not until I do something myself, do I more fully understand the language and what the curriculum is really driving at. Thus students need to explore different ways of doing calculations, talk about it, communicate their ideas in a variety of ways. I feel like [this experience] has cleaned my spectacles and I am reading the document with new vision.

A critical aspect of the Online Course was that teachers confronted their personal beliefs about mathematics and mathematics teaching in the context of practical inquiry with aesthetically-rich mathematics problems. In solving such problems, in observing students solve them, and in sharing, comparing and discussing solutions teachers realized that mathematics problems might be solved in many different ways. Another critical aspect was the reading and discussing journal articles that placed such experiences in the broader context of mathematics pedagogy. Online discussions allowed the personal kind of sharing that created community. This is not to suggest that such critical experiences created changes in teachers' perceptions of mathematics and mathematics teaching that were comprehensive or permanent or that significantly affected their classroom practice. How teachers teach is also greatly affected by accepted teaching practices in the wider school community (Buzeika, 1999; Ensor, 1998) and by conflicting priorities (Skott, 1999). However, such critical experiences, whether they are in online or face-to-face teacher education or professional development settings, may be important starting points for change in classroom practice.

Conclusion

There are important characteristics of online learning such as text-based communication and asynchronous discussion that distinguish it from face-to-face learning. However, the cases of the Online Course and the face-to-face professional development discussed above indicate that the components of critical experiences transcend such differences. These components include (a) aesthetic experiences with mathematics, (b) confronting personal beliefs about mathematics, (c) engaging in practical inquiry, and (d) discussing pedagogical implications in the context of mathematics education literature. We believe that in the design of online courses for mathematics teachers, the primary focus of teacher educators should be not on the technological differences but, rather, on the quality and the components of the critical experiences.

A. How do you think mathematically?

Let's take a close look at how your mind performs arithmetic operations. Try the following activities:

Activity #1:

- Multiply 16 and 24 in your head.
- Record the process you followed.
- Now multiply 16 and 24 on paper using the procedure you were taught in school.

Activity #2:

- Add 156, 78 and 9 in your head.
- Record the process you followed.
- Now add 156, 78 and 9 on paper using the procedure you were taught in school.

Activity #3:

- Ask someone else (a student, a teacher, a friend) to solve the following and then tell you the processes they used:
  - Multiply 16 and 24 in their head.
  - Add 156, 78 and 9 in their head.

To guide your thinking:

How are the processes you use to multiply or add in your head similar to or different from the paper and pencil procedures you were taught in school for multiplying or adding?

B. Jean Piaget

Jean Piaget, who spent a lot of time researching the mathematical thinking of young children, said that there are three types of knowledge (Kamii et al 1993):

1. **Physical knowledge:** This is the knowledge of our physical environment. For example, colours of objects, or the fact that an apple falls when you release it from your hand.
2. **Social knowledge:** These are, in part, the rules and conventions that we make up to make our social life run smoothly. For example, we all agree that a red traffic light means stop. Social knowledge is to some degree arbitrary. For example, we could all agree to stop on a green light and go on a red light.
3. **Logico-mathematical knowledge:** This is the knowledge of relationships. This knowledge allows us to see patterns and make connections in situations. For example, we can see two circles as representing a pair of glasses, the number eight, or a snowman. Or, when considering the following question, we can see different relationships that lead to different answers: Which one of the numbers 3, 4, 5, and 7 does not belong?

To guide your thinking:

Think about the procedures you learned in school for multiplying or adding numbers on paper. Which type of knowledge do they represent? Why?

Think about the processes you used earlier for multiplying or adding numbers in your head. Which type of knowledge do they represent? Why?

Think about the mathematics you learned in school. How would you classify it in terms of Piaget's knowledge categories? Can you identify some examples in each category?

Figure 1. Online course experiences.

References

Burns, M. (1994). Arithmetic: The last holdout. *Phi Delta Kappan, 75*(6), 471-476.

Buzeika, A. (1999). Teachers' doubts about invented algorithms. In O. Zaslavsky (ed.) *Proceedings of the 23rd Conference of the International Group for the Psychology of Mathematics Education*, (Volume 2, pp. 161-168). Haifa, Israel: PME.

Cohen, D.K., & Ball, D.L. (1990). Relations between policy and practice: A commentary. *Educational Evaluation and Policy Analysis, 12*(3), 331-338.

Ensor, P. (1998). Teachers' beliefs and the problem of the social. In A. Olivier & K. Newstead (Eds.) *Proceedings of the 22nd Conference of the International Group for the Psychology of Mathematics Education* (pp. 280-287). Stellenbosch, South Africa: PME.

Gadanidis, G., Hoogland, C., & Hill, B. (2002). Critical experiences for elementary mathematics teachers. *Proceedings of the XXIV Annual Meeting, North American Chapter of International Group for the Psychology of Mathematics Education* (in press). Athens, Georgia.

Kamii, C., B.A. Lewis, & S.J. Livingston (1993). Primary arithmetic: Children inventing their own procedures. *Teaching Children Mathematics, 1*(9), 77-99.

McGowen, M.A. and Davis, G.E. (2001a). What mathematics knowledge do pre-service elementary teachers value and remember? In R. Speiser, C.A. Maher, & C.N. Walter (eds.) *Proceedings of the XXIII Annual Meeting, North American Chapter of International Group for the Psychology of Mathematics Education* (pp. 875-884). Snowbird, Utah.

McGowen, M.A. and Davis, G.E. (2001b). Changing pre-service elementary teaches' attitudes to algebra. In H. Chick, K, Stacey, J. Vincent, & J. Vincent (eds.) *Proceedings of the 12th ICMI Study Conference: The future of the teaching and learning of algebra* (pp. 438-445). Melbourne, Australia: University of Melbourne.

Skott, J. (1999). The multiple motives of teaching activity and the role of the teacher's school mathematical images. In O. Zaslavsky (ed.) *Proceedings of the 23rd Conference of the International Group for the Psychology of Mathematics Education*, (Volume 4, pp. 209-216). Haifa, Israel: PME.

Stipek, J.S. et al (2001). Teachers' beliefs and practices related to mathematics instruction. *Teaching and Teacher Education*, 17, 213-226.

Asynchronous Video-Based Instruction with Variable Speed Playback: Is Faster Better?

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Abstract: In the summer of 2000, Variable Speed Playback functionality was added to an asynchronous video-based accounting course at Brigham Young University. This paper reports the results of student surveys on the use and value of VSP in the course. Student feedback was exceptionally positive on the value of being able to dynamically control the speed of their lectures-on-demand up to 2.5 times normal speed with no pitch distortion. On average, student time viewing lectures was reduced by over half, with no reduction in average quiz and exam scores.

Introduction

In recent months there has been a proliferation in higher education institutions of online lecture-based steaming media. New digital and streaming video technologies steadily facilitate the potential for increased user control over audio and video media (Galbraith 2000). Variable Speed Playback (VSP) represents a significant increase in user control over this linear medium. VSP, also known as Time-Scale Modification (TSM), or time compression, involves adjusting the duration of temporal content. From a student's perspective, VSP can be used to "speed through boring or redundant material and slow down for interesting, challenging or new portions of audio and video presentations."

In the Fall of 2001, tests began at Brigham Young University (BYU) on the 2xAV VSP plugin from Enounce Inc. (www.enounce.com). The 2xAV plugin provided a degree of control over their video-based accounting lectures that students had requested over previous semesters. When surveys were distributed to assess if student needs were adequately met with this tool, developers were caught off guard by both the overwhelmingly positive feedback received, and the average rate of acceleration employed. This feedback forced developers to research whether or not student claims of increased learning and sustained attentiveness at higher speeds were substantiated by previous research.

The research (Harrigan 2000, 1995) appears to bear out the students consensus that VSP abilities helped them stay more focused, learn more, and increased their exam scores—all at a significant time savings. One student responded, "In order to grasp everything [at higher speeds] it is necessary for me to pay closer attention. This fosters greater understanding of the course material. Since I started using the plugin, my grades have gotten better."

The Study

VSP abilities were made available to 2,400 students enrolled in a video-based, entry-level accounting course at BYU. Learners could view lectures at up to 2.5x the normal speed. Significantly, both speeding up and slowing down the audio is accomplished without pitch distortion (i.e., the sound does not sound like *chipmunks* when accelerated). A 6-item survey was made available to the students via the web-based course management system (Blackboard) Approximately 40% of course enrollees responded to the survey over the last two semesters, totaling 924 respondents (n=924).

Findings

Ninety-seven percent of students reported using the VSP functionality (acceleration) and found it very useful. The majority found that by accelerating the lecture speed to between 1.3x and 2.3x normal speed, comprehension was retained while time to move through the lesson content was decreased. Most reported accelerating during lengthy explanations or examples they felt irrelevant or redundant. One student commented that "when my attention started to wander I would speed it up and sort of 'skim' until I got to a part that I needed to pay closer attention to where I would slow it down again." The ability to *individually* control the rate of acceleration through the lesson materials appeared to be very valuable. Rather than present the lectures at a predetermined rate—perhaps at the 1.6x normal speed, students were able to find their own "sweet spot." Three non-native English speaking students were among the very few who reported not using VSP and would have been disadvantaged by fixed acceleration. One student remarked, "Initially, I listened at 1.5, then at about 1.7. . .I hypothesize that my brain was adjusting to intaking so much information. Shortly after adjusting to 1.7, I bumped up to 2.5 with no problems whatsoever. I feel that I have really been intellectually stimulated while listening at this high speed." This VSP ability is further supported by Harrigan (2000), Omoigui (1999) and Short (1977).

The study took an interesting turn upon evaluating data from the second semester. In the first semester, respondents reported using speeds from 1.3x to 1.8x, averaging out at 1.6x normal speed. Interestingly, the most recent data shows students reporting an average acceleration rate of 2.1x normal speed—reducing the time to view a lesson by over half. The highest number of students reported an acceleration rate of 2.5x. This startling increase might be attributed to a number of factors, with "ear training" being perhaps, the single most influential. "I found that the more I used it, the faster I could listen," wrote a student. "I started at 1.5 and worked up to 1.8." A 1965 study (Orr et al, 1965) noticed that listeners could tolerate acceleration up to 2.0x, but that with 8-10 hours of training, significantly higher speeds were possible. "He grows on you," said another student, "and you can understand him, even when it is at twice the normal speed. The brain is an amazing thing." Voor (1965) also found that comprehension levels of time-compressed speech increased with practice. Harrigan (2000), on the other hand, concluded that comprehension *declines* significantly with time-compression in the range of 33-50 percent. Intelligibility will decline for users at some point of acceleration, directly compromising comprehension (Heiman et al 1986). It would appear, however, that after using VSP for 3.5 months, processing roughly 52 hours of 1x video instruction, this group of students became quite conditioned to viewing lectures at unusually high rates of speed.

Other probable factors that contributied to this average speed increase between semesters, include qualities of the instructor, students and technology. Is the instructor naturally an unusually slow speaker? Does he have exceptionally good diction? Students complained about his repetition in the lectures. Does the fact that concepts were repeated, and multiple examples presented, encourage students to accelerate? They'll hear it twice more before he moves on to a new topic anyway! Is it because rewinding was so easy? When complicated or new concepts were presented, students reported that they could easily step back and hear it again–slower? Was it because students procrastinated, and were *forced* to view content at highly accelerated rates in order to pass quizzes or exams? Finally, did the combination of multiple lecture enhancements (Galbraith 2000) employed in the course (video of professor-body language, supporting synchronized slides and animations, custom navigation features) contribute to students' ability to comprehend the material at such high rates? The level to which all of these factors contributed is not known, but combined, they may proffer an explanation.

An important question yet to be analyzed is whether or not students are accelerating the lectures beyond their ability to fully comprehend the material. As if anticipating such a question, one student wrote, "very rarely would I jeopardize understanding for speed or timeliness. I found that at a faster rate, my mind wandered less than when I listened at a slower rate, because I was forced to pay attention." While mean scores did not go down for all participants in the class, was there a correlation between individual student exam scores and their reported acceleration rate? This remains to be seen, although Harrigan (1995) and Short (1977) indicate that learning and scores, in fact, increased with moderate acceleration.

Conclusion

Studies have shown that VSP is primarily desirable on information-based content rather than entertainment (Omoigui et al, 1999). Survey results clearly show the high value of the 2xAV plugin and VSP to the students in our study, where a high number of users reported viewing the lecture material at the plugin limit of 2.5x normal speed. Furthermore, the ability to intermittently decelerate and/or accelerate lectures according to individual comprehension level and interest, has the potential to fundamentally change the nature of video from a traditionally, "lean back" and "passive" medium, to a "lean forward," "active" instructional medium.

It is perhaps arguable whether such an amount (52 hrs) of lecture-format material represents sound instructional design in any setting or course. While this may be true given some circumstances, there are a number of good reasons to incorporate such material in many courses. Regardless of one's philosophy or preference on this matter, if the lecture format is to be used in asynchronous instruction, no learner should be with out the tremendous power of variable speed playback control. "It is pure information flowing into my head without air bubbles." concluded one student.

References

Galbraith, J. (2000). Using new internet technologies to enhance the effectiveness of asynchronous video-based instruction. Unpublished Masters Thesis, Brigham Young University. 1-84.

Harrigan, K. (2000). The SPECIAL system: searching time-compressed digital video lectures. Journal of Research on Computing in Education, 33(1), 77-86.

Harrigan, K. (1995). The SPECIAL system: self-paced education with compressed interactive audio learning Journal of Research on Computing in Education, 27(3), 361-370.

Heiman, G. W., Leo, R. J., Leighbody, G., & Bowler, K. (1986). Word intelligibility decrements and the comprehension of time-compressed speech. Perception and Psychophysics, 40(6), 407-411.

Omoigui, N., He, L., Gupta, A., Grudin, J., & Sanocki, E., (1999). Time-compression: systems concerns, usage, and benefits. CHI 99, 1999, Association for Computing Machinery, Pittsburgh, PA. 136-143.

Orr, D. B. Friedman, H.L., & Williams, J.C. (1965). Trainability of listening comprehension of speeded discourse. Journal of Educational Psychology, 56, 148-156.

Short, S. (1977). A comparison of variable time-compressed speech and normal rate speech based on time spent and performance in a course taught with self-instructional methods. British Journal of Educational Technology, 8 (2),146-57.

Voor, J.B. & Miller, J.M. (1965). The effect of practice upon the comprehension of time-compressed speech. Speech Monographs, 32, 452-455.

Educational Potential of eBook Technology

Abstract

The presenter will discuss and demonstrate the current state of eBook technology. More importantly, he will share experiences with using eBook technology within the framework of existing college courses. Characteristics of this new technology, both positive and negative, in relationship to accessibility and effectiveness will be presented. Implications for educators, such as content access and intellectual property concerns, will be discussed.

Proposal

The World Wide Web has emerged as a powerful force for education. Courses and expertise can be accessed outside of the traditional bounds of a school or university. In the classroom, the web provides a seemingly endless source of information and resources. Although the Internet is increasingly becoming a delivery system for multimedia, educators continue to rely on it to deliver text-based materials.

Unfortunately, the web lacks the portability of the most traditional educational medium, the book. A popular solution is to envision students equipped with laptop computers and Internet access provided by wireless and/or wired additions to a school's network. Unfortunately, this is an expensive solution, especially when the student can acquire a more powerful, cheaper desktop system (albeit a less portable one).

In the meantime, students and faculty achieve portability by printing copies of needed web content and assignments (a wasteful, inefficient use of resources). Outside of the computer classroom and away from a home system, the student is no more "connected" or "empowered" than a previous generation carrying a similar load of textbooks and papers around campus.

An emerging, potential solution is the development of handheld electronic books (or eBooks). The term “ebook” is often used to describe portable reading devices and the content they contain. Current models are somewhat bigger and slightly heavier than their paperback counterparts. Connectivity with a computer and/or the Internet provides a ready source of material. In addition to electronic versions of traditional books, existing web pages can be downloaded and read by these devices.

Many eBooks have accompanying software that allows the presentation of the same material on any desktop or laptop system. The price of some eBook hardware has dropped dramatically over the past few years and is likely to continue to decrease as the devices become more common. One current model, which sells for just under $300, can hold 55,000 pages of text and at least 20 hours of battery use without recharging. It is likely that the use and availability of eBooks will increase dramatically, regardless of their application (or not) in education.

Unfortunately, the book and electronic media have often been portrayed as competitors for the hearts and minds of students. Traditionally, books and literacy have been closely associated with education. Electronic media are a vast wasteland and contribute to the shortening of attention spans. Consuming technology requires isolating yourself in front of a television screen or computer monitor. On the other hand, young turks promote the new media as providing richer, alternative representations of knowledge. Dusty books contain outdated information; in the information age only the uninformed have to resort to RTFM ("reading the manual").

The integration of these apparently divergent viewpoints can be realized through the proper use of eBooks. Although a traditionalist will likely bemoan the loss of a certain tactile pleasure in the reading of an electronic version of a book, it is hard to argue that a portable, virtual library of readings in the students' hands (whether in the classroom, on a bus, or under a convenient shady tree) does not enable the depth of learning formerly confined to a library or well-stocked study. Electronic books do not provide the high-tech frills associated with current desktop and laptop systems. However, the lower cost and increased portability extend the reach of available content. This economy and accessibility are important concerns for the equitable use of technology in education.

Presumably, they are more environmentally friendly than the laser-printing alternative. It has also been estimated that at least 50% of the books printed by current publishers are destroyed after failing to sell (hopefully, a significant number are recycled and not totally wasted).

The presenter will discuss and demonstrate the current state of eBook technology. More importantly, he will share experiences with using eBook technology in existing college courses. Characteristics of this new technology, both positive and negative, in relationship to accessibility and effectiveness will be presented. Implications for educators, such as content access and intellectual property concerns, will be discussed.

Performance of Remote Anatomy and Surgical Training Applications Under Varied Network Conditions

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Abstract: SUMMIT (Stanford University Medical Multimedia and Information Technologies) is currently developing hypermedia applications for remote anatomy and surgical training. These applications include interactive high-resolution 3-D imaging, 3-D streaming video and haptic (force feedback) tools to be used in both self and collaborative study modes. These applications are network-intensive and the perceived performance quality of each one changes in a different manner to varying network conditions. Part of the research conducted at SUMMIT has been focused on determining the network requirements for medical training applications like these. This paper first presents the results of experiments that study the usability of these applications as the network conditions change and then discusses the implications that these results have on the development of similar networked hypermedia educational applications and on the design of networks to be used for them.

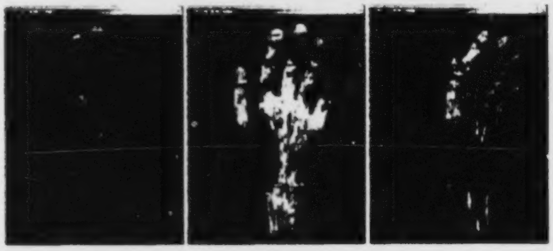
Introduction

SUMMIT is currently developing 3D applications and haptic tools that will be used for remote anatomy and surgical training. The 3D imaging applications allow, for example, anatomy students to view high-resolution images, such as those of particular body structures, in 3-D with the use of special glasses. The 3-D streaming video applications allow the broadcast of surgical procedures. These applications are greatly enhanced by adding haptic tools to them, which provide the user with a force feedback mechanism that creates the illusion of a sense of touch on the images or models. Thus, the student actually receives tactile feedback through a computerized model of a particular organ or structure, or when practicing a surgical procedure.

The ultimate goal is to be able to run these applications over the Internet. Today's Internet, however, cannot meet the demands generated by this new generation of applications as it does not offer the networking functionality and Quality of Service (QoS) guarantees necessary. As a result, a good amount of research today, such as the Next Generation Internet (NGI) and Internet2 initiatives, is focused on developing an advanced Internet that can provide enhanced functionality. While most people think of these improved networks in terms of additional bandwidth, it is important to note that there are other parameters such as packet loss, delay and jitter, which significantly affect the performance of sophisticated applications such as these. Part of the ongoing research at SUMMIT is to study the effects these network parameters have on hypermedia applications. The remainder of this paper discusses the methodology and results from tests conducted at SUMMIT to determine what minimum network characteristics are required to support this kind of applications. These results are of importance both to the network planners and to the developers of future remote educational applications.

Background

The two applications studied in this paper are the *JPEG Server* (3D-imaging) and the *AutoHandshake* (haptics). The JPEG Server application provides interactive access to high-resolution stereo image sets. An example of such a set is the full 360° rotation views of a dissection through several layers of the hand (Fig. 1). This application allows students to perform a virtual dissection of the organ or structure being studied (such as hand, leg, skull), by removing different layers (such as skin, fat or tissue). It thus helps anatomy students to gain a better understanding of organs and structures at different layers and to create better mental models of them. The JPEG Server uses the TCP (*Transmission Control Protocol*) network transport protocol to establish the session, do initial setup procedures and transmit user requests. The actual image data is transmitted using a modified UDP (*User Datagram Protocol*) that implements reliability. This reliability feature ensures that every received image is correct when displayed. Due to the high-resolution characteristic of the images, a high bandwidth network connection is required. Depending on the size and complexity of the image, the required bandwidth may go up to 40 Mbps (megabits per second).



(a) (b) (c)

Figure 1: Sample 3D-imaging pictures: (a) Hand with all layers, (b) Hand with some layers (skin, fat, etc.) removed, (c) Same image as in (b) rotated.

The other application described here, the *AutoHandshake*, is a variant of the *Handshake* application, which is intended to train students remotely in surgical procedures. This is done by using a haptic device at each end and having the instructor guide the movements of the student remotely. The AutoHandshake variant is used when no instructor is available and the movements have been previously recorded on a simulator. This application uses the TCP protocol for initial setup in the same way as the JPEG Server application and then UDP to transmit the haptic data. For this particular application however, the UDP protocol is not modified to be reliable, since there is no time to correct network transmission errors while doing a movement. Unlike the JPEG server, the AutoHandshake is a low-bandwidth application that uses only up to 128 Kbps.

Method

The purpose of the experiments was to study the performance of the 3-D imaging and haptic applications under varying network conditions. Since it is difficult to actually test these applications on different networks in different geographic locations, it was necessary to recreate the network conditions in the laboratory. To do so, software tools were used to investigate different networks in order to get an idea of how much network parameters (throughput, packet loss, delay and jitter) differ among different networks. This provided ranges of values for the parameters of each of the networks examined. A network emulator was then used to recreate these conditions in the lab. Then, by connecting the applications across the emulator, the perceived quality of the applications was evaluated as the network parameters were varied.

Network Characterization

Network performance can be described quantitatively using four basic parameters. These are: (i) *throughput*, the available bandwidth, (ii) *packet loss*, how many IP (*Internet Protocol*) data packets are lost during transmission due to congestion, link failures or other problems, (iii) *delay*, the time it takes for a packet to get from one end to the other and (iv) *jitter*, the statistical variance of the delay. These parameters vary constantly, even on the same network. For example, depending on the route a packet takes to get from one point to another, it might need to go through a different number of routers along the way leading to different delays. Also, the amount of traffic that goes through a particular router changes constantly. Thus, the amount of packets queued waiting to be serviced at each router varies constantly, causing different per packet delays and, when the buffers are full, packet loss. Due to the best effort design of the IP protocol, packet loss is not unusual.

A commercial software package by NetIQ Corp called *Chariot* was used to characterize various network connections. Chariot operates as follows: small memory resident programs called *Performance Endpoints* are installed on computers that are located on the ends of the connection being evaluated. There is also a controlling module residing on one of the endpoints or on a third-party computer. This module communicates with the endpoints and provides them with a script that simulates a particular network application, which can have a particular network transport protocol (TCP, UDP or others), data rate, session duration, packet size, etc. During the test, the endpoints measure, among other things, the average throughput, packet loss, delay and jitter and report these back to the controlling module.

For this experiment, network characterization was performed for four different types of two-endpoint network connections: a) connected across a 100 Mbps local area network, b) connected across a wireless local area network (WLAN) using the IEEE 802.11 standard, c) across an Internet connection with one endpoint at Stanford University and the other at the University of Wisconsin – LaCrosse, and d) across an Internet connection with one endpoint at Stanford University and the other at Sweden's Royal Institute of Technology (KTH). The latter two connections go through Internet2 research and education infrastructures, which provide higher performing connections than across the commercial Internet. Table 1 shows the results that characterize the four networks using the throughputs and protocols used by the two applications under study.

	JPEG Server – 10 Mbps, Reliable UDP				**AutoHandshake – 128 Kbps, UDP**			
	WLAN	100 Mbps LAN	Wisconsin	Sweden	WLAN	100 Mbps LAN	Wisconsin	Sweden
Packet Loss (%)	N/A	0.000	0.006	0.130	0.000	0.000	0.000	0.024
Delay (ms)	N/A	0.200	29.500	82.500	1.750	0.200	29.500	82.500
Jitter (ms)	N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 1: Network characterization results for different local and global connections

Network Emulation

Having obtained the values in Table 1, the next step was testing the perceived quality of each application under varying network conditions. To perform these tests using different values of packet loss, delay and jitter, a network emulator was used. The setup consisted of a gigabit fiber-optic connection between the server hosting the applications and the client computer. The network emulation occurred on a computer in the middle of the two endpoints. This computer used a public-domain network emulator software called NISTNet to manipulate the data traffic going between the two endpoints. NISTNet allows the emulator to behave like different networks by changing the values of packet loss, delay and jitter in a controlled fashion. Thus, using the values of the packet loss, delay and jitter obtained from the real networks, the emulator parameters were varied while running the applications to determine the boundaries of acceptable performance.

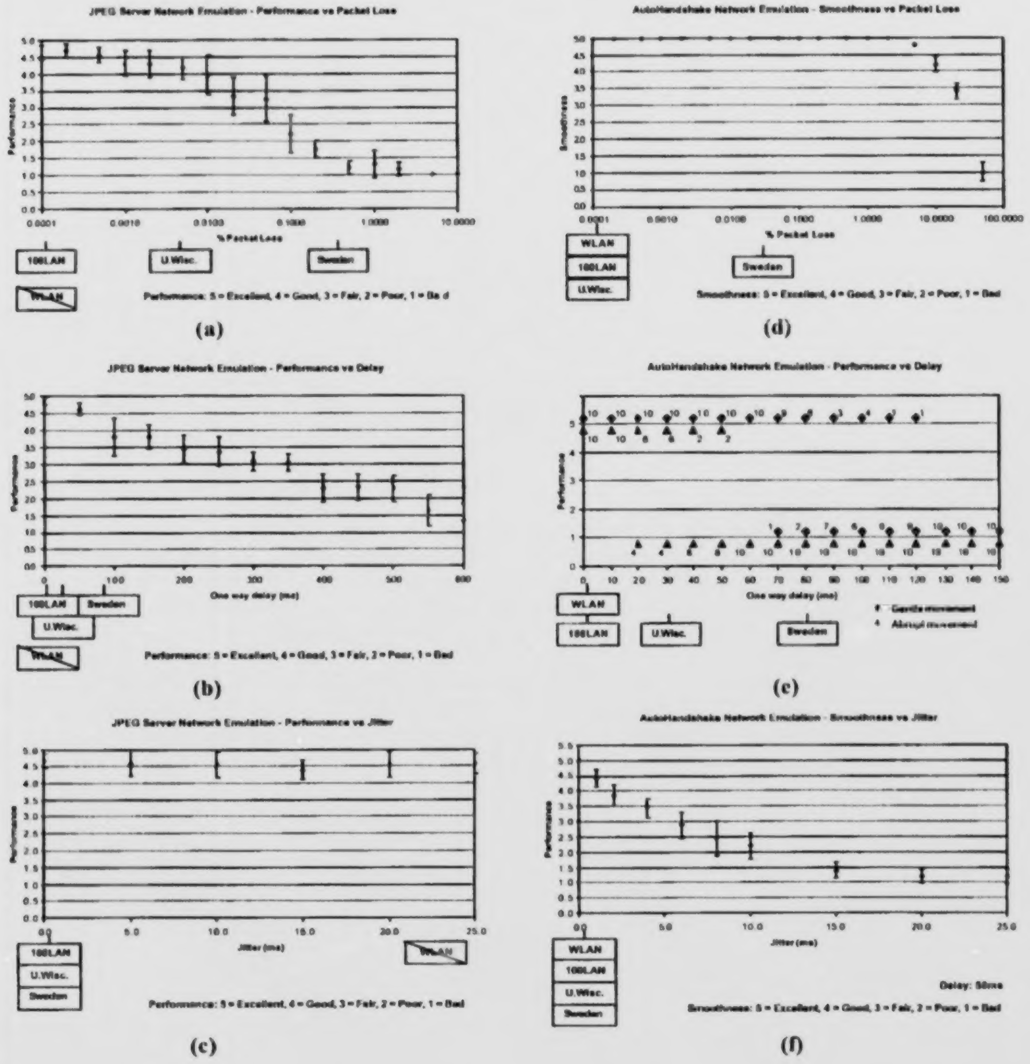
Application Evaluation

As mentioned earlier, the two applications studied were the *JPEG Server* (3-D imaging) and the *AutoHandshake* application (haptics). To determine the application quality, a conventional subjective grading scheme was used. The values for packet loss, delay and jitter were changed one at a time, and the users were asked to grade the performance of the application. It is worth noting here that the users were familiar with its performance under normal conditions. Each user graded their experience on a scale of 1 to 5. A score of 5 indicated "Excellent: network degradation is not noticeable": a score of 4 indicated "Good: network degradation is noticeable, but not annoying"; a score of 3 indicated "Fair: network degradation is evident and annoying"; a score of 2 indicated "Poor: network degradation is severely affecting the user experience and the application is minimally useable"; and 1 indicated "Bad: network degradation has made the application unusable". This grading scheme is similar to what has been extensively used previously for subjective video coding and transmission quality assessments (Webster et. al 1993, Watson, Sasse 1998, Jones, Atkinson 1998).

To test the JPEG Server, a set of 3-D images of the human hand was used (Fig. 1). Six test subjects familiar with the JPEG Server were asked to rate the performance of the application as the values of packet loss, delay and jitter were randomly changed. Similarly, for the AutoHandshake application, a subjective evaluation was performed using six test subjects that were fimiliar with the application and its capabilities under no network degradation. A Phantom Desktop haptic device, developed by SensAble Technology, was used during these tests. The AutoHandshake evaluation involved having the user make a certain movement with the Phantom device, and then having the server repeat the movement. The user would then determine if the accuracy and smoothness of the movement being repeated was equal to that of the original.

Results

Figures 2(a)-2(f) display the results for the JPEG Server and AutoHandshake under different packet loss, delay and jitter network conditions. In these figures, the characteristic parameter values for each of the four different network connections mentioned in Table 1 are indicated with markers ("100LAN", "WLAN", "U.Wisc" and "Sweden"). In Figures 2(a)-2(c), the "WLAN" marker is crossed out since this technology currently does not provide the necessary bandwidth for the JPEG Server application.



(a) (d)

(b) (e)

(c) (f)

Figure 2: JPEG Server performance affected by (a) packet loss, (b) delay and (c) jitter. AutoHandshake performance affected by (d) packet loss, (e) delay and (f) jitter.

Figure 2(a) shows how the JPEG Server performance degrades with increasing packet loss, reaching "Bad" performance levels at about .8% packet loss. Since the application retransmits packets that are in error, packet loss causes the images to be delayed or not shown at all. Figure 2(b) illustrates how the performance also degrades gradually with increasing delay, but never reaches the "Bad" level. It never reaches this level because the application will always eventually show the desired image, unlike the situation caused by packet loss, where it may never be shown due to continued retransmission requests until it fails. Figure 2(c) shows how the application is fairly insensitive to reasonable values of jitter. Jitter causes the JPEG server to have to wait just a few milliseconds more before displaying the image. This effect is barely noticed by the end user.

Figures 2(d)-2(f) show the results for the AutoHandshake application. Figure 2(d) shows that the application is very resilient to packet loss, starting to degrade only at values higher than 1%. Packet loss simply causes a few misses on points that describe the path that the haptic tool should be following. Since the sampling of points along the movement path is high, these missed points are averaged from the ones that do arrive, making the application fairly insensitive to packet loss. Figure 2(e) is different from the other ones, since the effect that network delay has on the application is different: it either works fine or it does not work at all. This is due to the force feedback loop in this application (Niemeyer, Slotine 1998). When the network parameters force the feedback loop into an unstable mode, the application effectively becomes unusable. In the studies, the application was run 10 times under a given delay and verified if it would work or not. The markers indicate the number of times the application did and did not become unstable. The results differ depending on whether the movement is gentle or abrupt. Again, this dependence occurs because of the dynamics of the force feedback loop. The application performance is particularly sensitive to jitter, as Figure 2(f) illustrates, reaching "Bad" performance levels at around 15 ms of jitter. Jitter causes this degradation as the arrival of data points out of order causes the path to loose smoothness, which is easily perceived by the end user.

	JPEG Server	**AutoHandshake**
Bandwidth	40 Mbps	128 Kbps
Packet Loss	< .01 %	< 10 %
Delay (one way)	< 100 ms	< 20 ms (abrupt movements) < 80 ms (gentle movements)
Jitter	Not sensitive to jitter	< 1 ms

Table 2: Minimum QoS requirements per application

The graphs on Figures 2(a)-2(f) can be used to determine the minimum network requirements for these applications. Table 2 summarizes the requirements that these two applications impose on the network. These requirements have been taken as the values where the evaluated performance is in rated "good" or better. The threshold for the JPEG Server is at about 0.01% packet loss and 100 ms one way delay, as can be seen in Figures 2(a) and 2(b). For the AutoHandshake, the thresholds are at 10% packet loss and 1 ms jitter as Figures 2(d) and 2(f) illustrate. For its delay threshold, it depends on the movement: for abrupt movements it would be at around 20 ms, while for gentle movements it would be at around 80 ms, as Figure 2(e) illustrates. It is worth noting here that this evaluation has been made on a per parameter basis: that is, each parameter was treated independently. The results that different combinations of these parameters may bring have not yet been studied.

Table 2 illustrates one important point: simply providing more bandwidth is not sufficient to support these applications or others like them. For example, even though the AutoHandshake application needs only 128 Kbps to work properly, it has minimum delay and jitter requirements that may be hard to meet even for east coast to west coast connections within the U.S. This delay constraint for a haptic real-time application results in a limitation on the geographical distance allowable between a client and server or between two peers. This can become a serious problem since irrespective of the network functionality available, certain delay requirements cannot be met for geographically dispersed locations as the transmission speed is bound by the speed of light.

Discussion

The previous results illustrate how these two applications impose a series of requirements on the network being used. These results can be used along with the ones obtained for network characterization to estimate the performance of the applications on different real networks. Table 3 illustrates this. For example, the network connection from Stanford University to University of Wisconsin-La Crosse would support good to excellent performance of the JPEG Server application, but only inconsistent use of the AutoHandshake with abrupt movements. The connection from Stanford to KTH, Sweden would not be good enough for the JPEG Server due to packet loss, and delay requirements would not allow the normal operation of the AutoHandshake application. It is worth noting that both of these connections go through the Internet2 infrastructure, but even so, the application requirements are higher than what they can provide. The only network connection of the ones characterized that can fully support both applications is the 100 Mbps LAN, which is local.

The delay requirement for haptic applications is particularly hard to handle from the point of view of the network implementers. First, there is a theoretical minimum delay, bounded by the speed of light. Then there is the delay that each router along the path causes during its normal operation due to queuing and switching. A QoS implementation that would allow minimizing the number of routers along a path or guaranteeing a maximum per router delay would be needed.

	JPEG Server			**AutoHandshake**			
	Packet Loss	Delay	Jitter	Packet Loss	Delay		Jitter
Connection Type					Gentle Movement	Abrupt Movement	
WLAN	N/A	N/A	N/A	Excellent	Excellent	Excellent	Excellent
100 Mbps LAN	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
U.Wisc	Good	Excellent	Excellent	Excellent	Excellent	Excellent 60%; Bad 40%	Excellent
Sweden	Bad	Good	Excellent	Excellent	Excellent 80%; Bad 20%	Bad	Excellent

Table 3: Application performance in some characterized network connections

Conclusions

These experiments have shown how applications for remote medical training have stringent network requirements. Contrary to common belief, it is not just a matter of higher bandwidth. Other network parameters, such as packet loss, delay and jitter, are also very important. There is a need to better understand the limitations that current and near-future networks have (Tab. 1) and design the applications accordingly. The sensitivities and requirements that a particular application may have on a given network may be modified by adjusting a variety of design factors, including whether the application is real time or not, the kind of media that is being transmitted, the expectations of the end users and the network protocols being used.

A public network infrastructure that is expected to support remote medical training will need to provide QoS guarantees in terms of packet loss, delay and jitter (Tab. 2) and mechanisms that go beyond those provided today. Internet2 infrastructures today are not capable of appropriately handling these applications.

Some of these applications are currently in use at the Medical School, such as the JPEG Server for the course "Surg 219: Human Anatomy and Development". Future work at SUMMIT includes the evaluation of other network intensive applications, such as streaming 3-D video and peer-to-peer haptic applications, studying the network traffic patterns that are generated when the applications are in use and evaluating their scalability.

References

Webster, A., Jones C., Pinson M., Voran S. and Wolf S. (1993). An objective video quality assessment system based on human perception. *Human Vision, Visual Processing, and Digital Display IV, 1993,* SPIE, San Jose, CA. 15-26.

Watson A. and Sasse M. A. (1998). Measuring Perceived Quality of Speech and Video in Multimedia Conferencing Applications. *6th International Conference on Multimedia, 1998,* ACM, Bristol, England. 55-60.

Jones, C. and Atkinson, D.J. (1998). Development of Opinion-Based Audiovisual Quality Models for Desktop Video-Teleconferencing, *6th International Workshop on Quality of Service, 1998*, IEEE, Napa, CA. 196-203.

Niemeyer, G. and Slotine, J.-J. E. (1998). Towards Force-Reflecting Teleoperation Over the Internet. *International Conference on Robotics and Automation, 1998*, IEEE, Leuven, Belgium. 1909-1915.

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Cooperative Learning & Working in a Virtual Environment: a Case Study

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Abstract

This paper focuses on examining the various kinds of pedagogical, organisational or technical elements and constraints of successful application of collaborative learning in distance education. Our research relies on case studies concerning collaborative learning and work in several courses in virtual learning environments. Firstly, based on the implementation and analysis of educational practices with clearly differentiated goals, contents and methodologies, our research revealed that the progress of virtual learning groups goes across four critical moments: *Group formation, consolidation, development* and *dissolution*. Finally, we propose, explore and evaluate tools and technical functionalities that mediate collaboration and support effective virtual collaborative work and learning

Introduction

Net learning based on global interactivity is emerging as an important element of a new educational paradigm which puts collaborative learning and lifelong learning at the center of the stage (Harasim, 2000). The net facilitates access to resources asynchronously without geographical and temporal limitations, promote interactions and information exchanges, due to larger opportunities of interaction.

In this context, one of the basic present educational challenges is to prepare people to be able to participate in an information society in which knowledge is the critical source of social and economic development (Cornella, 1999). In this society, productive collaboration is the key issue of interactive organization networks that are open to constant changes.

A group of professors from the Multimedia and Information Sciences department at the Open University of Catalonia (UOC), from Barcelona, we are looking for ways to enrich the learning capabilities of the virtual classrooms in our university campus. Within our teaching practices, we explored strategies for putting in place virtual teamwork, thinking that this learning methodology will provide and promote agile and quality interaction between professor, students and resources.

Pursuing this aim, we focused our work in two main objectives: *1.* To analyze, from a pedagogical viewpoint, cooperative working processes in a virtual campus environment to facilitate learning and apprenticeship processes to student and professor. *2* To identify the requirements that communication tools have to fulfill in order to be adequate for learning cooperatively in a virtual campus.

Description of reviewed cases: A pilot experience

In this article we present a Case Study experience. It is the result of our practice with teamwork learning in the virtual campus of UOC, within four courses with different goals, activities, and methodologies. In each case, the general methodology had to be adapted depending on size and group composition (heterogeneous or homogeneous), rules that should direct the activity, types of organization of working spaces, evaluation strategies, and roles that students can play. Four courses that included team project curricular design were chosen. We followed 154 groups of the different subjects

Experience Analyze

By implementing cooperative work in these courses, our research allowed us to identify, of a methodological point of view, that the progress of learning groups in a virtual environment goes across four critical phases (Guitert, 2002) that require defining specifications which are quite different from those applied in individual learning in virtual environments. In particular, based on the two main objectives defined before, we obtained the following results:
In virtual cooperative work, a group goes through four phases or stages during its learning process. These phases can be more or less evident o flexible depending on the working goal and methodology of the course at hand.
A. Group formation: This is the period in which working groups are formed. It is important that students themselves are actively engaged in forming the groups, being conscious that this phase forms part of their working process. At this phase, the guidance the tutor may give to the students can be materialised in the following tasks: *Information*: guides and resolves issues that a group may set as regards group work in a virtual environment. *Regulation*: influences on the direction task organisation of the group should take; inform to the group, if it is necessary, on task organisation, how to initiate an activity, how to adapt the planning system better, etc. *Support*: promotes the proper conditions that enable group consolidation and better task development; encourages group organisation, shows his/her support explicitly when the group needs it and tries to be always aware of how the group proceeds its work in the shared space.
B. Consolidation: At this stage, the groups have been formed and they are prepared to initiate the laboratory activities proposed to them. Before real work starts, though, it is the time when the group members should break the ice and get to know each other more deeply.
In a virtual environment, this moment is important for two main reasons:

1. It constitutes a warm-up activity before the group starts working on real learning activities.

It gives members the necessary time to make initial contacts with each other. In a non-distance educational environment, once formed, a group sets up a meeting and can start

2. working immediately; instead, in a virtual environment it is advisable for a group to spend some time trying to establish good organisation and planning of the work before starting working.

In this stage, the group has to decide who is going to be in charge of co-ordinating tasks. It has also to make decisions about the organisation of the shared space, decision making processes, the wok planning, as well as, the frequency the group is going to communicate
C. Development: This is the phase when the group applies and puts into practice all the decisions taken as regards scheduling and organisation forms, task sharing, etc. and when each member work cooperatively to carry out the assigned tasks. Once a group has started working on the task at the Development phase, the tutor will just wait to give his/her support whenever students will ask for it. She or he will give support in case they have a doubt about the content, or get stuck with a process or even when a conflict arises among them.
D. Closing: Once a group has reached the definite resolution of the project, every member realises a self-assessment of the work process carried out. The aim of this self-assessment is to give the chance to each member to evaluate the process they have been through, the results obtained by comparing them with the effort made, and the way they handled media and information and communication resources to accomplish the learning goals.
Finally, at this phase of the group work, it is important that the group would be able to close the process followed by evaluating not only the resulting work but also the attitudes and relationships that have been maintained among all members. For this reason, the tutor establishes and foments a common discussion space where students can consolidate their cooperative work process by generating common feed-back capable of assessing both positive and negative aspects of the experience.

In relation to the second objective of this case study, we identify the functionalities that tools have to have to help collaborative learning processes in virtual environments. The following are the main characteristics: focus on student needs, user-friendly, easy to learn and to use, a clear interface, and an Internet tool.

Main functions

The tools we used allowed these two essential processes take place:

1. Communication and information exchange (between students and between students and teachers)
2. Organization and management of information in the team

1. Students of the Virtual Campus use very common tools for interacting and communicating the electronic mail (asynchronous communication) and Chat (Synchronous communication). Chat is frequently used for quickly make decisions. In very specific moments, synchronous communication may be necessary. Instead, electronic mail, among

other functions, allows information exchange in a more elaborated way. It allows answers to questions be more analyzed.

2. The Virtual Campus offers the group a common disk. Therefore, the group has an instrument for exchanging and storing information. This way, group members can share documents and elaborate them together. Each member of the group is allow to create or eliminate fields.

The case study, clearly showed beyond its own scope, that for learning processes take fully advantage of the new media capabilities, it is crucial to understand how a virtual team exchange information and builds on knowledge. Moreover, it is not only necessary to have technological support for allowing team cooperation and interaction, but it is fundamental to better handle the learning process, and control all the elements that intervene on cooperative work on the net environments.

Bibliografía

Cornella, A (1999) *En la sociedad del conocimiento, la riqueza está en las ideas*
Guitert, M & otros (2002). *Cooperative Learning & Working in a Virtual Environmen t. EDEN RESEARCH WORKSHOP*, 2002, Hildhesheim, Germany.
Guitert, M, Giménez, F (1999) Aprendizaje cooperativo en entornos virtuales: el caso de la UOC de la Universitat Oberta de Catalunya *Ahciet Tele Educacion' 99*
Harasim,L. Starr, S, Turoff, M.,Teles, L. (2000) ***Redes de aprendizaje. Guía para la enseñanza y el aprendizaje en red.*** Ed. Gedisa, EDIUOC. Barcelona.

Collaborative Problem Solving in the Online Environment: A Case Study of a Web-based Undergraduate Business Course

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Abstract In building an online course or transforming a traditional course for online delivery, the most critical element is not the selection of appropriate media but the selection of the most effective teaching strategies. Competitive online courses are those that are designed; 1) to involve students in the learning process, 2) to engage them in conducting learning activities, and 3) to enable them to readily apply what they learned in the real world. This paper presents a case scenario where an undergraduate course was designed based on the instructional theory model of collaborative problem solving (CPS). It demonstrates the rational for choosing the theory and the design of the course following the guidelines suggested by the model. Student feedback and suggestions on improvement are also presented in the paper.

Collaborative Problem Solving

Collaborative problem solving (CPS) is a newly developed instructional theory that combines two instructional approaches: cooperative learning and problem-based learning (Nelson, 1999). It emphasizes cooperation—the key of cooperative learning—in the context of "a carefully constructed problem scenario", which is the essence of problem-based learning (Savery & Duffy, 1995). As a theory model, CPS provides guidelines that address the whole process of collaborative learning including: a) building a readiness in students to learn collaboratively; b) developing group skills; c) forming groups; d) engaging in collaborative problem solving; e) finalizing the process through appropriate analysis, synthesis, assessment, and closure activities (Nelson, 1999).

The goal of CPS theory is to develop knowledge of a content area that consists of complex domains. In the meantime, it emphasizes the development of problem-solving, critical thinking, and collaboration skills. CPS holds the pedagogical values of maximizing the natural collaboration processes of learners; creating a situated, learner-centered learning environment; honoring ownership of the learning experience for students; encouraging content analysis and exploration from multiple perspectives; acknowledging the importance of social context for learning; and cultivating supportive relationships among learners (Nelson, 1999). With group problem solving being a common practice in this age of information, collaborative problem solving prepares learners with the most necessary skills in the workplace – the ability to collaborate and a desire for lifelong learning.

Using Collaborative Problem Solving in INS 344

INS 344, Commercial Liability Risk Management and Insurance was offered by the School of Business at Indiana State University as a required courses for undergraduate students majoring in insurance and risk management and as an elective course for other business majors. It is also part of the DegreeLink program, which offers students with associate degree an opportunity to get a baccalaureate degree by completing two additional years of coursework in the areas of insurance and business administration. Since most of the DegreeLink students are working adults who are not able to attend classes on campus, DegreeLink courses are delivered over the distance using the Web as the major modality. INS

344 that previously was offered as a face-to-face class, became available online in the fall semester of 2001. Sixteen students enrolled in this solely web-based course, seven students were majoring in Insurance and Risk Management and nine identified other areas of business including Business Administration, Finance, and Commercial Law and Accounting.

The design and development of INS 344 from face-to-face to the online format took place a year before the delivery. The transformation brought dramatic changes to the course not only in terms of its delivery media but also the instructional approach. Instead of using the traditional textbook chapter-by-chapter coverage, the instructional designer and the instructor decided to change the instructional design to a project-driven course with strong emphasis on interaction and collaboration among the learners themselves. Among the various available instructional theories, collaborative problem solving (CPS) was chosen because of the good match between the course and the CPS conditions including type of content, learning environment, and characteristics of both learners and instructor.

Course Content

INS 344, Commercial Liability Risk Management and Insurance, focused on an examination of the major commercial liability loss exposures including premises, products, completed operations, contractual, workers' compensation, and other miscellaneous liability coverage. During this class, students were asked to identify and analyze different corporate liability risks and then to select optimal combinations of risk treatment and insurance for financial protection against liability losses. The assignments in this course were mostly heuristic in that they required a complex system of knowledge and skills that could be combined in a variety ways to complete the task successfully. The content of the course therefore suited the conditions for using CPS, which is found to be most appropriate with heuristic tasks as opposed to procedural tasks (Nelson & Reigeluth, 1997).

In addition to the complex nature of the project scenarios and the variety of knowledge and skills needed for completing the assignments and obtaining project solutions, the individual projects also varied from one group to another. Thus, there would not be a single question or one best way of doing something – a situation in which CPS is found to be most appropriate methodology to use (Nelson, 1999).

Learning Environment

A learning environment conducive to collaboration, experimentation, and inquiry was found to be the most effective environment for CPS (Nelson, 1999). Therefore, building this type of learning environment was the intent of the instructor and the designer of INS 344, including a component that would provide sufficient time for individual groups to become established. To support interaction among project team members, group space was created to enable online communication via email, discussion board, file exchange area, and virtual chat room.

Learner Characteristics

Nelson (1999) pointed out that having self-directed learners who are comfortable with, and willing to take responsibility for their own learning is an essential factor for the successful implementation of CPS. The characteristics of a CPS learner coincide with that of a successful distance learner in terms of independence and self-discipline (Nipper, 1989 & Guan, 2000). Other findings indicate that students who choose to take distance courses demonstrated lesser need for control and affection. They had more need to initiate actions than to wait passively for actions (Guan, 2000).

Instructor Characteristics

Having taught three different online courses, the instructor was comfortable in his role as a facilitator who would spend most of his time observing students' interactions and would intervene only when it was absolutely necessary. He was therefore well suited to the CPS approach, which requires that instructors be flexible and tolerant of a certain degree of ambiguity in what exactly is to be learned and how the learning will take place (Nelson 1999).

Designing and Developing INS 344 with CPS

As a comprehensive instructional theory, CPS provides two general categories of guidelines to assist the implementation process: (a) *comprehensive guidelines*, which support the entire process, and (b) *process activities*, which provide step-by-step guidance for designing the appropriate learning activities.

Based on the *comprehensive guidelines*, the roles and the responsibilities of the instructor and the learners were clarified as the following:

Instructor:

- Provide resources as needed by the learners
- Identify roles in each project team
- Establish project timeline
- Formulate questions to focus learner on the critical elements of the content
- Facilitate group building
- Collect feedback from students and modify learning activities
- Offer just-in-time instruction when requested by learners

Learners:

- Prepare for team project by completing a mini project
- Select roles in the project team
- Collaborate with team members in identifying a problem pertinent to the subject area
- Collect background information of the company where the problem was identified
- Propose and conduct cost-benefit analyses for alternative solutions
- Complete online learning exercises over commercial liability content areas
- Present recommended solutions to the problem
- Share the final project report with the whole class

Instructor & Learners:

- Collaborate to determine learning issues
- Exchange/share learning resources
- Conduct formative and summary evaluations
- Provide group and individual evaluations
- Offer suggestions for course revision

In contrast to the comprehensive guidelines, which help clarify each party's responsibilities during the learning process, *process activities* provide guidelines for building the learning events. As a project-driven course, the content of Insurance 344 was structured around the need to recommend solution(s) for a major business problem facing a large corporation. As shown in Table 1, the learning process consists of seven learning modules, each carrying at least one process activity suggested by CPS.

Table 1. INS 344 Learning Modules & Collaborative Problem Solving Process Activities

Learning Modules	Process Activities
Module 1: Introduction	1: Building Readiness (as an individual)
Module 2: Team Building, Role Selection	2: Form and Norm Groups 4: Define and Assign Roles
Module 3: Warming Up Exercise for Team Project: A Mini-Case	1: Building Readiness (as a group)
Module 4: Company Background	3. Determine a Preliminary Problem Definition
Module 5: Problem Identification	3. Determine a Preliminary Problem Definition 5: Engage in Iterative Collaborative Problem-Solving Process
Module 6: Solution Alternatives – Cost/Benefit Analyses	5: Engage in Iterative Collaborative Problem-Solving Process 6. Finalize Solution Alternatives 7. Conduct Financial Analysis
Module 7: Recommended Solutions	8. Synthesize and Reflect
Course Survey	9. Assess Products and Processes 10. Provide Closure

Although the learning modules were in accord with the CPS process activities, the sequence of procedures was slightly altered. Because the course was offered totally online, adjustment was made in a few areas: a) introduction to online learning, b) pre-defined roles of project members, and c) instructor-built project timeline.

Introduction to Online Learning

An introductory module was created for the very beginning of the course to prepare students for online learning. In this module, each student was asked to find results for a given problem related to risk measurement. To complete this assignment, students would learn to navigate the course site, review online documents, open an attached sample report, and use the Class Discussion Board to post their own responses.

Pre-defined roles of Project Members

Instead of letting students define their own roles in the project team, the roles were defined by the instructor before the team was built up. Each project team consisted of four members: a project manager, a risk manager, an insurance analyst, and a financial analyst. Job descriptions and responsibilities of each role were posted on the course site for students to review. Position selection took place in an online discussion forum that contained four discussion threads named after the roles, such as Project Manager, etc. Students were asked to claim their roles by replying to the appropriate thread. Since there was a total of sixteen students signed up for the course, four project teams were to be organized, with only four opportunities available for each role. In other words, once the role of Project Manager, for example, had been claimed by four people, that position was closed. A rule was made clear that "the person with the first date and time claiming a position has priority in the selection process."

Identifying the principal roles needed to complete a design plan is a critical part of the learning process (Bridge, 1992; Johnson & Johnson, 1997; West, 1992). It is also a time-consuming task that requires significant interaction and communication and negotiation among the team members. Considering the overall semester time limit and the amount of content to be covered in the course, the activity of identifying the separate groups was conducted by the instructor instead of the students. Thus, students could quickly find their position and be ready for the forthcoming tasks.

Instructor-built Project Timeline

The combination of the web-based format and project-driven approach doubles the chance for students to lose track of time. So, instead of allowing project team to develop their own individual timeline for their project, a mile-stone chart was shared with the students at the beginning the semester to provided them with a clear understanding of due-dates and deliverables. Within individual modules, there was also a timeline chart that highlighted the time frame expectations for that module.

Researching Design of INS 344

Since collaboration is "the hallmark" of the CPS theory and is built upon interaction (Nelson, 1999), investigating the collaboration and interaction among students within project groups became the main focus of the research. By tracking the quantity and quality of online interaction and by surveying students, the course instructor and instructional designer intended to examine: a) students participation of interaction, b) the effectiveness of interaction, c) students perception of interaction, d) students reaction to CPS, e) students preferences of interaction media, and f) suggestions for improvement.

Students Participation and Interaction

In general, interaction among students in this class was quite intensive with a total of 133 messages posted on the class discussion board. Additionally within the separate group space, the intensity of group interactions was strong in three of the four groups, although as seen in Table 2, the quantity of interaction turned out to be quite unbalanced.

Table 2, Data from Group Page

	Number of Messages Posted	On-line Chat	File Exchange
Group 1	103	5	0
Group 2	86	5	39
Group 3	92	3	2
Group 4	6	0	0

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Effectiveness of Interaction

All of the students agreed or strongly agreed (28%) that they learned more by doing the course project collaboratively with other team members than they would have by working by themselves. Comparing with groups in other classes, 53% of the students rated their INS 344 project group as excellent, 33% rated good, and 13%, fair.

Students Perception of Interaction

The survey showed that 60% of the students expected to have the greatest amount of interaction with their team members while 27% expected to interact mostly with their team project manager. One student expected to have the greatest amount of interaction with the instructor and another one chose the textbook as the major interaction object. In reality, 73% of the students said that they ended up having the greatest amount of interaction with their team members while some (13%) doing so with classmates outside their team.

Students Reaction to CPS

When asked, "how do you feel about problem-based-learning as the instructional methodology used?", 93% of the students chose "Favorable" and 7% chose "Very strongly in favor." All but one student was in favor of the course being primarily project driven. Some of the comments made by students in regard to the project:

> "loved my group!"
>
> "I liked the course because the project gave me a chance to see a real world thing."
>
> "I liked the structure and the project based learning."
>
> "I really enjoyed the group project for this class. It was really nice to know the group members. This way it was easy to get ahold of them and be able to communicate with them. I know that my group was taking the class to learn and it wasn't just a class to blow off."
>
> " Communicating with member was easy"
>
> "Our Instructor was very helpful, and he put us in groups with people that we all work really well with."
>
> " I liked the group project."
>
> " Got to work on actual real world company."

All the students either agreed (60%) or strongly agreed (40%) that they were motivated by the effort their team members had put into the group project. No one was discouraged by the lack of involvement of any team members. They all believed that their group was able to work effectively as a team and that their team members' contribution were equally distributed. Of their own contribution to the team project, 80% of the students described themselves as "a strong worker with fair amount of input" while 20% called themselves "THE major contributor".

Students Preferences of the Interaction Media

In terms of the communication channels used for interaction, the discussion board was used most extensively, followed by email and then face-to-face meetings.

Suggestions for Improvement

A content analysis from students' feedback offered the following themes:

1) Information & Resource Sharing
   – Several students indicated that they "had difficulty finding some information" and were "wondering if I was getting a broad enough knowledge base for achieving objectives." Suggestions for improvement include "giving an example of the final project at the start of class" and "post a suggested reading list/schedule." It was also suggested that "(Instructor should) require postings of other group materials, so that we way (will) learn from others."
2) Project Direction, Schedule, and Pace
   – 53% of the students said that "keeping up the project schedule" had been the most challenging aspect of the course. Some student felt that it is difficult to "complete everything by due dates. It was tough to lay it out at

beginning. Falling behind, then catching up, quite sporadic." One student found it difficult "having to follow a schedule, rather than work at our own pace."

3) Web Access and Navigation
   --Learning the structure of the site was found to be difficult by some students. Others encountered technical problems accessing the course and the learning exercises.

Conclusion

As indicated in the Leaner-Centered Psychological Principles (APA Online, 1999), learning can be enhanced when learners have the opportunity to interact and to collaborate with others on instructional tasks. Collaborative problem solving (CPS) provides a theoretical framework for instructors and course designers to build a learning environment that allows for social interactions, and that encourages flexible thinking and social competence. By using the CPS model, the undergraduate business course, INS 344 broke down the traditional lecture-and-exam structure and brought students closer to the real world situation. This approach cultivated a teamwork environment that mirrors the most common and natural situations in the age of information.

This paper outlined the design and delivery of an online business course using Collaborative Problem Solving instructional approach. It has been demonstrated from the learning outcomes and students' feedback that the CPS offered effective instructional methods that were well suited to the content and the context of the course. Also, from analysis of the groups' learning process, it was concluded that there is need for continuing evolvement and more creative usage of the CPS guidelines.

References

Bridges, E.M. (1992). *Problem-based learning for administrators*. Eugene, OR: ERIC Clearinghouse on Educational Management. (ERIC/CEM Accession No: EA 023 722)

Guan, S. (2000). *The relationship of graduate students' interpersonal needs with interaction preferences in distance learning*, UMI Dissertation Publishing, Ann Arbor, MI: Bell & Howell Information and Learning.

Johnson, D.W., & Johnson, R.T. (1997). *Joining together: Group theory and group skills (6th ed.)* Boston: Allyn & Bacon.

Learner-centered psychological principles: A framework for school reform and redesign, American Psychological Association. Available at: http://www.apa.org/ed/lcp2/

Nelson, L. M. (1999). Collaborative problem solving. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory*. Mahwah, NJ: Lawrence Erlbaum Associates.

Nipper, S. (1989). Third generation distance learning and computer conferencing. *Mindweave*, available at http://www-icdl.open.ac.uk/mindweave/chap5.html

Savery, J. R., & Duffy, T. M. (1995). Problem-based learning: An instructional model and its constructivist framework. In B. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design*. Englewood Cliffs, NJ: Educational Technology Publication.

West, S.A. (1992). Problem-based learning--a viable addition for secondary school science. *School Science Review*, 73, 47-55.

Using a Metro Map Metaphor for organizing Web-based learning resources

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Abstract: This paper briefly describes the WebNize system and how it applies a Metro Map metaphor for organizing guided tours in Web based resources. Then experiences in using the Metro Map based tours in a Knowledge Sharing project at the library at Aarhus School of Business (ASB) in Denmark, is discussed. The Library has been involved in establishing a Learning Resource Centre (LRC). The LRC serves as an exploratorium for the development and the testing of new forms of communication and learning, at the same time as it integrates the information resources of the electronic research library. It is the objective to create models for Intelligent Knowledge Solutions that can contribute to form the learning environments of the School in the 21st century. The WebNize system is used for sharing of knowledge through metro maps for specific subject areas made available in the Learning Resource Centre at ASB. The metro maps now serve as the entrance to learning resources for several hundred students.

1. Introduction

Support for structured navigation in large bodies of information has been an issue for hypermedia research since Bush (1945) introduced the notion of Trails. In hypermedia research (Trigg, 1988) the trail concept is called guided tours and a number of systems have been implemented to support trails and guided tours also for the Web.

Among the systems supporting guided tours for the Web, are: Pooh's Guided Tours Service (www.infosys.tuwien.ac.at/GuidedTour/GuidedTour.html), Footsteps (Nicol et al., 1995), Walden's Paths (Furuta et al., 1997), and Ariadne (Jühne et al, 1998). All of these systems provide value-adding services for the WWW making it easier for the prospective users of the WWW to find their way through relevant information. This paper presents a hypermedia based guided tour system for the WWW (Berners-Lee et al., 1992), which was developed as an integrated part of the open hypermedia system called Webvise(Grønbæk et al., 1999), which is now a commercial product called WebNize. The WebNize guided tours can be used by readers in plain browsers without using Java or any plug-in. The WebNize system is a full-blown open hypermedia system, with an integrated guided tour editor. WebNize generates guided tours in plain HTML and PNG formats for access through a plain browser.

The WebNize Guided Tour System is inspired from open hypermedia (Grønbæk & Trigg, 1999), classical hypertext (Trigg, 1988; Zellweger, 1989), and the recent Web initiatives mentioned. WebNize improves support for users in navigating through prepared presentations of subjects. In addition to inspiration from the classical hypertext systems we have been inspired from the ideas of simplified metro or bus maps to communicate information on routes in a complex city. This idea came across when our pilot users pointed to a handcrafted web page at Chalmers, Sweden (educate2.lib.chalmers.se/demopath.html). The WebNize system including the Guided Tour System as described in this paper is available from www.hypergenic.com.

The paper is organized as follows: First we describe the context in which WebNize has been brought into use for organizing learning materials. Secondly, we describe the how WebNize support the organization of learning materials. Then we describe experiences and results and finally we conclude the paper.

2. Learning Resource Centre (LRC)

The Library at the Aarhus School of Business presents the results of co-operation between the Library and the Faculty of Modern Languages at the Business School. The purpose of this co-operation has been the development of a knowledge sharing platform and tools to facilitate knowledge sharing in a modern international environment of education and research at the Aarhus School of Business (Bang, 2001).
With the Library as the centre, the co-operation resulted in the establishment of a Learning Resource Centre (LRC) primarily aiming at servicing students, teachers, and researchers at the Faculty of Modern Languages.

The LRC has been established in close co-operation between the three environments: research, teaching and library. This co-operation has been prompted by an urgent need of initiating experiments with new forms of learning and education. Experience shows that new teaching methods generate quite new demands for developing new ways of giving students, teachers, and researchers access to quality-assessed information resources and to technology support. A modern research library must be capable of supporting the new learning environment with a wide selection of services matching the needs of the users.

Thus, the LRC has been organized as an "exploratorium" for students in new forms of learning and for training of teachers who are to act as facilitators in the virtual learning environment. The LRC centre both functions as a physical meeting place and as a place where electronic information resources and learning tools are available to the users via well-arranged and clear user interfaces accessible 24 hours a day.

2.1 Learning portal based on Metro maps

The Metro map metaphor has proved to be a suitable user interface for at learning portal for students and teachers in a LRC exploratorium. The Metro metaphor is fascinating, familiar to most people and easy to comprehend. It provides a general view, is useful for structuring a very large amount of web sites and it is next to impossible to get lost in. The METRO allows a graphically oriented user an easy navigation round the information and learning resources displayed in the show window of the electronic study of the LRC. All along you can follow a predefined search route for the drive of your journey from station to station on a key map. You can even get off and on as you like, without losing track of where you are.

The Library uses the metro map metaphor as a basis for constructing paths in the form of guided tours to the learning and information resources in the LRC (Jensen & Harbo, 2000). The Metro in the LRC at the Library of the Aarhus School of Business is based on the use of the open hypermedia system called WebNize.

2.2 New Learning Environments and Guided Tour Systems

In recent years the study and learning environments at the institutions of higher education in Denmark have changed. The frames earlier set by the traditional class- and lecture-room education do not suffice. The students still follow conventional lectures, but the responsibility for own learning is growing. To a large extent they work problem-based and project-orientated and need to meet in seminar rooms with facilities giving access to a wide range of quality-assessed information resources - electronic and printed – and user support tools side by side with teaching materials and learning tools. New and different physical and intellectual demands on facilitation of the study and working processes arise as a natural consequence of modern teaching methods. This only draws a picture of the facilities supporting the traditional daytime students at the universities and the institutions of higher education. Distance learners and part-time students have special needs.

Teachers and the research library only reach the students in these environments via an electronic user interface on the Internet. The support for studies and learning of such dimensions is a pedagogical challenge to institutions of higher education and to research libraries. The development of entirely new tools and methods for presenting library resources and guiding the students is necessary to ensure optimal use of information content.

At the LRC of the Business School we have chosen to use the Metro metaphor and the concept of 'Guided Tours' as the educational concept, which is to support user access to electronic information resources, to the learning content and to the tools supporting the learning process itself. The concept of 'Guided Tours' in the learning portal offers the opportunity of guiding the user via pre-defined routes in the shape of linear courses. The users may also choose to plan their own individual course based on their needs.

3. The WebNize hypermedia System

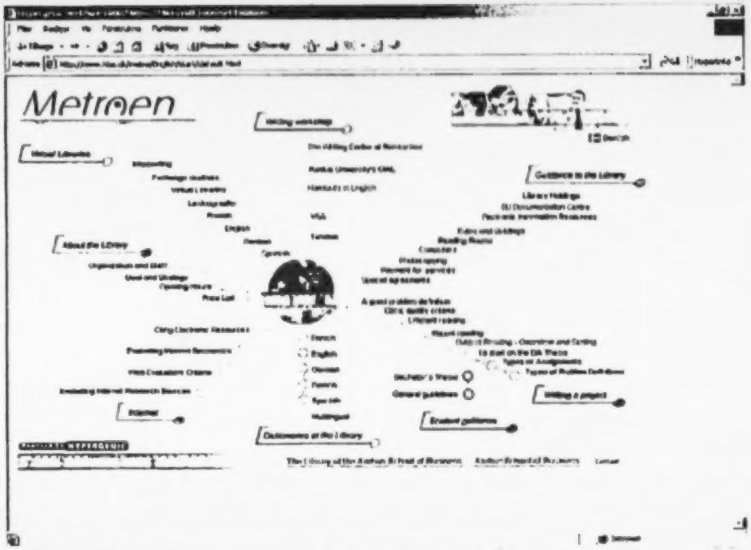

Figure 1: The metro map generated from the guided tour editor

We believe that support for guided tours is needed in many application domains. Teachers, librarians, Web journalists, portal editors, publishers, governmental administration etc. often wish to present procedures or collections of information in a homogeneous manner.

This is supported by the fact that the notion of a guided tour has become quite common on the Web. The search terms "guided tour" gave in December 2001 more than 550.000 hits on Google (www.google.com). Many of these hits actually represent sites that present a certain topic in a sequence of web pages and commented links like, e.g. the Visual Human (www.madsci.org/~lynn/VH), Wind Energy (www.windpower.dk/tour) and the Chalmers Library guide (educate2.lib.chalmers.se/demopath. html). The WebNize system has been designed to overcome problems and limitations of manually created guided tours and existing guided tour systems.

3.1 The metro map metaphor

As described in (Sandvad et al., 2001) the metro map has been used in WebNize, because:

- It is an intuitive metaphor – navigation resembles familiar ways of navigating metro and bus maps
- It creates an overview of a large complex of related guided tour modules – the Metro Map
- It maintains focus and overview for the user navigating a specific guided tour module – the Route Map

Usage of the metro map metaphor in guided tours has shown to be an efficient technique for providing overview over a set of web documents because the metaphor is intuitive and simple. Many people around the world know how to read route maps for metros or busses. Given the destination station it is easy to find which route to take even in large cities like Paris and London. Designing metro maps in the real world is, however, not a simple matter (Garland, 1994; Tufte, 1997), and it is not either simple on the Web, where we don't have a fixed underlying map of the structure to traverse similar to a city map. But we provide a general tool that allow map designers, i.e. the domain experts, a large degree of freedom in the design of simplified maps of arbitrary complex underlying structures.

The main idea in using the metro map metaphor in guided tours is to consider each major subject in the web information as a route in the metro map. When the reader wants to know something about a certain subject s/he just has to "take the metro" on the route that deals with that subject. If the reader is very unfamiliar with the subject s/he should start at the central metro station whereas more experienced readers can enter the metro farther out on the route (see Figure 1).

Hence, metro maps are used to provide overview when entering the information infrastructure by showing an overview over all routes. But the metro map metaphor has more to give. Inside the real metro wagons a horizontal route map is shown with all the stations on the route, and every time the metro stops at a station the traveller can see where s/he is on the route, which stations have already been visited, and which stations are yet to be visited (see Figure 2). This has inspired the presentation of a route map above the Web document as will be shown in the following.

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To take full advantage of the structure of the guided tour, the user should be able to view the relevant part of the tour while following a route. The user should be able to monitor the stations in the tour that have been visited and where the user is currently located within the tour. Finally, the author of a tour should help the user by adding names or/and annotation to the stations.

This is supported in the WebNize Guided Tour System. It helps users keep their orientation in the tour, e.g. if the user has lost orientation because s/he has gone off the tour by following links from a page in the tour, a quick look at the graphical presentation of the tour helps the user regain the focus. The annotation support gives the author the possibility to add comments about Web pages within the tour. This can be used in a variety of use situations, e.g. if the author wants to review the sites in the tour, draw the readers attention to a specific topic in the page or — in an educational situation — adding questions to the topics touched in the page.

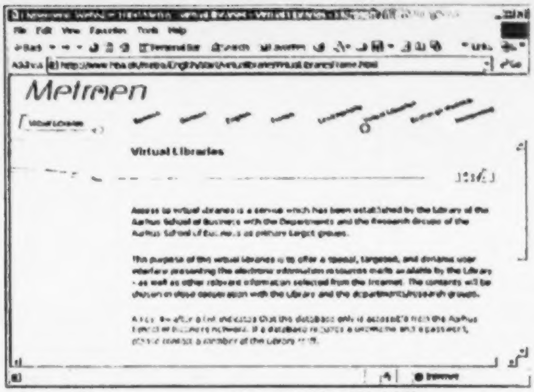

Figure 2: A route map generated by WebNize

4. Usage of WebNize generated tours

This section presents the metro map metaphor and shows an example of how it has been used in a user guidance system at the Library at the Aarhus School of Business. We present a metro map and one of the route maps that are generated from the WebNize guided tour editor. The generated metro and route maps can be visited at www.hba.dk/metro.

4.1 The generated metro and route maps

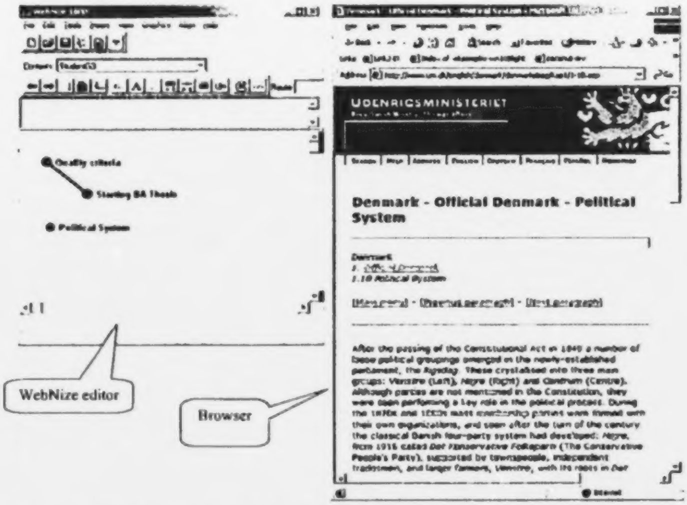

Figure 3: WebNize Metro Map Editor Interface

Figure 1 shows the metro map of the user guidance system. The different routes in the map present different recommended ways through the user guidance system. Each route represents a certain topic. The topics are: literature, library orientation, study guidance, project writing, Internet, vocabularies, writing laboratory, virtual libraries and information retrieval. If the user wants to follow the recommended sequence s/he just has to click on the oval figure of a route. Otherwise s/he can jump directly to a particular station by clicking on it. When clicking a station in the metro map, a route map is shown together with the contents of the parti-cular station. If the 'Virtual Libraries' station is clicked in the yellow route the frameset in Figure 2 is presented.

The frameset consists of two frames: a *navigation frame* and a *contents frame*. The navigation frame shows the selected route and the position on the route by red colouring of the current station. The contents frame shows the contents of the current station, i.e. the URL that the station represents. Each station can be selected directly by clicking on it, and the route map highlights the current station. The Metro and Route maps helps maintaining an overview of where the user is in a large body or related learning resources.

4.2 The user interface of the WebNize Guided Tour System

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The guided tour editor is a drawing editor (see Figure 3) that makes it possible to define the sequencing of stations in the guided tour in a general graph. Stations can be added to the graph in different ways. One way is adding a URL to the guided tour by using the command 'Add to guided tour' in an extended popup menu of the Internet Explorer. URLs (from the Address field and links in the web pages) can also be dragged into the guided tour editor. More facilities are described in details in (Sandvad et al., 2001)).

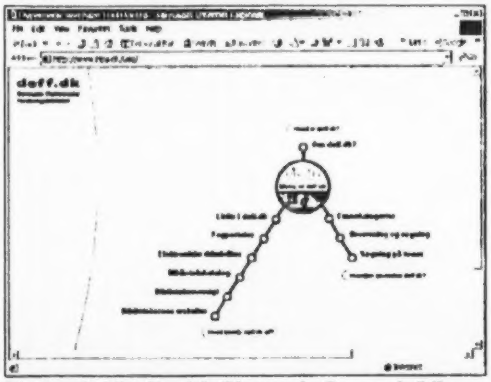

Figure 4: The Danish Electronic Research Library instruction Metro map running in the LRC.

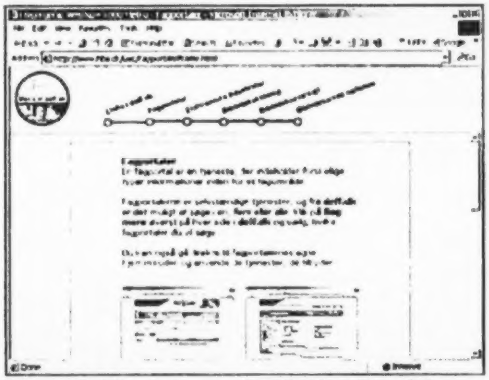

Figure 5: The route map for "Subject Portals"

5. Results and experiences

Till now, WebNize has been used as a developing platform for the Metro concept and to create Guided tours for the use of establishing learning platforms in the LRC exploratorium at the Business School. Feedback from students and teachers confirm that the concept presenting large amounts of information, courses and teaching material in a linear and transparent manner is valuable. This gives occasion for the further development and use of the concept in professional learning platforms of other Danish research libraries.

The Business School Library has recently made use of the WebNize tool in designing a portal for knowledge sharing for a cross-departmental research team working with e-Business (www.hba.dk/webnize100server/tours/e_business/index.htm). E-Business Forum is a platform for knowledge sharing across professional environments and frontiers, and it will develop into a dynamic site with researchers sharing their knowledge, commenting on research results, and automatically 'reap' information from databases.

The Business School Library has also utilized the Metro concept for experiments with user instruction for The Danish Electronic Research Library Project (DEF). Here the Guided Tours have been used for structuring the content of the DEF Project as search instructions for users (www.hba.dk/uec/) as well as Figure 4 and 5.

6. Conclusion and future work

This paper has described the WebNize guided tour system, which consists of an editor/viewer helper application and a generator to create a stand-alone guided tour website consisting of only HTML and PNG files, which can be used through plain browsers. The status of the WebNize guided tour system is that it is now a product, which is being developed and used for a number of portal projects on consulting basis by Hypergenic.

The Metro Map based guided tours have been in use at the Aarhus School of Business since September 2000 (www.hba.dk/metro). The guided tours have been used as basis for introducing all first year students to library use and information search. In addition the Metro Map is the start page on all PCs (70) in the Learning Resource Centre with 1250 students and 130 teachers. The response is very positive from the students as well from the teachers and the Aarhus School of Business are using to the approach in other domains beyond library introduction. A new route 'Courses' with a station for each course is currently being developed in collaboration with the teachers and the use of the system is by teachers as well as students expected to increase in the future.
To a larger extent the Metro Map is being used for structuring 'Virtual Libraries', that is, targeted vertical portals holding parts of the information resources of the research library, targeted at a department, a team of

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researchers, students or a company. Next step is developing the tool, thus enabling the user to download it and use it for creating personal learning platforms 'my courseware' or personal libraries 'my library'. In co-operation with Hypergenic A/S, the LRC is experimenting on the development of such facilities.

Acknowledgements

The Metro Map metaphor was inspired by the Chalmers Library guide (educate2.lib.chalmers.se/demopath.html) and part of the development of WebNize was developed by Mjølner Informatics (www.mjolner.com) under contract with the Library at the Aarhus School of Business (ASBL). We wish to thank: Finn Nyborg and Birgitte Eltzholtz at ASBL who were our first pilot (author) users. They inspired our development of support for the Metro Map with useful feedback in a highly iterative development process. Finally, we wish to thank Elmer Sørensen Sandvad, Lennert Sloth, and Kristine Thomsen from www.hypergenic.com for the development of WebNize and the support given to ASBL.

References

Bang, T. (2001) Knowledge Sharing in a Learning Resource Centre by Way of a Metro Map Metaphor, *67th IFLA Council and General Conference, Boston 2001.* Conference Paper 088-99-E

Berners-Lee, T., Cailliau, R., Groff, J. (1992) World Wide Web: the information universe, *Electronic Networking Research, Application and Policy,* 1(2): 52–58, 1992.

Bush, V. (1945) As We May Think, *The Atlantic Monthly,* 76: 641–649, August 1945.

Furuta, R., Shipman III, F.M., Marshall, C.C., Brenner, D., and Hsieh, H.-W. (1997) Hypertext paths and the World Wide Web: experience with Walden's Paths, in: *Hypertext '97 Proceedings ACM,* 1997, pp. 167–176.

Garland. K. (1994) Mr Beck's Underground Map. Capital Transport Publishing. 1994.

Grønbæk, K., Sloth, L., & Ørbæk, P. (1999) Webvise: Browser and Proxy support for open hypermedia structuring mechanisms on the WWW. In Computer Networks – The International Journal of Computer and Telecommunications Networking. Vol. 31. 1999, pp. 1331-1345.

Grønbæk, K. and Trigg, R.H. (1999) From Web to Workplace: Designing Open Hypermedia Systems. MIT Press, Boston Massechussets. July 1999, 424 pp (ISBN 0-262-07191-6).

Jensen, L. and Harbo, K. (2000) "Wiring the Ivory Tower Contribution at the EADTU (European Association of Distance teaching Universities". Paris Millenium Conference September 2000. http://www.eadtu.nl

Jühne, J., Jensen, A.T., and Grønbæk, K. (1998) *Ariadne: a Java-based guided tour system for the WorldWide Web.* In proceedings of The Seventh International World Wide Web Conference (WWW7) Brisbane, Queensland, Australia, 14 - 18 April 1998.

Nicol, D., Smeaton, C., and Slater, A.F. (1995) Footsteps: trailblazing the Web, in: *Proc. of the 3rd International World Wide Web Conference,* Darmstad, 1995.

Sandvad, E.S., Grønbæk K., Sloth L., and Knudsen J.L. (2001) A Metro Map Metaphor for Guided Tours on the Web: the Webvise Guided Tour System. In proceedings of the Tenth International World Wide Web Conference, Hong Kong, May 1-5, 2001. ACM: New York, 2001. pp326-333.

Trigg, R.H., (1988) Guided tours and tabletop: tools for communicating in a hypertext environment, *ACM Trans. Office Information Systems* 6(4, October): 398–414, 1988.

Tufte, E. R. (1997) Visual Explanations . Graphics Press. Cheshire, 1997. 156 pages.

Zellweger, P.T. (1989) Scripted documents: a hypermedia path mechanism, in: *Proc. ACM Hypertext '89,* Pittsburgh, Pennsylvania, 1989, pp. 1–14

Video Support for Multimedia Knowledge Information Systems

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Introduction

Companies are increasingly becoming aware of the importance of knowledge for their competitiveness and success. Knowledge should be kept and distributed in the company. For this reason, the preservation of expert knowledge is becoming an important challenge for knowledge management. We argue that knowledge acquisition techniques can help to meet this challenge: we are using expert interviews to elicit knowledge from experts and compile this knowledge into a XML-based information system.

Up to now the contribution of video components in the process of knowledge presentation in information systems has been underestimated. Therefore we present a concept for including automatically generated context-dependent video sequences from the recording of expert interviews. We explicitly focus on the requirements for attribution of video sequences and information concepts with metadata and outline the idea of a "fuzzy" metadata attribution scheme which is used to control automatic selection and combination of video sequences.

Process of Knowledge Acquisition

Our research group raise knowledge in cooperative sessions with experts of a company. We use structured interviews, a well known knowledge elicitation technique (cf. [4]). Just before the interview the expert obtains a special structured questionnaires for preparation. The interview is recorded with a video camera but so far only audio information is (semi-)automatically attached to the questionnaire and retrieved later in the information system. During the interview mindmaps are generated by the knowledge engineer (cf. [3]) whose information modules are filled up by information gathered out of the interviews. The preparation of questionnaires, the presentation of interviews and the identification of knowledge are also conducted by the knowledge engineer.

Structure of an Information System

An information system can be understood as an electronic reference book for browsing and finding knowledge of practical experience from experts. This knowledge could hardly be made explicit so far. As stated in [6] the basis for such an information system is a knowledge map consisting of hierarchically arranged knowledge items which are called concepts or information modules. These modules may contain contextual information, images, links and other resources which are needed for a comprehensive presentation of the concepts.

These different entities are tagged with metadata which are an essential requirement for connecting the information system with other systems, e.g. learning systems or tutor/training systems. So far we use a custom metadata scheme and encode the descriptors into a XML-representation.

Automatic Generation of Context Dependent Video Information Resources

In the previous sections we have motivated the usefulness of video sequences for technical oriented information systems. A realization which tries to generate context dependent video sequences from the expert interview recordings needs to address the following topics:

- linking and synchronization of video recordings with concepts from the knowledge pool
- necessary metadata for automatic recombination
- integrated and interactive visualization of concepts and video presentation

"Fuzzy" Video Attribution

The problem with temporal media - like video or audio recordings - is to find a precise and sufficient attribution of presented concepts. Normally knowledge experts won't describe a single concept from beginning to end before they start discussing the next one, but they jump between describing interrelated concepts. An attribution mechanism for such interrelated descriptions should be able to define a temporal varying degree of relevance of presented semantic concepts in the recording. We therefore suggest a method for attribution of video recordings called "fuzzy" video attribution. It refines the concept of overlapping attributes or conceptual structures (cf. [1, 2]) by specifying a time-dependent relevance curve for each attribute.

Metadata Requirements for Automatic Video Information Resource Generation

A metadata scheme which can be used for automatic video resource generation has to address mainly the issues of video sequence selection and combination. We therefore suggest the creation of four additional metadata descriptors for video sequences:

- *Content Type*: Characterization of video sequence, e.g. description, example
- *Content Level*: Characterization of complexity, e.g. introduction, detailed technical description
- *Audience*: Specification of user roles for which recording is intended, e.g. beginner, technical experienced user
- *Concept Relevance Level*: Time-dependent degree of relevance of recording for specific topic

The first three descriptors can easily be mapped to *Learning Object Metadata* (LOM, cf. [5]) educational category data elements (5.2 Learning resource type, 5.5 Intended end user role, 5.10 Description). Unfortunately there is no possible mapping for *ConceptRelevanceLevel* as this descriptor needs to encode time-dependent values for different concepts. Possible implementations might be to specify a value for each second in the corresponding video sequence or to conduct a Fourier transformation for the specified relevance curve and assign calculated parameter values to the descriptor.

Integrated and Interactive Visualization of Concepts and Video Presentation

Presentation of video sequences is only useful if it is tightly integrated into the underlying information system. This implies that navigation between different topics must be possible from within the video stream and that the semantic context for the presented video sequence should be indicated. Furthermore the relevance level information needs to be presented to the user (e.g. by showing a "relevance meter").

The constructed video presentation also needs to be customizable by the user, e.g. in order to tell the system to generate only technical video sequences. Another possible customization would be to specify a lower limit for the relevance level which therefore gives the user some control over the length of the generated video sequences.

Outlook

Information modules should be processed efficiently by a reasonable linking to templates of an task-oriented tutor system. Through this it is firstly possible to develop specified task types, secondly to adjust the proposals of solution delivered by the students. Taken the presented requirements into consideration an implementation of a prototype video sequence construction system based on the *Synchronized Multimedia Integration Language* (SMIL, cf. [7]) specification is currently planned. Navigational elements to different topics and presentation of semantic context will be realized by producing a SMIL document.

References

1. T. G. Aguierre-Smith, G. Davenport: The stratification system: A design environment for random access video, MIT Media Lab Technical Report, 1992.
2. S. Butler, A. Parkes: Film sequence generation strategies for automatic intelligent video editing, Applied Artificial Intelligence, No. 11, 1997.
3. Brian R. Gaines and Mildred L. G. Shaw. Eliciting knowledge and transferring it effectively to a knowledge-based system. IEEE Transactions on Knowledge and Data Engineering, 5(1): 4--13, 1993.
4. B. Grille, H. Stoyan, B. Gaede, M. Müller: Effiziente Erstellung hypertextbasierter Informations- und Tutorssysteme aus Expertenwissen, in: H.-P. Schnurr, S. Staab, R. Studer, G. Stumme, and Y. Sure (eds.): Professionelles Wissensmanagement – Erfahrungen und Visionen, Shaker-Verlag, 2001.
5. IEEE P1484.12 Learning Object Metadata Working Group, http://ltsc.ieee.org/wg12/
6. J. Scott, E. Clayton and E.L. Gibson: A Practical Guide to Knowledge Acquisition, Addison Wesley, Reading Massachusetts, 1991.
7. Synchronized Multimedia Integration Language, http://www.w3c.org/AudioVideo/

Orienting Students to Distance Learning: Strategies for Success

Since 1995, the University of Northern Colorado has offered a graduate program in speech-language pathology that is delivered through distributed learning environments. Two cohort groups have completed the program , a third group will graduate in August, 2002, and a fourth group began the program in August, 2001. One of the challenges in designing and implementing a program that uses distance technologies is insuring that the students, many of whom have not participated in formal education for several years, have basic competencies in using technologies to access courses, find reference materials, prepare and transmit class assignments, and communicate with faculty, library personnel, administrators, and fellow students. A second, and no less important, challenge is to assist students in evaluating their own learning styles and strategies to facilitate their success as independent, adult learners in nontraditional learning environment. Introductory orientation materials, which incorporate basic information about program procedures (e.g., class registration) and an introduction to technology are provided prior to the initial semester; however, the faculty felt a more in-depth experience was required.

This session describes the objectives, content and outcomes of the class that was designed to meet these challenges. An earlier version of this course, which focused primarily on development of graduate level writing, was offered to the first two cohorts. Evaluation of student and faculty experiences revealed that the course needed to be redesigned to orient students to distance learning strategies, skills, and technologies. While a writing component is incorporated in the course, it is used as a mechanism to meet the orientation goals, as well as introduce students to faculty expectations for graduate writing. This course was offered to the third and fourth cohorts.

The redesigned class incorporated the following six objectives that students meet as they participate in the class:

1. Students will evaluate their learning needs, learning styles, learning strategies, study habits, and technology experiences to facilitate participation as successful adult learners in distributed learning environments.
2. Students will demonstrate competencies in accessing and transmitting course information and assignments online and using email, chat rooms, and listservs to communicate with fellow students and the instructor.
3. Student will develop appropriate topics for review papers in communication disorders.
4. Students will use appropriate strategies to access and obtain reference materials through the UNC library.
5. Students will demonstrate strategies for accessing and evaluating internet documents of research purposes.
6. Students will write a review paper that demonstrates competence in using a word-processing program and APA editorial, writing, and manuscript styles.

Activities designed to help students meet these objectives included:

1. Accessing the course webpage and using it to retrieve course information and communicate with other students and the instructor.
2. Readings and activities in *How To Be a Successful Distance Student*, Marguerita McVay (2000), including completion of surveys for self-analysis of learning needs, study skills, learning strategies, and technology experiences.
3. Maintaining a learning journal on at least a weekly basis to facilitate development of reflective learning strategies.
4. Developing annotated bibliographies of print and internet references using OVID databases (e.g., Psychinfo, Medline, ERIC) and online search strategies.

5. Evaluating internet references using criteria presented in the McVay text.
6. Selecting a topic in speech-language pathology of appropriate scope for a short (8-10 page review paper).
7. Completing the paper using APA style guidelines.

Students are instructed how to submit assignments online through the course webpage or as attachments to email and strongly encouraged to do so.

Finally, examples of student products and communication, from the third and fourth cohorts, were presented along with an analysis of learning journal entries from the third and fourth cohorts. These entries provide insights into students' unique learning styles, strategies and challenges, their perceptions of readings, their development in use of technologies, and their reactions to the assignments. Patterns of entries will be presented, as they provide a clear picture of student outcomes for the class. For example many students expressed increased confidence in using technology. Midway through the course one student wrote,

> This class......is really helping me to relate what I've learned to my professional environment. In times past, I would never have attempted to even turn on a computer at work. I've always relegated myself to "working" at home where I could be under the watchful eye of my husband who is always quick to lend a hand with helping me understand and maneuver the computer.
>
> As I am acquiring more knowledge of the computer, I am excited about it.
>
> (PB, 10/22/99)

At about the same time, another student wrote, "I have become more confident using the Internet, finding different links, getting focused on what information I am looking for." (CR, 10/23/99). Patterns that reflect frustrations and successes with using the tools of technology, developing communicative competence in an on-line environment, and building interpersonal relationships among students and faculty were highlighted.

Bibliography

Ehrmann, S.C. (1995, July). Moving beyond campus-bound education. *The Chronicle of Higher Education.* Retrieved December 20, 2001 at http://www.learner.org/edtech/distlearn/chronicle.html

Kerka, S. (1996). Journal writing and adult learning. *Eric Digest No. 174.* Retrieved December 20, 2001 at http://www.ed.gov/databases/ERIC_Digests/ed399413.html

McVay, M. (2000). *How to be a successful distance learning student: Learning on the internet* (2nd ed.). Needham Heights, MA: Pearson Custom Publishing.

Library services for distance education and off-campus programs. University of Northern Colorado, Libraries. Retrieved December 20, 2001 at http://www.unco.edu/library/distance/online.htm

Zimmerman, B. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*(1), 3-17.

Using Threaded Discussions As A Discourse Support

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Abstract: Students construct meaning from text through conversation and social interaction. The aim of this research was to examine how the use of an online, threaded discussion, as a discourse support, can facilitate deeper levels of student understanding. The basic assumption being tested is that using discourse supports, applying various discussion strategies like reciprocal teaching, creates an underpinning to do intellectual work and that these supports can be employed in an online discussion environment. Four online discussions were conducted over a period of two months, two in my Advanced Placement American Government classes, and two in my college-prep American Government classes. In an online discussion, the students and the teacher have a visual record of the conversation and the quantitative and qualitative aspects of the conversations. The online discussion environment allowed more students to participate in a class discussion and increased the amount of their participation.

Introduction

Students constructing meaning from text through conversation and social interaction, teachers creating scaffolds to support those activities – these are ideas that I have only recently begun to consciously apply to my teaching strategies. Intuitively and through my model for teaching, the Socratic method, I know I have been basically doing the good things for my students. However, I realize that I have missed the theoretical underpinnings that might allow me do more or be more consistent in what I do. Equipped with a better theoretical understanding, I am energized by the prospect of creating a stronger environment for my students in both classroom work and the use of the Internet as supports for learning.

My experience as a member of the CHSSP-TRIP project, in early February 2001, provided the inspiration to research the use of online discussions as a way to support deeper understanding of course content. It motivated me to investigate the literature about constructivist ideas and learn about the use of discourse strategies like reciprocal teaching.

Many teachers have "ah ha" experiences in their classrooms without a lot of background in the learning theory to explain the results. They have difficulty repeating the same outcome in other elements of their teacher strategies; successful activities become hit and miss. However, if more teachers had access to examples of teacher research, they could use these as templates for their own research. Far more beneficial than obtaining sample lesson plans, teacher research models provides teachers with ways to apply sound learning theory while transforming their classrooms into learning laboratories. This is an exciting way to teach.

Research Question

How can the use of an online, threaded discussion, as a discourse support, facilitate deeper levels of student understanding?

Assumptions

1. Discussion engages students in more thinking than listening to lectures or just responding to teacher questions.
    a. The discussion experience contributes to deeper understanding and retention of concepts. Studies into the effects of reciprocal teaching strategies confirm the relationship between discussion and understanding (ncrel.org).
2. The use of discourse supports, like reciprocal teaching, create an underpinning to do intellectual work in ways that provide assistance in deeper levels of thinking and understanding. As Professor Robert Bain has stated, "Until internalization occurs, all performance must be assisted" (Bain, TRIP).
    a. The reciprocal teaching strategies, as I used them to support content comprehension were presented and explained to the students in the following order: prediction, clarifying, summarizing, and questioning.
3. The use of a internet discussion board creates the opportunity to extend a discussion outside the class time, allowing for more reflective responses and create a record of the discussion that can be referred to at a later time.

The Research Plan and Observations During the Process

Phase One - Instruction in the reciprocal teaching strategies

First, I modeled the four parts of reciprocal teaching strategies for them: prediction, clarifying, summarizing, and questioning. Second, we used the reciprocal teaching steps to read another short selection of text together. Finally, after organizing into groups, I assigned the class to do another short part of the text applying the strategies.

Phase Two - Checking for understanding of the short readings and feedback on their first use of these strategies

The initial reaction from all six of my classes was positive; students recognized that support from the group aided their individual understanding and extended their thinking to other government related topics. These are all seniors. Not all of them are particularly willing to volunteer, to the whole class, that they just learned something helpful. Ironically, the shy or "too cool" groups of students will later find their voice in the online discussions.

Phase Three - Integrating reciprocal teaching strategies into the daily life of the class and then practiced in online discussions

Before I could give them an assignment to use the discussion strategies online, I wanted to be sure my students were comfortable with the reciprocal teaching process. Based on my observations of their notes, group conversations, and the follow-up whole-class discussion, more of the students had a better understanding of the pertinent concepts than if they had read the article by themselves before discussing it in class.

At the conclusion of the two online discussions, all of the classes, approximately 170 students, completed an evaluation of their two online experiences.

Findings

Despite having used a reciprocal teaching strategy to facilitate an online discussion of text materials only once with the American Government classes, the test scores in two of three classes slightly exceeded the test scores, on the same exam, of the class the first semester. There are many variables that can account for the differences, however, the online experiences of my classes demonstrated, to me, the usefulness of online discussions. In an online discussion, the students and the teacher have a visual record of the conversations, both in the quantity of talk and quality of the conversations. While the teacher can give students "robust" comprehension strategies for face-to-face talk, the teacher does not usually require a transcript of the conversations. The online record creates links between assessment and student accountability. The students also noticed the value of both the reciprocal teaching strategies and the online discussion. One of the student comments was:

> "At first, I didn't understand how to predict, clarify, or summarize, the documents correctly. Yet, with practice, I was better able to understand the document. Now that I know how to read and study compositions, I have a better understanding of homework and what I read everyday. After reading and discussing articles online each night, I was able to come to class and discuss and share with my table what I took to be the meaning of the article. Table discussions allow people to share extra information with others giving a deeper insight into the significance of writings."

Concluding Thoughts about Teacher Research

One important question is how to bring in the scaffolding tools to "do" political science as students cover course content. This is an area requiring more research.

Another question, which I continue to explore, is whether or not the online conversation about a reading can improve a subsequent, whole class discussion? Can the students' understanding of the reading enable the teacher to add additional things for the students to think about? There might be issues and ideas that the students would not otherwise been able to see or reflect on without a good understanding of what they had read. This is particularly important with readings that are more difficult than the basic textbook.

This project has made an impact on my teaching and creates important implications for the teaching strategies of other social science teachers. If discourse supports are effective in increasing student understanding of content, teachers not using discourse supports in their strategies, need to alter what they are doing with students. If online use of discourse supports can extend those effective strategies even further, teachers need to rethink their use of the Internet.

References

Bain, R. (2000) "Into the Breach: Using Research and Theory to Shape History Instruction."

Bain, Robert. (2001) Speaking at the CHSSP-TRIP project. UCLA.

El-Hindi, Amelia E. (1999) "Beyond Classroom Boundaries: Constructivist Teaching with the Internet Children's Literature in the Classroom." *Reading Online.* http://www.readingonline.org/electronic/RT/constructivist.html

"Reciprocal Teaching"(2001)North Central Regional Educational Laboratory
http://www.ncrel.org/sdrs/areas/issues/students/atrisk/at6lk38.htm

Sherry, Lorraine, Tavalin, Fern, and Billig, Shelley H. (2000) "Good Online Conversation"
http://www.rmcdenver.com/webproject/JILR.HTM

Sherry, Lorraine. (2000) "The nature and purpose of online conversations: A Brief synthesis of current research." *International Journal of Educational Telecommunication.* 6 (1), 19-52.

Incorporating Concept Maps in a Slide Presentation Tool for the Classroom Environment

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Abstract: We present a slide presentation software that incorporates a concept map, which explicitly shows how the various slides (and other multimedia components) presented are related to each other. Furthermore, presentations are conceived as hypermedia systems, where the presenter can navigate among slides (and the concept map) instead of the typical linear ordering of slides. This approach will alleviate the load on the audience to memorize, recognize and process perceived information. This tool can be extremely useful to enhance understanding of presented material, which is particularly valuable in the classroom environment.

Introduction

Slide presentation software systems are very widely used teaching aids. Tools like *PowerPoint* have contributed enormously by making the preparation of slides efficient and convenient, and by providing numerous features that enable high quality display of slides. Nonetheless, they offer limited facilities to automatically organize the slides in a logically coherent manner. These tools typically provide a linear ordering of the slides, and the presenter usually goes forward from one slide to the next, and occasionally goes back to previous slides. This approach has its limitations, especially when the subject matter presented is complex. It is a very common experience to feel "lost" while attending a presentation because the information currently perceived (visually or orally) cannot be placed in its appropriate context. Furthermore, a complete grasp of the information being presented often necessitates considerable memorization and processing of material contained in previous slides. But the *Model Human Processor* (Card et al. 1986) describes the limits of the human mind in perception, memorization, processing, recognition, discrimination, etc.

Also, a linear ordering of slides often encourages *linear thought* (Zuhn 1995) i.e. following a sequential association of ideas, linking each concept with a single pre-requisite concept and the next logical concept, instead of the more instructive *global thought* (i.e. choosing from divergent paths of multiple linkages of concepts to reach a conclusion).

Typically the individual slides in a presentation are logically connected to each other, and the relation among slides can be represented by a network. This can be viewed a small-scale hypermedia system. The objective in this research project is to design, develop and evaluate a slide presentation tool that makes the relation of individual slides to the overall network visible throughout a presentation. That is, each slide is placed in a wider context. This will make understanding easier for the audience as well as enhance the expressive capability of the presenter.

Related Work

Computer-Human Interaction research can enormously contribute to the effective dissemination of knowledge in the classroom environment, especially when the design of hardware and software systems is sensitive to human and psychological factors, such as capabilities and preferences of users. In (1995), Zuhn describes the use of concept maps in a hypermedia system to help teachers organize and deliver teaching material. The system encourages global thinking about concepts and skills to be learned by students. Franklin et al. (2000) show how PowerPoint can be enhanced with a speech-based interface in the context of the Intelligent Classroom Project. The use of multiple input modes (particularly visual ones) to eliminate reliance on a single constraining input mode in a classroom environment is described in (Flachsbart et al. 2000). Visualization of information, particularly in the context of hypermedia systems, is a related research area. Conventional interactive systems provide inadequate views of the information space being explored and hide most of the information, especially about the organization of the information. Many researchers have suggested graphical overviews for the users (Nielsen 1990, Zizi 1996). For example, Zizi (1996) describes *topic* and *document maps*, which provide an abstract global overview of documents and their contents. Other research on information visualization includes the Visualizer Project (Card et al. 1991), Tree Maps (Shneiderman 1992), Starfield Displays (Ahlberg et al. 1994).

Design and Implementation

The system we present consists of mainly the following: (1) a graphical representation of the network of slides, and (2) individual slides which essentially contain the material to be presented with some added information, such as hyperlinks to other slides. We use a concept map to represent the network. The nodes in the network can be slides or documents (document map) or topics (topic map). The *links* are logical relations among nodes. These links can be represented in various ways (such as directed lines) to depict different types of relations among slides or topics. We also group nodes into *concept regions* which associate logically related slides based on proximity on a concept map. We can use scrolling facilities when there are many slides, and a hierarchy of maps when the subject matter can be more naturally presented at various levels of abstraction, thereby avoid cluttering one map with too many details. As the presentation progresses, the nodes on the concept map are updated (by changing their color, for instance) to show that they have already been presented. The concept map also contains hyperlinks to connect to individual slides.

The individual slides also have hyperlinks to the concept map and other directly related slides. Furthermore, a smaller version of the concept map (without any text) is displayed on individual slides. This scaled-down concept map is made up-to-date i.e. it reflects where we have reached in the presentation and how it is related to the slide currently been displayed. The presenter has the flexibility of moving directly from one slide to the next or via the concept map. It should be pointed out that the design of the system should be simple and intuitive, such that its *cognitive load* does not outweigh the gains in enhancing understanding. We now describe in detail the precise design choices we made for a prototype of the system that was developed.

Design of the Concept Map

Fig. 1 is a concept map of a presentation on this paper [1]. The concept map is based on a combination of the document map and topic map approaches. That is, each node in the concept map can be a slide or a topic. For instance, "Related Work" is a topic, whereas "The Organizer Project" is a slide. Nonetheless, these two types of nodes are not graphically differentiated, so as to avoid confusing the audience with too much information. The title of the presentation is also displayed at the top, which is a useful reminder of what the talk is about. The links are represented by lines of various colors and thicknesses to show various types of relations. In Fig. 1, only two types of links are shown: (1) black, uni-directional lines for parent-child relationship in a tree structure, and (2) a brown, bi-directional line to connect two slides at different parts of the tree. Other types of links can also be used, but they should be clear and intuitive or based on standard diagrammatical notations. Otherwise they should be explained to the audience.

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[1] Although colors are not shown in Figures 1-4, the use of colors is essential in this system.

Concept regions group a few logically related slides/topics together and show them in a blue area (Fig. 1). A concept region is shown on single-clicking anywhere in the region (except on the boxes for nodes). Only one concept region is shown at a time. If there are too many slides to fit one screen, then we can have a multi-level concept map, where a topic node at a higher level map opens up another map. This enables display of information at different levels of abstraction. Another option is making the concept map large, which can be viewed through a scrolling facility. At the beginning of a presentation, all nodes are shown in green on the concept map, to indicate that the corresponding slides have not been *completed* yet. The presenter can open an individual slide by single-clicking on its box. If a topic box is clicked, then it connects to its leftmost, nearest descendant which is a slide. If no such slide exists, then nothing happens on the mouse click. When a slide is opened, then it is said to be *active*. On returning to the concept map after showing an active slide, the latter becomes completed. Once a node is active, it remains active as long as at least one of its descendants is active or non-completed. If all its descendants are completed, then the node becomes completed. Active slides are indicated in a yellowish color and completed ones in deep pink (Fig. 2).

If the text in a node box is not adequate to convey what it contains, then we have a longer narration on a *mouse-over* action on the box (Fig. 3). Clicking on the narration will remove the narration. The relation between particular pairs of nodes can be emphasized by a mouse-over action on the corresponding links, whereby the related nodes are highlighted (Fig. 3). In fact, a link can be further emphasized by opening a slide to illustrate the relation. We can also connect a node directly to a graphic, audio or video component. In our example presentation, we include an audio component and indicate it by an appropriate icon on the concept map.

Design of Individual Slides

Individual slides are made of four frames (Fig. 4). One central frame contains the material being presented. The three frames on the right respectively contain: (1) a smaller version of an up-to-date concept map to reflect the current status of the presentation; this map does not have any text, but shows the concept region which contains the current slide; (2) named hyperlinks to all slides connected to the current slide; as a convention, we opted for the topmost hyperlink to be the parent node (if any); (3) a hyperlink to the concept map (or maps at various hierarchical levels). The presenter can always choose to show only the information being presented (i.e. omit the last three frames) in situations where more space is required on the screen, or additional information like hyperlinks are redundant.

The slides have a default ordering. The presenter can show the next slide through one of the typical PowerPoint-like actions: single-click, PageDown or Return. Besides these options, the presenter can choose to go to any slide by doing one of the following : (1) click on a named hyperlink, (2) click on the appropriate box on the smaller version of the concept map, or (3) go via the concept map. The presenter should choose the option which will make the presentation clearer and the flow smooth and intuitive.

Implementation

The prototype was implemented in PowerPoint, using macros and modifying the Visual Basic code generated. In the current prototype, many of the functionalities have been hard-coded to suit a particular presentation. We can envision a more generic tool, where most of the features are automated and the user has the flexibility to customize the presentation by, for instance, choosing color schemes, disabling some features, choosing templates for organization of nodes on the concept map, automating the creation and maintenance of maps and slides, etc.

Extensions

There are many ways in which this prototype can be extended, and individual features can be variously implemented. Some examples of new features and variations of existing ones have already been discussed. A few more suggestions follow:

- Place *anchors* within the presented text in individual slides;
- Flexibility of organizing the contents (and sizes) of frames on individual slides;
- Explicitly distinguish among nodes, which can be topics, slides or other entities like audio, graphic or video objects; suitable graphic and auditory icons can also be used;
- Differentiating between the user actions (like mouse clicks) that the presenter wants the audience to see and those which should be hidden, and using short-cut keys for the latter;
- Different ways of showing the current status of the presentation. For instance, a node can be shown as completed as soon as any of its descendants is completed;

A good design of the system would have to be based on factors like feedback from target users, the particularities of the teaching environment (type of learning institution, subject matter, etc.), familiarity of the audience with the features, etc. One approach is to provide a wide range of features, options and templates, and let the presenter customize the system.

Evaluation

Our prototype was used for actual formal presentations in graduate classes in the Department of Computer Science at Texas A&M University. The system was evaluated through a questionnaire, which essentially queried students about the effectiveness of individual features added to PowerPoint to help understanding the presented material. More evaluation was performed informally with students and faculty of the department. The response obtained was largely positive. Over 85% of the people queried felt that the use of concept maps has a potential to facilitate learning during a presentation. Around 70% of the students who attended the formal presentations found our prototype useful. 10% felt that the system made it more confusing. The remaining 20% saw no significant benefit of our extensions to PowerPoint. We obtained many suggestions during the evaluation phase, some of which were subsequently incorporated in our design. But there were some criticisms as well; the most common ones are summarized below:

- Invoking the concept map can be obtrusive to the general flow of the presentation;
- The audience can be confused by the extra information provided; familiarity with the features is necessary;
- The smaller version of the concept map and the named hyperlinks take up too much space on individual slides;
- The presenter should fully master the tool; it is very easy to perform an incorrect action (such as clicking at the wrong spot), which can send the presentation in an unintended direction;
- The presenter may be confused when faced with too many optional actions. (This problem can be partly solved by a subtle indication of one preferred action at each stage of the presentation);
- The current status of the presentation (indicated by non-completed, completed and active nodes, using different colors) is not always obvious;

It should be noted that the proposed system focuses on the audience as the "user". As far as the presenter is concerned, it is clear that he/she has to spend more effort in the preparation of a presentation, in mastering the various features and in organizing the presentation to ensure a smooth flow and logical coherence.

The benefits of the system, as reported to us during the evaluation, are summarized in the following:

- The ability to constantly perceive the "big picture" rather than merely focus on individual slides;
- More awareness of what the presenter is really thinking about;
- Induces the presenter to organize his material more logically;
- Questions can be answered more effectively by conveniently accessing relevant slides;

- Decisions about which slides to show and which ones to pass over during a presentation can be made on-the-fly in a convenient and logical way - for instance, parts of the tree or hierarchy of nodes can be left out from the presentation, without the inconvenience of opening slides, examining them and finally deciding to skip them;
- The possibility of catching up with the talk even if you come in late or doze off for a while!

Conclusion and Future Work

We hypothesize that the slide presentation tool described in this paper has considerable potential to facilitate learning in the classroom, especially since slide presentation systems are so widely used. The key advantages of the system we propose are: (1) The ability to graphically perceive the inter-relationships among various fragments of information, and (2) the possibility of smoothly and logically navigating through the network of ideas, topics and documents.

Myriad variations and extensions of the design we have presented can be thought of. The tool will need to be customized to suit the target audience: classrooms with different types of students, and other audiences like seminars, conferences, marketing, etc. In fact, we advocate a high degree of automation and customization, so as to reduce the effort required to prepare a presentation, and to efficiently and effectively tailor the tool for different situations. As future work, we envisage the development of a fully generic, customizable prototype, and its evaluation by objectively assessing how different features (or sets of features) impact understanding (as well as ease of presentation) in various environments.

References

Ahlberg, C. & Shneiderman, B. (1994). Visual Information Seeking: Tight Coupling of Dynamic Query Filters with Starfield Display. *Proceedings of CHI, 1994,* MA: ACM Press. 313-318.

Card, S.K., Mackinlay, J.D. & Robertson, S.G. (1991). The Information Visualizer, An Information Workspace. *Proceedings of ACM SIGCHI, 1991,* MA: ACM Press. 181-188.

Card, S.K. & Moran, T. User Technology: From Pointing to Pondering. (1986). *Proceedings of the ACM Conference on History of Personal Workstations, 1986,* MA: ACM Press. 183-198.

Flachsbart, J., Franklin, D. & Hammond, K. (2000). Improving Human Computer Interaction in a Classroom Environment Using Computer Vision. *Proceedings of IUI, 2000,* MA: ACM Press. 86-93.

Franklin, D., Bradshaw, S., and Hammond, K. (2000). Jabberwocky: You don't have to be a rocket scientist to change slides for a hydrogen combustion lecture. *Proceedings of IUI, 2000,* MA: ACM Press. 98-105.

Nielsen, J. (1990). *Hypertext and Hypermedia.* San Diego, CA: Academic Press.

Shneiderman, B. (1992). Tree Visualization with Tree Maps: 2-D space Filling Approach. *ACM Transactions on Graphics, 11(1)* , 92-99.

Zizi, M. (1996). Interactive Dynamic Maps for Visualization and Retrieval from Hypertext Systems. In *Agosti, M. & Smeaton, A. (Eds.), Information Retrieval and Hypertext,* NY: Kluwer Academic Publishers.

Zuhn, J.A. (1995). The Organizer: A Hypertext Tool to Assist Teachers in the Development and Delivery of Cognitive-Constructivist Curriculum. PhD dissertation, Department of Curriculum and Instruction, Texas A&M University.

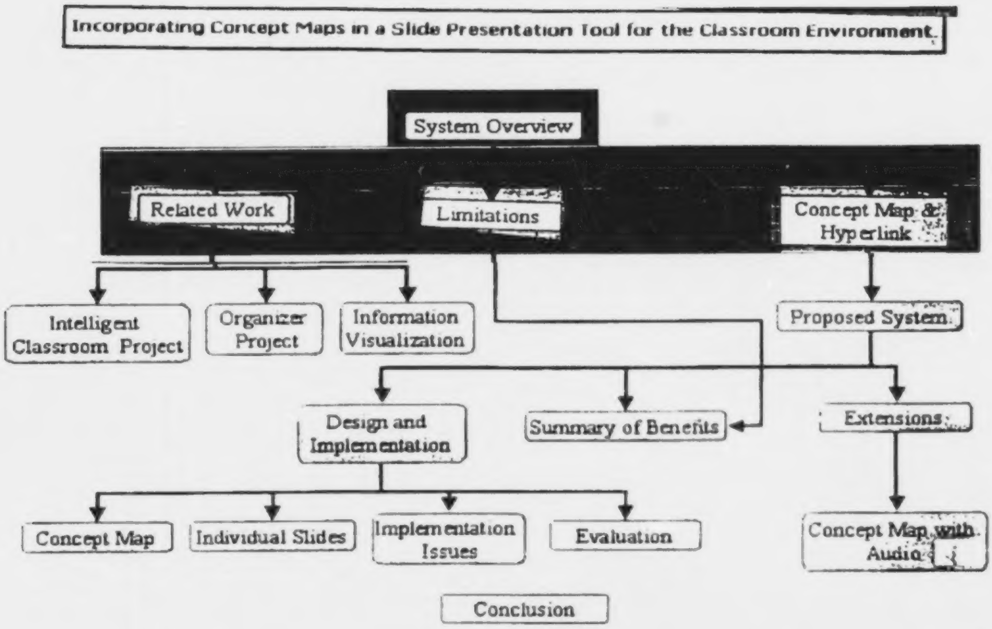
Incorporating Concept Maps in a Slide Presentation Tool for the Classroom Environment.
System Overview
Related Work
Limitations
Concept Map & Hyperlink
Intelligent Classroom Project
Organizer Project
Information Visualization
Proposed System
Design and Implementation
Summary of Benefits
Extensions
Concept Map
Individual Slides
Implementation Issues
Evaluation
Concept Map with Audio
Conclusion

Figure 1: A concept map with a concept region grouping 4 nodes; uni-directional and bi-directional links are also shown. "System Overview" node is active; all other nodes are non-completed.

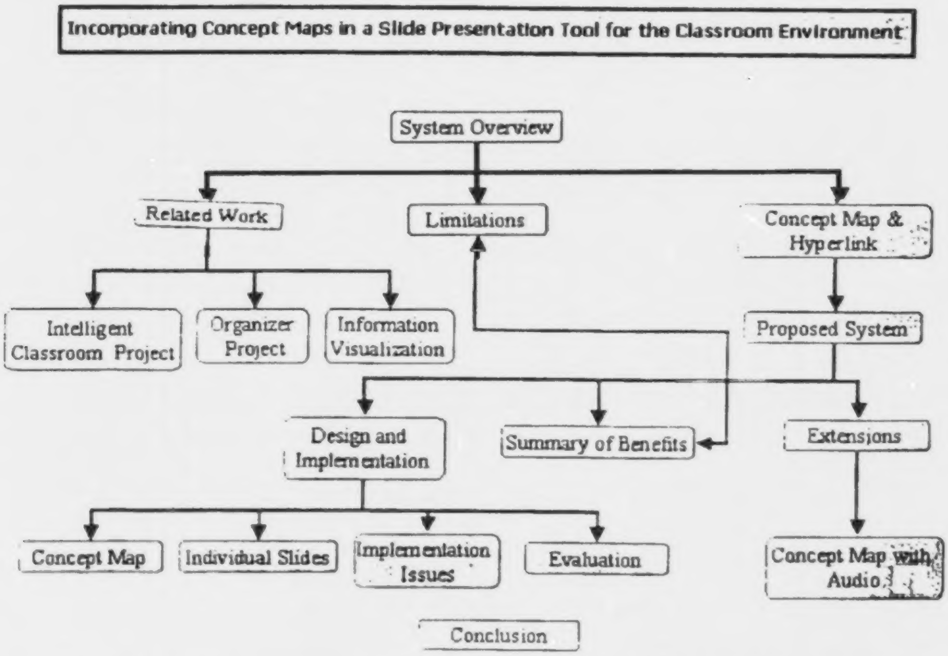
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Figure 2: Different colors are used to display completed nodes (like "Related Work"), active ones (like "Limitations") and non-completed ones (like "Conclusion").

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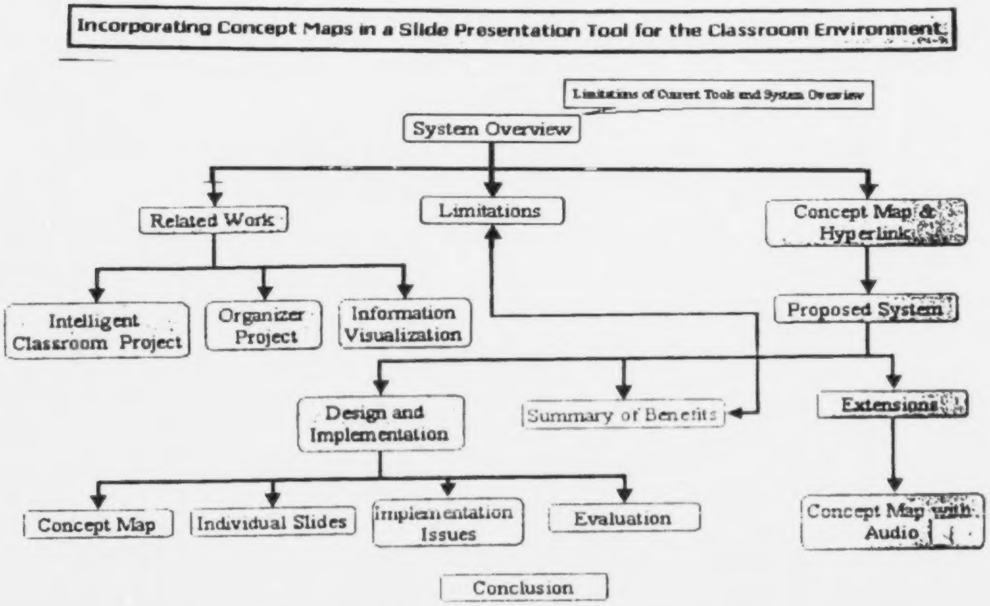
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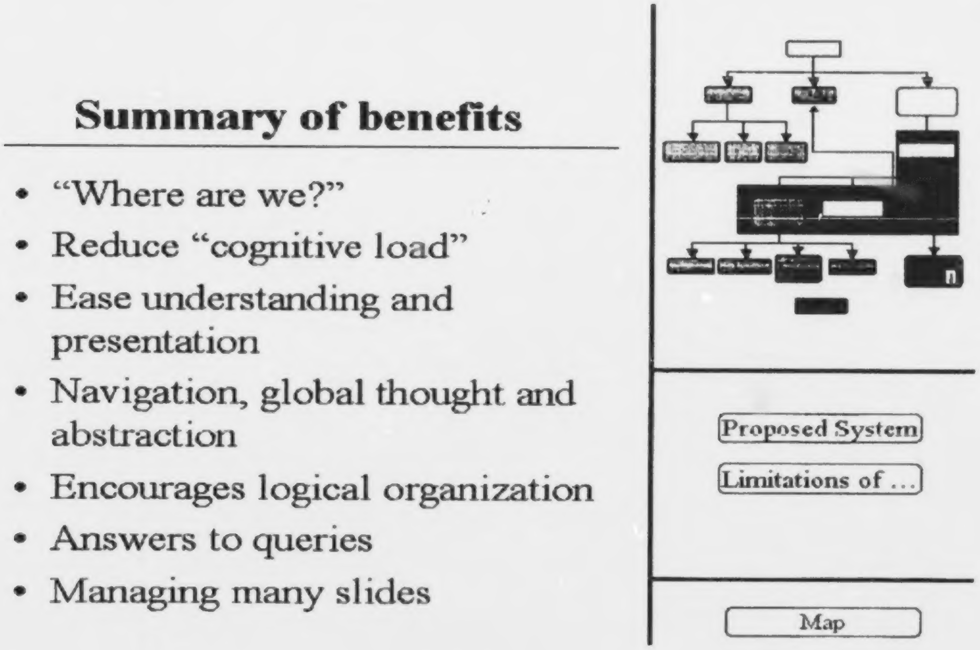
Limitations of Current Tools and System Overview
System Overview
Related Work
Limitations
Concept Map & Hyperlink
Intelligent Classroom Project
Organizer Project
Information Visualization
Proposed System
Design and Implementation
Summary of Benefits
Extensions
Concept Map
Individual Slides
Implementation Issues
Evaluation
Concept Map with Audio
Conclusion

Figure 3: This concept map shows a narration and highlights two linked nodes.



Summary of benefits

- "Where are we?"
- Reduce "cognitive load"
- Ease understanding and presentation
- Navigation, global thought and abstraction
- Encourages logical organization
- Answers to queries
- Managing many slides

Proposed System
Limitations of ...
Map

Figure 4: A typical individual slide with four frames.

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Technology Drives Learning - Learning Never Ends
Professional Development Needs of Faculty

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Abstract: This paper describes an innovative study that collected data through personal interviews from one-hundred members of a faculty of education to investigate the barriers and enablers to using technology in communication, teaching and research. The findings and recommendations are of value to faculty who are interested in learning and using technology and to those responsible for implementing technology and its infrastructure.

Introduction

Through research and development, a plethora of technologies and applications are available for faculty to use in their communications, in their teaching and in their research. Researchers, such as Chizmar and Williams (2001), support the need for studies to investigate technologies, services and products that faculty members want and can successfully use. Chizmar and Williams compared their assertions with the results of a faculty survey to determine faculty needs. With a range of interests and abilities from early adopters to wary adopters, this study was implemented to investigate the enablers to faculty members' use of technology.

The Study

The research study was conducted to investigate the faculty member's use of technology. A convenience sample was used. Each participant was personally interviewed by one of three experienced graduate student interviewers. Of the 120 invited for interviews, 100 participated. The interview followed a guided question approach with an open-ended question to capture any input from the participants that the participants deemed necessary to include. The data was then carefully read and sorted and entered into an electronic database for sorting, resorting, queries and classifications. The findings from the study were condensed and presented to the faculty at an open invitation meeting.

Findings

Several themes emerged from the participants' comments in the study including barriers and enablers to implementing technology in their communication, in their teaching and in their research. All of the participants in the study indicate that they use technology to communicate, and most participants are interested in learning more about technology and how it can be incorporated into their communication, teaching and research. Two barriers to incorporating technology that emerge from the study are a lack of time and an increasing lack of contact with colleagues.

Participants comment that their most complex barrier is their lack of time and that evolving technologies are demanding of their time to continuously learn. Participants suggest it is not just a barrier to wary adapters, but it is also a barrier to those who are adept at using technologies. Participants comment that learning new and updated technologies is time consuming, and that self-teaching or troubleshooting is often the least effective use of their time.

Recognizing that technology drives learning, and their learning will never end, participants look for a supportive technology infrastructure, templates and technical services, and access to ongoing help to enable them to use their time more efficiently to learn and use technologies.

Participants comment that technology allows them to work from home or elsewhere; and to communicate with students, colleagues and administration locally, or with colleagues with similar interests globally, all without leaving their desks. Participants also comment that as they gain confidence in using existing technologies, they become less dependent on their colleagues for help. Although being able to work off campus, and communicate without leaving their workstations increases their productivity, it limits opportunities to personally communicate with faculty of education colleagues. Participants recognize that limited access to colleagues within the faculty of education can be a barrier to discussions on the impact of technology on education and learning, and to the sharing of new technologies and best application practices. To overcome this barrier, participants suggest faculty of education colleagues need to meet to enable discussions. Participants look for opportunities for faculty of education members to meet to discuss technology issues such as ethics, intellectual property, copyright, permanence of electronic data, and impact on education and learning as a broad issue and from a perspective from their disciplines. Participants also look for opportunities to learn about new technologies and best practices from early adapters of technology through casual conversations or from demonstrations in order to determine the relevance of the technology to their work. Participants ask early adapters not to make any assumptions—colleagues are relying on early adapters to communicate with them, to show new and emerging technologies and to make suggestions how technology could apply.

As technology drives learning, learning never ends. To this end, participants suggest enablers such as a strong infrastructure that supports access and technical support, and an interconnected support system to provide help at the right time for the right needs. Participants also suggest open communication with colleagues to discuss issues relevant to technology in education, and best practices. Specific findings and recommendations from this study are of value to the users of the applications and to those that are responsible for implementing the technologies and infrastructure.

References

Chizmar, J. & Williams, D. (2001). What do faculty want? Online [http://www.arts.ilstu.edu/CAUSE]

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Are You Being Served? Students' E-learning Needs – A Survey

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Abstract: In this paper we present the main results of a study concerning students' e-learning needs at a Belgian universtiy (VUB). Our analysis focuses on the type of academic education they prefer, which e-learning facilities they expect and how they perceive the consequences of internet based education. The data reveal that students want a blended educational system, with considerable elearning aspects but no genuine distance education. They show a multitude of negative and positive attitudes toward the impact of e-learning.

Introduction, objectives and methodology

In October 2000, the staff of the Vrije Universiteit Brussel, a mid-sized Dutch speaking university in Belgium, accepted the new concept of 'competence based learning in flexible education'. By 2005 university policymakers expect a series of powerful learning and teaching environments, where information and communication technologies (ICT) play a significant and role. Initiatives have been planned which will be characterized by (Derks, 2000): (1) an extension of the ICT infrastructure (e.g. wireless campus) and system administration, (2) more and better ICT support for educators, (3) an integral ICT approach and (4) bottom-up and top-down methods. In order to fulfil the various *educational functions*, i.e. 'facilities for stimulating specific student learning activities', e-learning modes are to be implemented. According to Webb (1997) an Internet based learning environment consists of different major players: the teacher, the learner, the technical support officer and the central administration. To be successful when implementing any educational innovation one has to keep in mind the role of the student, otherwise the university risks to make heavy but useless capital investment. Consequently, it is crucial to conduct exploratory research, because there is a strong need 'to consider the characteristics of our target audience when designing and exploiting educational provision' (Valcke, 2000).

In this study we attempt to explore the future prospects of e-learning at our university. We investigated three research domains: (1) which kind of academic education do students prefer - traditional, blended or pure online?, (2) which aspects of e-learning are *most wanted*? and (3) how do students perceive the outcomes of e-learning? Data were collected through an anonymous questionnaire administered to 470 undergraduate and graduate students from different education levels and disciplines (representative multiple stratified sample, N= 9451).

Results

University Type

The majority of learners (88.6%) of learners have positive associations with a combination of a traditional and a virtual study environments. Only 3 (exclusively male) students think pure e-learning is convenient, while 11% want to stick to the traditional approach.

E-learning facilities

Despite these rather conservative attitudes toward e-learning, students *do* want a lot of practical and pedagogic facilities to be online. By means of the data modes we defined what students most prefer (table 1). Practical study organisation, access to information and communication are wanted online but not elements like distance courses, chat sessions or interactive classes. Surprisingly, students do not favour a compulsory computer and internet course.

Coursematerial on Internet	Mode	Practical information via Internet	Mode
Course outlines/self study guides	yes	Electronic information board	yes
Exercises	yes	Exam timetables	yes
Sample assignments	yes	Exam regulation	yes
Sample exams	yes	Exam results	yes
Self-assessment tests	yes	Course timetable	yes
Computermanaged exams	yes	Complete list of staff (tel., e-mail, etc.)	yes
1 web page per course	yes	University web site for enrollment	yes
Online purchase of course-notes and books	yes	University web site for entering choice of optional courses	yes

Infrastructure	Mode	Communication via Internet	Mode
More computer rooms	yes	Discussion forum about courses and/or exercises	maybe
Laptop purchase via the university (at reasonable price)	yes	Tutoring timetable via e-mail	yes
Wireless internet access on campus	yes	Chat sessions with educators/teaching assistants	maybe
Software service on campus	yes	Chat sessions with fellow students	maybe
Helpdesk on campus	yes	Distance education	no
Computer renting	yes	Interactive classes via computers to replace lectures	maybe
Financial help with purchase of computer material	yes	Assignments via e-mail	yes
Cheap internet access	yes		
Compulsory computer and internet course	maybe		

Table 1: Students' preferences for specific e-learning facilities

Perceived outcomes of e-learning

Using a 5-point Likert-type scale ranging from *strongly disagree* to *strongly agree*, respondents were asked to provide their opinions on a variety of issues related to the impact of e-learning. The majority of students believe that e-learning will bring some educational benefits like more attractive education and better preparation for the job market. However, a significant proportion of students are undecided about the potential of e-learning for increasing the quality of the learning experiences. Almost six out of ten (57%) do not know if more enrollments can be expected, whereas the remaining 43% are almost equally distributed over the *disagree* and *agree* categories. The benefit of lowered inhibitions (where education is more accessible) is recognised by 46% of the respondents. More than 50% of the sample fear encroachment on social contacts and life on campus. On the other hand students do not think it will threaten their privacy. Students anticipate difficulties with self discipline and pace of study. They express more or less neutral feelings toward control and security issues. Opinion is divided over whether e-learning is more cost effective than other forms of learning.

Conclusions

Students at the Vrije Universiteit Brussel reject e-learning as a substitute for other forms of training. They strongly opt for a blended model of online and face-to-face education. E-learning is thought to be convenient, allowing to use online course material, organize and communicate easily about their studies in a flexible way. Our findings contradict the opinion of the educators adopting a booster opinion towards ICT in education.

References

Derks, T. (2000). *Competentiegericht leren in flexibel onderwijs. Het vernieuwde onderwijsconcept van de VUB*. Brussels: VUB.

Valcke, M. (2000). ICT in Higher Education: Threats and Opportunities. G. Vouros (ed.), *New Technologies for Distance Education*, 1-12. Samos: University of the Aegean.

Multimedia: a powerful support for multidisciplinary approach. A Case Study from the Project Discetech-Bimbotech.

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Abstract: The Discetech project, which has started in 1996 in Northern Italy, aims at experimenting the introduction of new technologies within the teaching-learning activities of high school classrooms. Since 1998, a similar project, Bimbotech, has been developed for initial classrooms (from 4 to 10 years old children). Several hundreds experiences involving several thousands pupils have been carried on by the teachers who have been previously instructed and assisted by the project's staff. This paper briefly introduces a case study, one of the most interesting Bimbotech experiments analyzing the organization, the phases, the results and the learned lessons. The final section wants to suggest a few useful remarks upon mutual connection between multimedia and knowledge.

1. An overview of the project

DISCETECH and BIMBOTECH are twin-projects, which try to experiment new technologies to teach and learn in the Italian school system. Discetech started in the city of Como[1] in 1996, while Bimbotech in 1998, under the initiative of Politecnico di Milano[2]; in 1997 it also branched out in Lecce[3], for the initiative of the Faculty of Engineering of the local University. Finally last year a new branch was opened in Milan.

The Discetech project as target has high school teachers and students while the Bimbotech one aims at children from 4 to 10 years of age (this is equivalent in Italy to "scuola materna" and "scuola elementare").

First of all, we attempt to support teachers to achieve the basic ICT knowledge necessary to their teaching activities using computers. In a second time, on the other hand, teachers are asked to plan and realize a didactical experience in the classroom in order to:

- Try to employ multimedia technologies within the class curriculum to find out their useful potential;

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[1] Como is a town near Milan, where another headquarters of Politecnico has been placed.

[2] The largest technical University in Italy, with Faculties of Engineering and Architecture.

[3] Lecce is a town in the south of Italy.

- Evaluate the efficiency of the above goals regarding:
    - Content acquisition
    - Knowledge building process (e.g. focusing on and selecting information);
    - Behavior skills acquisition (e.g. co-operative skill and teacher-student communication).

Our vision aims at improving the teacher's background and skills with the purpose to experiment new didactical solutions with students where new technologies must be involved and projects carried on collecting data all the school-year long. These attitude answers the purpose to acquire expertise mainly in experimenting with computer and interacting with multimedia instruments rather than discussing what should be done and so stopping just on theory.

Besides, there's no intention to judge the relationship between teachers and pupils or to give advice about the pedagogical approach that teachers choose to make use of: they have total autonomy on selecting the one they prefer and wish.

The project would require a three years commitment:

- the first year (**basic level**) looks after the off-line and on-line multimedia employment;
- the second one (**advanced level**) focuses on planning and carrying out a simple hypermedia product (off-line, e.g. a power-point presentation, as well as on-line e.g. a small HTML hypertext);
- the third and last one (**experimental level**) encourages teachers to realize (with Discetech staff support) a complex and complete multimedia project.

The first two years are organized in three phases:

- **formation** (from October to January): teachers acquire the ICT knowledge necessary to the experience that Discetech suggest them to realize in the classroom;
- **modeling** (February): teachers are guided by the staff to think about a proper personal project;
- **working within the class** (from March to April): each plan is developed during the school time.

Overall 600 teachers joined the Discetech program (some of them for more than 1 year) and more than 300 educational projects have been carried out, involving nearly 9000 students up till now.

In the next section we will present one of the best experiences, according to the originality and the quality of results, made during last year (2000/2001) in Como.

2. A Case Study: The *Pinocchio*'s tale

This experience has been carried on by one of the most active group of teachers taking part to the Bimbotech program.[4] The classes involved were two, both consisting of thirty 7-8 years old children.

7 years old children	30
8 years old children	30

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[4] The school is *Scuola Elementare di via Giussani – circolo Como 4, via Giussani - Como* The teachers involved are Raffaella Ciceri and Francesca Rossi.

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The overall aim of the experience can be summarized as it follows:

a) Get children used to the PC in the day by day class activities, promoting self-interaction with computer.
b) In particular, knowing and using the Microsoft program called Power Point as a tool to realize a slide each of the children as a part of a global classroom work.
c) Employing the new technologies to unify all the different experiences of the knowledge building process including both the traditional teaching method (like frontal lesson) and new attempts concerning theatrical activities, drawing, creative writing.

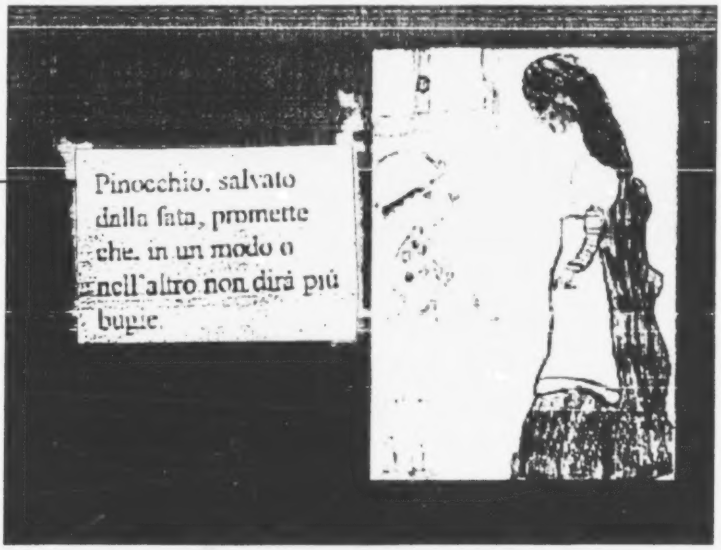
The project took up several subsequent months trying to make the *Pinocchio* 's tale the topic of the entire school year.

The teachers started with the reading of the tale, followed by the comprehension of the text. In a second time they made the children split it up in several sequences, one for each of them so that every child has been able to make a little abstract and a drawing in color, interpreting the characters in theatrical laboratories and thinking over the whole tale plot, interacting successively each other in the classroom. After that, the last step of the experience concerned the employment of computers: children are put in the position to scanner their drawing and to realize a Power Point slide. In this phase teachers just guided and supported them on demand to do themselves every step, letting them using entirely the PC.

The Power Point presentation contains:

- **The complete tale** developed slide by slide in order of time, each one made by a singular pupil, which includes the insert of a colored background, some buttons, a text, a scanned drawing and an animation (see the picture below as example – figure 1–).

Pinocchio after been saved by the fairy, promises he will never say lies again.



Pinocchio, salvato dalla fata, promette che, in un modo o nell'altro non dirà più bugie.

Figure 1: The screenshot of an explicative slide.

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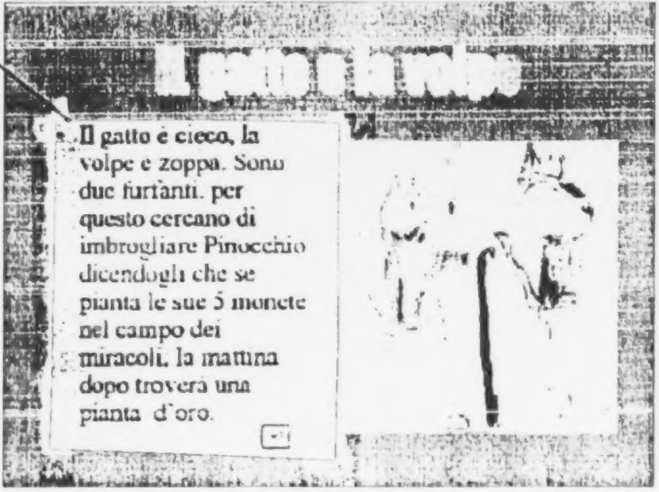
- **The cast** of *Pinocchio*'s tale developed in some slides, one for each character, realized by children who thought about the most relevant qualities that marked them out, as you can see in the next picture, illustrating the cat and the fox, two bad characters who want to lead Pinocchio astray. According to the hypertext structure every slide has a special button that allows to turn back to the home page.

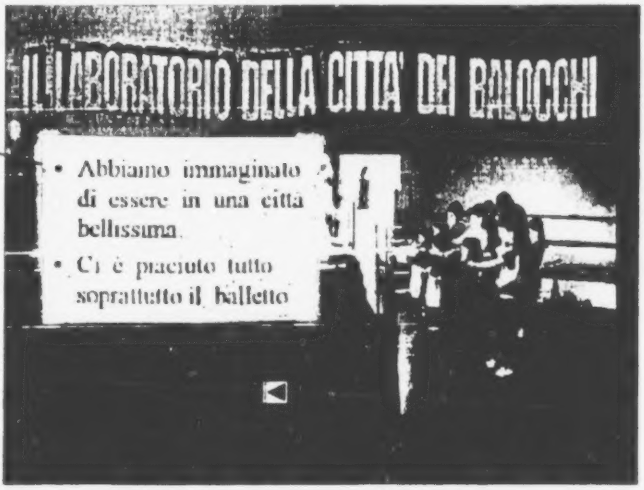


- Il gatto è cieco, la volpe e zoppa. Sono due furfanti. per questo cercano di imbrogliare Pinocchio dicendogli che se pianta le sue 5 monete nel campo dei miracoli, la mattina dopo trovera una pianta d'oro.

The cat is blind while the fox is limping. They are two scamps and that's why they try to cheat Pinocchio: they want him to plant his money in the miracles field because the morning after he could find a gold tree.

Figure 2: The cat and the fox.

- **The theatrical laboratories**: according to the school guidelines, which in Italy are fixed by P.O.F.[5] since 1999 with the beginning of the self-governing school, the whole work program during the school year has been based on the novel of Pinocchio. That's why teachers chose to stage it involving several classes and let the children socialize from a classroom to another. The hypermedia is a precious support to relate this experience as you can see in the following picture.



IL LABORATORIO DELLA CITTA' DEI BALOCCHI

- Abbiamo immaginato di essere in una città bellissima.
- Ci è piaciuto tutto soprattutto il balletto

We imagined to live in a beautiful and magic town. We liked everything about this experience especially the ballet.

Figure 3: The description of the theatrical lab with photo.

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[5] P.O.F. is the Plan of the Formative Offer, which defines the cultural and planning school identity and helps to explain and share the pedagogical and didactical directions. This plan allows to fix a specific goal trying out a new strategic lineup to get to it.

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- **Different conclusions**: as a creative writing exercise, teachers asked children to invent some gripping imaginary ends and put them in a slide in accordance with each one wish (see the picture showing the opening slide to the different courses).

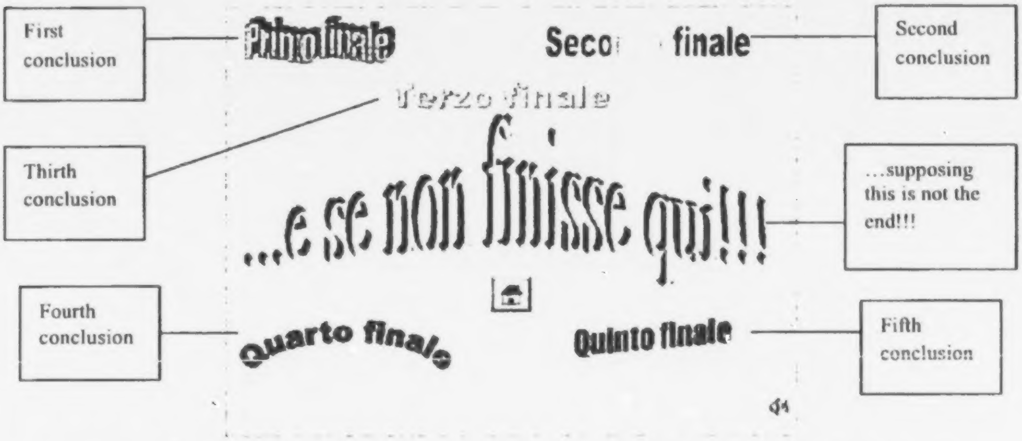

Figure 4: The screenshot where you're supposed to explore alternative conclusions.

3. Conclusion

The importance of this experience consists on the attempt to combine different activities, which culminate in a multimedia product: its creation allowed a new manner for children to relate each other mutually. Furthermore it helps to renew learning and teaching contents: indeed, *Pinocchio*'s tale has been approached in a different way and this permits to create a new manner of knowing by the development of a radically fresh work. The fact that pupils have found out several different conclusions to the story (see previous picture – figure 4 –) is exemplary for us to explain the innumerable creative powers of a project like this one.

Discetech highlights every intelligence style: in this particular perspective technologies and especially multimedia are very useful to improve all learning and teaching process structures, exploiting a richer interaction across the activities. They keep concentration up as well, feeding a reticular knowledge based on the association's reasoning and powering every human talent up contributing to make the classroom's relationship stronger and more complete than usual since computers naturally encourage cooperation, as Maragliano and Moretti say[6].

We think that an experience like the one we reported could be easily and successfully exported in a lot of other primary schools. That's why we are strongly interested to spread out this project offering the possibility to share this work and the useful information about it and to approach other works too by Internet.

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[6] R. Maragliano, G. Moretti, *Valutare nel multimedia*, in R. Maragliano, *I media e la formazione*, Roma, La Nuova Italia Scientifica, 1994.

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This experience is a meaningful example about the role that multimedia languages could hold inside the school system. The computer-assisted education is important for several reasons: besides the merely technical and application-oriented aspects, new technologies are means for communication's increase and teaching method's strengthening widening knowledge searching a new and stronger interconnection between different disciplines. Their employment allow to get over the traditional teaching statute promoting a different way of being together and communicate, which is possible thanks to their ability to actively involve students in learning processes.

WEB-VOCAL: A COMPREHENSIVE CALL-EFL READING DEVELOPMENT PROGRAM FOR ACADEMIC PURPOSES UTILIZING INTERNET RESOURCES

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Abstract: Web-VOCAL is a VOcabulary Concordance and Academic Lexis CALL design with integrated web browser functions. Web-VOCAL has concordance and collocation features particularly relevant for study in EFL courses oriented toward the comprehension of factual information: using web-VOCAL a student is able to sort a text for vocabulary types, find word-frequencies and collocations, and use up to four default corpora. Word-families can be displayed throughout a text. Words, phrases and concepts can be searched in dictionaries and through the Internet utilizing site links defined in the program. Internet web pages can be stripped of html tags, converted to text (.txt) files and collocated in various ways. The goal of the program is to enable vocabulary study to be further integrated into English for Academic Purposes (EAP) reading classes, encouraging accelerated comprehension of the target academic language by the student. Current EFL vocabulary research and pedagogical considerations related to the Web-VOCAL project are summarized.

Introduction

The Web-VOCAL program began development two years ago. At that time, research was oriented to program design considerations (Gilbert & Matsuno, 2001). We have now developed a revised, functioning prototype, for the first time incorporating web-resource functions. In this article we will discuss the prototype CALL software implementation, and also examine some of the pedagogical issues relevant to the project. Web-VOCAL is a multimedia "VOcabulary Concordance and Academic Lexis incorporating Web resources." The program has been designed to provide English for Academic Purposes (EAP) students with options allowing them to discern quickly, from computerized text, words in three parsed hierarchies of vocabulary; to search quickly for definitions and/or translations of terms; to examine collocations from selected corpora; and to acquire new vocabulary though a tripartite General Service List/Academic Word List/Technical Word List approach to vocabulary acquisition.

Using Web-VOCAL, internet web pages and site information can be quickly found, automatically stripped of html/meta-tags and converted to Web-VOCAL-usable text (.txt) files. Online dictionaries, thesauri, encyclopedias and translation dictionaries capable of translating both web pages and text can be accessed from within the pop-up Web-VOCAL browser window (with one mouse-click). Web-VOCAL allows selected parts of reading texts, collocations, and word definitions to be combined, organized and saved. Internet bookmarking features allow site bookmarks to be saved/exported/imported on floppy or hard disk by the student.

The overall purpose of Web-VOCAL is to create a single comprehensive CALL environment in which necessary reading-comprehension study tools are easily available to students as they read the study-text in the "source reading text" (SRT) frame of the program (Fig. 2). Novel CALL-based tools have been created in order to potentially accelerate a student's reading comprehension by focusing on methods of accessing unfamiliar vocabulary, in both contextual (collocational and encyclopedic) formats and non-contextual (dictionary/translation dictionary) formats.

The SRT module is composed of three frames: the "SRT" frame (largest frame), the "Word List" frame (left side), and the "Collocations" frame (lower frame). "Site" and browser buttons displayed on the main window activate Web browser functions.

Accessing new vocabulary

It should be noted that vocabulary knowledge and reading comprehension are very closely related (Nation, 1999). In fact, the correlation is high and reliable enough that TOEFL researchers at one point considered whether both vocabulary items and reading items needed to be included inthe TOEFL test, "and if not, which of the two could be dispensed with" (Read, 1997). Three vocabulary lists are utilized in our current concordance design. They are: 1) the 2000 highest frequency word families included in West's (1953) General Service List of English Words (GSL), further sub-divided into two subgroups of 1000 word families; 2) Coxhead's 1998 Academic Word List (AWL) (Coxhead, 1998), a multi-disciplinary academic word list of 570 word families—note that "academic words" will not include all of the terms denoted by "semi/sub-technical vocabulary" as used in ESP nomenclature, but are approximately equivalent, as discussed in Nation (Nation, 1999); and 3) technical vocabulary, representing words or terms that are largely field-specific. Nation points out that, "The division of the vocabulary of academic texts into three levels of (1)general service or basic vocabulary, (2)sub-technical vocabulary, and (3)technical vocabulary is a commonly made distinction" (Nation, 1999).

We might ask, why select particular, limited vocabulary sets for study, while ignoring the bulk of the English vocabulary? The answer lies in a real-world situation having to do with the number of word families in English, the disparity of vocabulary knowledge between typical undergraduate L1 (source language, mother tongue) and L2 (target language) English users, and the limited time available to educate students in order to achieve academic goals in English, e.g., reading essays and research papers in their academic field, the overwhelming majority of which are in English:

> Even many journals of smaller nations' scientific societies, like those of Slovenia for example, publish also in English. When abstracted more widely these are then accessible to a world audience. For a scientist to publish in a language other than English therefore is increasingly to cut herself off from the worldwide community of scientists who publish in English. The work may then be ignored simply because it is published in a language unknown to the rest of the world (Wood, 1997).

Webster's Third New International Dictionary contains approximately 114,000 word families, excepting proper names (Goulden, Nation & Read, 1990); a number well beyond the knowledge of most L1 or L2 students. Though past measurements of vocabulary size have been found to be erroneous (Nation, 1999), recent reliable studies (Goulden, Nation & Read, 1990; Zechmeister et al, 1995), indicate that educated native English speakers know about 20,000 word families; the educated undergraduate L2 learner of English may only have 10%-15% of this vocabulary, a comprehension of 2,000-3,000 or so word families. This places them at a great disadvantage, as "to read with a minimal disturbance from unknown vocabulary, [English] language users probably need a vocabulary of 15,000 to 20,000 words" (Nation, 1999).

Researchers have attempted to determine what percent of the vocabulary in a given text needs to be comprehended by an L2 learner of English in order to (a) adequately comprehend the text, (b) comprehend a new vocabulary item by context, and (c) read comfortably/read for pleasure. Research (Liu & Nation, 1999) suggests that at least 95% of the running words in a text need to be known to the learner, in order for unknown vocabulary to be comprehended by context. This 95% figure, which indicates that a reader will encounter, on average, one unknown word for every two lines of (10 words average per line) text, and 20 unknown words on a (400-word average) page, seems as well to be a *lowest threshold* for successful reading comprehension. Laufer (1988), examining successful readers of an English for Academic Purposes text in the "First Certificate in English" exam, found that scores in the 95% percentile and above had a higher number of successful readers. Readers who scored at 90% (one unknown word per line of text) did not do significantly better or worse than others scoring up to 94%; these scoring-groups did not have many successful readers. A recent study (Liu & Nation, 1999) of reading comprehension, examining adequate vocabulary coverage related to reading for pleasure, found that when 80% of the words of a fiction text (i.e. two unknown words per line) were familiar to readers, none gained adequate comprehension; at 90% to 95% some, but not many, gained comprehension. It was found that only at about 98% coverage (eight unknown words per 400 word page) was "unassisted comprehension" gained. A general conclusion is that:

> Knowing academic vocabulary is a high priority for [L2] learners who wish to do academic study in English. After gaining control of the 2,000 high frequency words, learners need to then focus on academic vocabulary. Knowing the 2,000 high frequency words and the Academic Word List will give close to 90% coverage of the running words in most academic texts. When this is supplemented by proper nouns and technical vocabulary, learners will approach the critical 95% coverage threshold needed for reading" (Nation, 1999).

Thus, this area of research has been able to establish that the 95% figure is workable as a threshold for known/unknown vocabulary in EAP study.

Nation's 2,000 highest frequency words (headwords/word families) are taken from West's 1953 general service list, which, though aging, is defended as remaining "the best of the available [general service vocabulary] lists" (Nation & Waring, 1997). Coxhead's AWL is composed of the most frequent word families from a 3,500,000 running word academic corpus containing a balance of the four general fields of science, arts, commerce and law—with each of these fields further divided into seven subject areas. Each word contained in the list has a range that includes all 28 (4 x 7) subject areas (the corpus texts are divided equitably across all subject areas), and a frequency in the complete corpus of at least 100. The third list, the technical/other word list, must be either imported or composed by the teacher: this list may be designed as field-specific, syllabus-specific, or as a multi-disciplinary list, at the teacher's discretion. A breakdown of coverage by the different kinds of vocabulary in a typical academic corpus is seen in Table 1, below.

Type of Vocabulary	% of Coverage
1st 1000 word families:	71.4%
2nd 1000 word families:	4.7%
AWL 570 word families:	10.0%
Others:	13.9%
Total:	100.0%

Table 1: Percent word-coverage in the academic corpus (Coxhead, 1998)

In terms of EAP coverage, as a rule of thumb the most frequent 1,000 GSL words cover approximately up to 77%, the second 1,000 cover approximately up to 5%, AWL (semi-technical) vocabulary will account for approximately 8.5% -10%, and technical words (words very closely related to the topic and subject area of the text) typically cover about 5% of the running words of a text. The total percent-coverage then, is 95.5%-97%, which provides the target goal for academic vocabulary acquisition, leading to the unaided comprehension of unknown vocabulary by context, and successful reading comprehension, within a particular academic field. The additional "missing" 5% represents vocabulary of lower frequency than the first 2,000 GSL words, and/or words which are semi-technical but not in the AWL list.

We can note the specificity of the AWL to academic texts. The third group of 1,000 GSL word families (words with a frequency of 2,000 to 3,000) covers only about 4.3% of the AWL corpus. Though there has been little comparative research, one study has shown an AWL coverage of only 1.7% in fiction texts, compared to 10% coverage in academic texts (Nation, 1999). These results indicate a high degree of specificity of academic vocabulary, and suggest that while the typical EFL student will have a goal of comprehending the first 3,000 GSL word families, it is beneficial for the academically-oriented student to focus on semi-technical vocabulary after they have succeeded in comprehending the first 2,000 GSL word families. For the "English for academic purposes" (EAP) student then, the GSL 2,000 highest-frequency words represent core vocabulary, while the AWL words can be considered high-frequency vocabulary.

By focusing on words within the academic word list, students will utilize their study time efficiently, as AWL vocabulary has relevance across academic disciplines. Students entering an academic program can be assessed using a measure such as the Vocabulary Levels Test to determine whether they have a satisfactory comprehension of the first 2,000 GSL words, and to what extent semi-technical/AWL vocabulary is known. As well, AWL vocabulary, studied within the context of academic texts, should provide an efficient approach to TOEFL preparation.

EFL design concept

> Emerging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimagined even a few years ago. — Robbie McClintock (1999)

The idea for the Web-VOCAL program began with classroom observations made over several years with students in several fields (science, economics, social welfare, and liberal arts) who were attempting to read content-oriented English texts assigned both in EFL reading classes and in non-EFL classes taught in Japanese. Typically, students read with a translation dictionary nearby, looked up unknown words and wrote the Japanese translation above the word in the text, and/or in a notebook, paired with the English term. This process was laborious and time-consuming. In some native-language (L1) course curricula, particularly in science and English-language literature classes, students were assigned readings in difficult content-related English-language texts (e.g. *Walden, Silent Spring,* scientific essays, literary review essays). In such cases, students would sometimes be looking up several vocabulary items per line in their attempts to comprehend the texts.

One of the principles defining the purpose of reading in "English for specific purposes" (ESP) study as opposed to general EFL study is the functional shift from 'text as a linguistic object (TALO)' to 'text as a vehicle for information (TAVI)' (Dudley-Evans & St. John, 1998): "The key principles [are] that, for ESP learners, extracting information accurately and quickly is more significant than language details; that understanding the macrostructure comes before language study; and that application of the information in the text is of paramount importance." Web-VOCAL's basic goal is to promote the TAVI process by simplifying, accelerating and enhancing the process by which students extract meaningful information from texts—through aiding comprehension of targeted vocabulary items, presenting collocations and providing web resources. The software has been designed to have "low-impact imposition" in that software function avoids complex user-routines (difficulty of use) or conceptual hurdles (high software learning-curves) that might cause the student to have greater difficulty utilizing the CALL resources than the non-computational resources already at hand.

Upon the above pedagogical foundation, cognitive enhancements to the reading process, including (a) vocabulary acquisition, (b) memorization, (c) organization, and (d) novel research strategies, become possible in the CALL design environment. Corpora/collocation features quickly yield sample usage sentences, which can be easily saved for later study. Hierarchic GSL/AWL/Technical vocabulary parsing helps the student categorize and "rate" a particular vocabulary item for generic relevance. Vocabulary analysis of texts provides a rapid means to roughly access texts for difficulty.

CALL in the classroom also has the potential to change the dynamic between student and teacher:

> With digital information technologies, what is pedagogically possible changes. Possible educational attainments are different and greater than they have hitherto been. . . . Educators are engaging in the social construction of a new educational system . . . in this case from the potentialities arising through the use of information technology in education (McClintock, 1999).

One of the several benefits of CALL in the classroom is that learners are given "freedom to explore alternative pathways—to find and develop their own style of learning" (Berge & Collins, 1995). Synergy between the user, CALL program, classroom environment, curricula, and teacher cannot be determined without pilot and outcomes studies. Nevertheless, certain scenarios become possible which are unattainable outside of the Web-VOCAL environment. Students are able to input their own texts and use the program to analyze any text-based correspondence (e.g. email, internet); they can share study-files and bookmarks. The program may also be used in independent/distance-learning environments. The program is individually customizable, giving students power and autonomy: for instance, students can build up large, subject/field-tailored vocabulary databases, store, organize, and (yet) easily access them over long periods of time; as well, students can be shown how to create their own micro-corpora (see section 4.1). Web-VOCAL is also effective for the second-language reader engaged in independent study: academic researchers/professors needing to read and/or publish (in English) in international journals can make use of the program.

Program Description

Using a browser (e.g. IE-5/6) students download Web-VOCAL from the class homepage (Fig.1). Following simple instructions, the program self-installs, creating two folders (in "C:\Program Files") and a desktop shortcut. All files except corpus files are contained in the "WebVocal" folder. A second folder ("WebVocCorpus") contains the corpus files. This allows students to export Web-VOCAL to another computer on a single floppy disk, as the program and essay files combined are unlikely to exceed 1.2 megabytes. The main-program view can be seen in Figure 2. After Web-VOCAL installs, students click the desktop shortcut link, the program opens and the student presses the (large orange) "BROWSER" button in the main window (as mentioned on the class homepage). The default browser URL is the class homepage, so the Web-VOCAL browser returns the student to the class homepage where the essays (as .txt file links) are located. Clicking on an essay link automatically downloads the file and places it within the "Source Reading Text" (SRT) frame, where it can be analyzed for word-frequencies and vocabulary sets. Collocations for words/phrases can be found by using one of using four different corpus sets (highlight the word/phrase, right-click the mouse, select "Collocations"). Relevant "micro-corpora" corpus sets, designed by teacher or student for Web-VOCAL, can be created from a CD-ROM encyclopedia in little time (see section 4.1); individual corpora can be selected through the "Tools" menu.

There are two methods for incorporating Web information into the SRT. The Web-VOCAL browser will automatically strip all tags (creating a .txt file) of any HTML page and display the new file in the SRT window (by pressing the "ANALYZE" button in the Web-VOCAL browser). All resulting files can be saved; any .txt file or HTML file can be imported into the program as well.

Vocabulary items found in the reading-text or collocation sentences in the "Collocations" frame (below the SRT frame) can be searched using one of the four "Internet link" buttons found on the upper right-hand side of the main-program window. Experience has shown that often, Japanese students have little idea of the web resources available which may aid them in English comprehension. The four "Internet link" buttons each contain several URLs: "E Site" contains English dictionaries, encyclopedias, thesauri; "J Site" contains similar Japanese resources; "Trans." Contains English-Japanese/Japanese-English translators (there are translator sites providing real-time, free, side-by-side bilingual translations of English/Japanese web sites). "Search" contains search engine URLs, both Japanese and English. URLs defined by the "Internet link" buttons can be easily changed by the teacher. Voice synthesis is also available, providing text-to-speech ability, aiding in English pronunciation (right-click mouse menu. The "Tools" menu contains a "Web Resources" button; this button links to a teacher-defined set of URLs designed to be subject/course specific links.

When students click on a headword in the "Word List" frame, all words in that word-family will be automatically highlighted throughout the main text. Individual words within a word family can likewise be highlighted in the main text. Often students are unable to save their data on the university's LAN between sessions, and use different computers each day. For this reason, Web-VOCAL is designed to be easily downloaded onto a floppy, and includes a save/delete/export/import feature for internet bookmarks, so students can keep track of their internet research and maintain both a web and an essay database. There are several other features at the student's disposal. Any text can be sorted to discover high-frequency vocabulary ("GSL button"), academic vocabulary ("AWL button"), and extra vocabulary ("XTRA button"), which contains low-frequency vocabulary absent from any other category. The "TECH button" is designed to provide vocabulary created by the teacher to display low-frequency vocabulary: 1) relevant to the course, 2) the essay(s) under study, 3) an upcoming lecture, 4) scientific terms, 5) proper names, 6) archaic spellings, etc.

Creating Micro-Corpora

Web-VOCAL does not include its own corpora at this time, advocating (and instructing the user on) the construction of micro-corpora. As shown by Tribble (and our own experience) a teacher is able to construct a micro-corpus of some 50,000 words, drawn from a CD-ROM encyclopedia, in about 30-40 minutes:

> The non-standard corpus which I am advocating for students with an interest in learning how to write factual texts . . . is the widely available multimedia encyclopedia. I am proposing the use of such a corpus with *students who are beginning to learn how to write formal, professionally oriented texts*. . . The *Encarta Encyclopedia* [*Deluxe 2002* CD-ROM contains 60,000] separate articles listed in the "search" facility. These contain anywhere between 200 and 5000 words. If we take a pessimistic mean of 1000 words, then the biggest possible "corpus" based on this source of texts could contain [60,000,000] words. . . . [One is] able to construct themed, twenty to thirty-thousand word micro-corpora in fifteen to twenty minutes. Although such a corpus sounds insignificantly tiny when compared with the huge corpora which can now be accessed, I would argue that if one wishes to investigate the lexis of a particular content domain (e.g. health) a specialist micro-corpus can more often be useful than a much larger general corpus. (Tribble, 1997) [*Encarta Encyclopedia* information updated to 2002.]

The corpus files, which may grow large, can be exported on a second floppy disk. With regard to .txt file sizes, the *Canterbury Corpus* (Powell, 2001) shows that a work of fiction containing 140,000 words yields a .txt file of approximately 750Kb while a non-fiction work of 101,000 words yields a .txt file of 600Kb. A complete Web-VOCAL corpora "set" of four 50,000 word corpuses (containing "general", "academic", "journal" and "user" corpora) will thus fit on a 1.2 megabyte floppy disk; if larger corpus sets are needed they can be accommodated on extra floppies.

Discussion

We have found that a fruitful CALL design-approach weds pedagogical considerations to interface metaphors in a co-emergent design process, giving equal weight to educational conceptual structures and application control structures. The psychological space of user-CALL program interaction is a virtual space, which remains largely unexplored in terms of how the design of educational tools should best be implemented. In order to further investigate the potential of the program, Web-VOCAL is being readied for pilot testing later this year.

References

Berge Z. & Collins, M. (1995). Computer-mediated communication and the online classroom in distance learning, *Computer-mediated communication magazine* 2 (4), 2.

Coxhead, A. (1998). An academic word list, *E.L.I. Occasional Publication Number 18*, LALS.

Dudley-Evans, T. & St. John, M. (1998). Developments in English for special purposes: A multidisciplinary approach, Cambridge University Press.

Gilbert, R. & Matsuno, R. (2001). Integrating Vocabulary Acquisition for University EFL Science/Non-Fiction Reading Classes: A Multimedia CALL Design, *Language Issues, 7* (1), 13-44.

Goulden, R., Nation, P. & Read, J. (1990). How large can a receptive vocabulary be? *Applied Linguistics 11* (4), 341-363.

Laufer, B. (1988). What percentage of text-lexis is necessary for comprehension? In C. Lauren and M. Nordmann (Eds.) *Special language: From humans thinking to thinking machines*, Multilingual Matters Pubs.

Liu, N. & Nation, P. (1999). Factors affecting guessing vocabulary in context, *RELC Journal* 16 (1), 33-42; also: Hu, M. & Nation, P. (1999). *Unknown vocabulary density and reading comprehension*. In progress. Victoria University of Wellington, New Zealand.

McClintock, R. (1999). The educators manifesto: Renewing the progressive bond with posterity through the social construction of digital learning communities, Institute for Learning Technologies, Columbia University, NY.

Nation, P. (1999). Learning vocabulary in another language, *E.L.I. Occasional Publication Number 19*.

Nation, P. & Waring, R.(1997). Vocabulary size, text coverage and word lists, In Schmitt, N. & McCarthy, M. (eds) *Vocabulary: Description, acquisition and pedagogy*. Cambridge University Press.

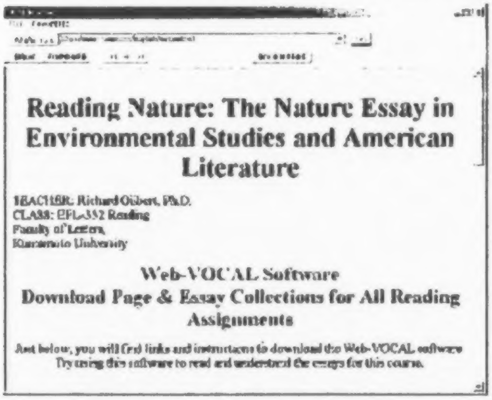
Powell, M. (2001). *The Canterbury Corpus*. Accessed April 25, 2002 at: http://corpus.canterbury.ac.nz/descriptions .

Read, J. (1997). Vocabulary and testing. In N. Schmitt and M. McCarthy (Eds.) *Vocabulary: Description, acquisition and pedagogy*, 305.

Tribble, C. (1997). Improvising corpora for ELT: Quick-and-dirty ways of developing corpora for language teaching, In Melia, J. & Lewandowska-Tomaszczyk, B. (ed.) *PALC '97 Proceedings*, Lodz University Press, Lodz, Poland. Accessed April 25, 2002 at: http://ourworld.compuserve.com/homepages/Christopher_Tribble/Palc.htm .

Wood, A. (1997). International scientific English: Some thoughts on science, language and ownership, *Science Tribune 2* (4). Accessed April 25, 2002 at: http://www.tribunes.com/tribune/art97/wooda.htm .

Zechmeister, E., et al. (1995). Growth of a functionally important lexicon, *Journal of Reading Behavior 27* (2), 201-212.



Reading Nature: The Nature Essay in Environmental Studies and American Literature

TEACHER: Richard Gilbert, Ph.D.
CLASS: EFL-352 Reading
Faculty of Letters,
Kumamoto University

Web-VOCAL Software
Download Page & Essay Collections for All Reading Assignments

Just below, you will find links and instructions to download the Web-VOCAL software
Try using this software to read and understand the essays for this course.

Figure 1. Class homepage

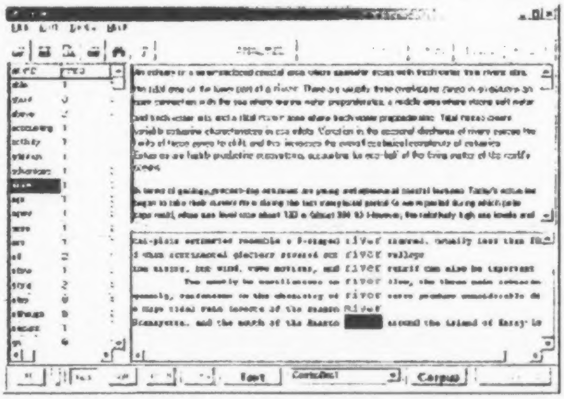


Figure 2. Web-VOCAL main window

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Teaching mathematics and science: Using global learning for the effective preparation of prospective elementary teachers

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Abstract: Research and experience suggest that structured reflections and metacognitive thinking positively influence prospective teachers' pedagogical content knowledge (PCK), and beliefs and attitudes (dispositions) about mathematics/science learning and teaching. To provide a challenging learning environment for such activities, prospective teachers from different educational cultures will be paired in this global learning project. They will engage in interactive (online) reflective journaling based on experiences that combine content and pedagogy; and design a sequence of activities to teach a mathematics/science concept that will be displayed on joint web pages. The activities will be assessed for evidence of positive growth in PCK and dispositions related to the teaching and learning of mathematics/science. Specifically, the project is guided by the question: How do cross-cultural shared experiences affect the development of specific PCK and influence prospective teachers' dispositions?

There is a basic need to develop greater self-efficacy in elementary education teachers related to mathematics and science learning and teaching. Many of these teachers have negative beliefs, attitudes and anxieties about learning mathematics and science that constitute a significant barrier to teaching these subjects in a meaningful way. Prospective teachers have developed their beliefs over time before they enter the university. To change undesirable/negative dispositions therefore will take time (Hart 2002). Educators in the USA and Australia are recognizing this barrier and making efforts to overcome it (Mulholland & Wallace 2001; Ramey-Gassert & Shroyer 1992; Schoon & Boone 1998; Watters & Ginns 1995).

A number of studies support the belief that reflective teachers positively effect the education experiences of their students both in the development of positive dispositions and pedagogical content knowledge (Abell & Bryan 1997; Clarke 2000; Fennema & Romberg 1999; Francis, Tyson & Wilder 1999; Hart 2002). Abell and Bryan designed their elementary science methods course around "(t)he reflection orientation ... grounded in the belief that learning to teach science, like learning science itself, is a process of re-evaluating and reforming one's existing theories in light of perturbing evidence (p.154)."

At Wichita State University, prospective elementary teachers take an integrated mathematics and science methods class in the first semester of their senior year, just prior to their student teaching semester. Reflective practice is nurtured to ensure a supportive environment that addresses the barrier of teachers' negative beliefs, attitudes and anxieties. Student responses to weekly online reflective questions have focused attention on a number of issues related to teacher dispositions and topics broached during classroom activities. The first result is that, faculty gain insight into the thinking of the students, and the insights guide ongoing efforts for cultivating effective mathematics and science teaching. In addition, students have increased opportunities to form the habit of reflective journaling. Anecdotal evidence suggests that students are particularly motivated to examine their thoughts in relation to those of their classmates. Online synopses of student responses have often raised the level of interest and resulted in further discussions about students' positive growth in pedagogical content knowledge and dispositions.

Reflective thinking is fostered in lesson preparation and teaching assignments. Lesson planning and peer teaching routinely contain a required reflection on the process and product. The course culminates in a five-week field experience with many opportunities and demands for reflection with respect to teaching experiences in the elementary classroom. Often the primary concern expressed in the latter reflections is about classroom management, but it is still felt that the reflective piece is needed that is more directly connected to mathematics and science related pedagogical content knowledge.

For example, Teacher's Inquiry into Children's Knowledge and Learning Evolvement (TICKLE) is an assignment designed to make the connection between content learning and teaching practice more apparent to the students. The TICKLE assignments are given as a springboard to ideas about pedagogical content knowledge. Each student works with a child between the ages of four and twelve and explores the child's thinking about concepts within a broader topic such as volume or light. Before each TICKLE assignment, a collection of activities is introduced to provide the background needed to design activities that they deem developmentally appropriate for the child with whom they are working. After analyzing individual results, students come back to class with new pedagogical content knowledge. Together they build a deeper understanding of the developmental sequence necessary to teach a given concept. As a result they begin to answer for themselves the question: what is appropriate for the grade level that I'll be teaching?

Faculty have found that the diversity of learners, even within a single classroom, demands a diversity of teaching approaches. Already the challenges of negative student dispositions have been addressed in a variety of ways. As expected in the presence of student diversity, our multiple strategies have met with mixed success. Some students respond to a given strategy and other students respond to significantly different strategies. However, the common successful thread among the strategies has been an emphasis on reflective thinking about learning and learning to teach mathematics and science within the existing learning environment. With this in mind, we are attempting to extend this reflective/metacognitive environment by pairing students at Wichita State University with their counterparts at an Australian university to determine how cross-cultural reflection and communication affects students' self-efficacy.

Initially, students will engage in guided reflections centered on questions related to their personal beliefs about teaching and learning mathematics and science. To become acquainted with each other's dispositions, they will co-reflect via email on such questions as: What do you know about reflective practice? Based on past experience, how do you feel about learning science and mathematics? What are your concerns about teaching mathematics/science? What would help you become a better science/mathematics teacher? This ongoing reflective practice will provide a supportive learning environment to encourage the changing of negative dispositions and the development of mathematics and science activities for teaching with understanding (Fennema & Romberg 1999).

For part of the semester, students at both universities will be involved with identical mathematics and science curriculum. Based on that common curriculum, pairs of students, one from each country, will collaboratively develop and publish on the web a collection of activities. In the process of designing these activities, students will be guided to reflect on their individual learning as well as the collaborative, creative process in order to support meta-cognitive thinking and learning in the development of PCK and positive dispositions. The intent then is to have the students publish their reflections on the web along with their activities. Such sharing will allow both current classmates and future students in these methods classes to observe and learn from other students' experiences.

A global learning environment designed in this manner will provide reflective opportunities for faculty and students through content-specific dialogue. These cross-cultural shared experiences should positively effect prospective teachers' development of specific pedagogical content knowledge and bring about positive changes in their evolving dispositions.

References

Abell, S.K. & Bryan, L.A. (1997). Reconceptualizing the elementary science methods course using a reflection orientation. *Journal of Science Teacher Education, 8*(3), 153-166.

Clarke, B. (2000). Supporting Teachers in Understanding, Assessing and Developing Children's Mathematics through Sharing Children's Thinking. Paper presented at The 9th International Congress of Mathematics Education.

Fennema, E. & Romberg T. A. (Eds.), *Mathematics classrooms that promote understanding*. Mahwah, NJ: Erlbaum, Lawrence

Francis, A., Tyson, L., & Wilder, M. (1999). An analysis of the efficacy of a reflective thinking instructional module on the reflective thinking demonstrated in the field experience logs of early elementary preservice teachers. *Action in Teacher Education*, v. 21, n3, 38-44.

Hart, L.C. (2002). Preservice teachers' beliefs and practices after participating in an integrated content/methods course. *School Science and Mathematics, 102*(1). 4-11.

Mulholland, J. & Wallace, J. (2001). Teacher induction and elementary science teaching: Enhancing self-efficacy. *Teaching and Education,* 17, 243-261.

Ramey-Gassert, L. & Shroyer, M.G. (1992). Enhancing science teaching efficacy in preservice elementary teachers. *Journal of Elementary Science Education, 4*(1), 26-34.

Schoon, K.J. & Boone, W.J. (1998). Self-efficacy and alternative conceptions of science of preservice elementary teachers. Science Education 82, 553-568

Watters, J. & Ginns, I.S. (1995). Origins of, and changes in preservice teachers' science teaching self-efficacy. Paper presented at the annual meeting of the National Association for Research in Science Teaching.

School Leaders and Teachers, Strategic Planning, and Technology Integration: A Research Approach to a Five Year Technology Plan

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Abstract: How is technology (IT) integrated? When is IT integrated? Where is IT integrated? How much is IT integrated? Too often, little thought is given to determine a school district's response to these questions or to the analysis of current IT usage or future IT needs. The approach to planning for the integration of educational IT into the learning environment described in this paper focuses on the collaborative efforts of school district personnel, and faculty and graduate students from a local university in the mid-western region of the United States.

Introduction

Forward looking school leaders concerned about their ability to effectively lead schools into the IT-based learning environment of the 21st century are aware of certain verities of educational life that should impact school leader behavior. Bracci (1999) suggested one of those truths related to the integration of information IT into learning environments. The questions became not whether IT should be integrated, but; How is IT integrated? When is IT integrated? Where is IT integrated? How much is IT integrated?

Another truth in the world of education suggests that the mere presence of IT has became a measure by which some school districts assessed their effectiveness. Many administrators, parents, and teachers believed that if they had a large number of computers in the classroom, they were "cutting edge" and therefore effective. However, too often, little to no thought was given to determine a district's current IT usage or future IT needs. Jukes (2000) observed, "The key is how you use the technology, not how often" (p. 73). It has been made clear that effective use of IT in the learning environment begins with deliberate and futures-based planning.

The approach to planning for the integration of IT into the learning environment described in this paper focuses on the collaborative partnership efforts of school district personnel, and faculty and graduate students from Wichita State University in the mid-west of the United States. These educators formed a partnership to collaborate on the development of an approach to strategic planning for IT integration that has been effective in revisiting and re-enlivening a school district IT plan that had lost its way.

Research Design

In a recent paper, Gibson (2002) claimed that school leaders must be the focus of new efforts to guarantee the effectiveness of IT integration efforts. While agreeing that significant attention should continue to be paid to the IT development of tomorrow's teachers, he suggested an increasing realization that teachers were not as effective in their IT integration efforts without the support of school leaders capable of motivating, collaborating, and supporting IT integration efforts. The graduate program in Educational Administration at Wichita State University attempted to address these issues through construction of a program of school leader preparation designed to produce visionary leaders for twenty-first century schools. The study reported here emphasizes the collaborative research orientation of this program and the need to use current data on technology usage in planning for IT use. The study was designed to examine the use of IT in the instructional environment of a local school district and make recommendations for updating the district IT plan.

Multiple research methods used to explore the research questions relating to current use of IT, perceptions of IT needs from students', teachers', and administrators', and suggested improvements regarding the integration of IT included focus groups with district students and faculty, interviews with administrators and IT coordinators, and an analysis of district documents. Inductive and constant comparative analysis of these triangulated data resulted in a series of conclusions and recommendations designed to assist district staff in revising their district IT plan, and a process that could be used in the future for continued data-based analyses of district IT needs.

Conclusions and Recommendations

The study's conclusions were grouped into seven major themes: current support, parent usage, administrator usage, teacher usage, student usage, perceived needs, and proposed needs. Recommendations related to these findings were:

- Formative evaluations of the IT plan should be conducted yearly and focus on integrating IT into the learning environment emphasizing student-centered activities and targeted staff development.
- The allocation of funds for IT should continue to increase.
- Funds should be allocated to support full-time coordination and assistance throughout the district.
- Resources (personnel, time, financial, equipment, and facilities) should support the plan.
- Access to Internet should be made available for all students and staff.
- Training should be provided for students, parents and teachers to enhance the effective use of IT.
- Staff development should increase awareness of the potential of IT to transform the learning process to focus on student-centered activities.
- Student-free time should be regularly scheduled to assist staff in learning about IT.
- Results-based staff development, designed for IT integration, should be targeted specifically to learner skill levels.
- Support and encouragement should be provided to all staff as they integrate IT into the instructional environment.
- Emphasis should be placed on innovative ways to integrate the Internet into the learning process.
- Specific resources (websites, professional library, examples of lesson plans, network contacts, site visits, expert colleagues) should be developed to assist teachers to integrate IT into learning environments.

Conclusion

As a result of this process, school district personnel identified IT needs crucial to future growth within this district using baseline data comprising a realistic evaluation of existing usage patterns, an understanding of existing attitudes of students, teachers, and administrators towards IT and its connection to the learning process. A clear picture of the gap between what could be currently accomplished with the existing IT infrastructure and skill levels, and what was considered to be realistic future needs of the district resulted.

Further, in the process of participating in this program, graduate students conducting the research gained valuable insight into their responsibilities as IT leaders, at the same time as exploring a process of data gathering, future planning, and realistic program evaluation that will benefit them as school leaders. With data derived from studies like this, and an understanding of the process of data gathering and analysis derived from participation in this program, these school leaders have come to understand the purpose of identifying the IT realities of the district as the first step in the process of district decision-making based on assessing the status of district level IT usage merged with an understanding of future district IT needs.

Most importantly, these students discovered a critical criterion required for IT planning was vision. As Jukes (2000), suggested, integrating IT is far more than just doing computers' or allowing students to spend time online. Effective integration occurs only when IT adds real value to recognized educational needs of individual learners. These graduate students gained experience suggesting that future minded educators must have a vision that integrates IT not just into a school or a school district, but into the learning process.

References

Bracci, R. (1999). It's in the plan. *American School & University, 71*(11), 36-39.

Gibson, I. W. (2002). *PT3 AND T3L – Teaching Tomorrow's Technology Leaders: Preparing School Leaders to Use Technology.* Paper presented at the 13th annual meeting of the Society for Information Technology and Teacher Education, Nashville, TN.

Jukes, I. (2000). Ian's mind jog. *Technology & Learning, 20*(9), 73.

Developing a Global Forum on School Leadership: Using interactive communications technology to enhance the achievement of learning goals in a school leader preparation program.

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Abstract: Challenging tomorrow's school leaders to develop deep understanding and respect for alternative conceptions and responses to everyday leadership issues is a major undertaking. This paper presents a description of the rationale and development of the Global Forum on School Leadership. Conceived as an extension to existing reflective and dialogic practices of a pre-service leader preparation program in the mid-west of the United States, the forum attempts to incorporate the perspectives of global colleagues on issues related to everyday practices and school leadership conundrums in a mediated, asynchronous, web-based discussion format. This project adds a needed global orientation to leadership preparation in a post September 11th international context.

Project Rationale for the Global Forum on School Leadership

Developing leadership expertise requires foundational knowledge and use of inquiry and reflective practice skills applied in context specific experiences. These experiences provide opportunity for the integration of theory and practice focusing on school improvement. Yet, the contextualizing of leadership experiences in traditional and unvarying cultural contexts often presents its own limitations, particularly during the formative period of leadership philosophies, perspectives, and practices. For that reason, the idea of incorporating a global orientation to leadership preparation, particularly in a post September 11th national and international context, has merit on many fronts.

The Global Forum on School Leadership challenges tomorrow's school leaders to develop deeper understanding of areas of responsibility and of professional behaviors related to topics of professional concern through involvement in collegial analyses of views and experiences that vary from the norm or the expected. Intellectual and professional challenges to the status quo, to standard and expected culturally derived responses, will result from the global interactions contained within this shared international forum.

Description of the Context of the Project

The Masters in Educational Administration at Wichita State University has been designed to prepare visionary, reflective leaders for Kansas schools. This integrated program prepares future school leaders to be competent in leadership, interpersonal relationships, school law, school finance, school personnel, curriculum management, learning theory, inquiry, human development, school improvement processes, and supervision, and grooms them to become administrators who create and maintain effective schools. This program is a clinically oriented, field-based, applied inquiry program that distinguishes itself from traditional administrator preparation programs through a design that emphasizes the integration and contextualization of the curriculum, incorporation of field-based research studies, a collaborative, team-based approach to teaching and learning, a mediated internship program, and a cohort-based student support structure. Students enrolled in this program participate in mediated on-line discussions as part of the assessment of their performance in the program.

Based upon a theoretical framework derived from problem-based learning (PBL) (Boud & Feletti, 1991; Bridges, 1992), this program functions with the belief that authentic problems of practice, explored in collaborative team settings lead to learner-directed and setting-enhanced learning. The underlying propositions of constructivism (Savery & Duffy, 1995), including the ideas of cognitive dissonance and negotiation of meaning, are core program components. Studies of student thinking during the initial problem analysis phase of PBL (De Grave, Boshuizen, & Schmidt, 1996) corroborate the belief, clearly in evidence within this program, that exposure to different ideas in a group leads to conceptual change and that group interactions serve to encourage activation and elaboration of existing knowledge and integration of alternative views.

The Global Forum for School Leadership

Pre-service school administrators enrolled in this program will participate in mediated, asynchronous discussions with local and international colleagues to explore issues of professional relevance. Exploration of authentic problems of practice, analyses of philosophical stances on leadership behaviors and orientations, dissection of the rationales governing daily actions and decisions, and challenges to strongly held beliefs, attitudes, and dispositions will constitute the form and the substance of interactions in the Global Forum.

Existing groups of neophyte administrators in training and their professors and mentors will interact on self selected issues relevant to their profession and to their studies. Topics of discussion would include an analysis of cultural perspectives on any areas of leadership responsibilities such as strategic, organizational, instructional, political, and community leadership.

The technology infrastructure necessary to support this project relies on accessibility to the internet via appropriate computer interfaces. The telecommunications needs of the project requires access to Blackboard and to a website via the internet for participants at both ends of the interaction. Threaded discussions, and a web-mediated approach will be supplemented by full text access to a variety of field-based action research reports. A trial website has been established to demonstrate the potential of sharing practitioner conducted research (http://education.wichita.edu/aces/admin).

Graduate program activities focus around authentic problems of practice, explored in collaborative team settings, and generating learner-directed and setting-enhanced learning. Within this environment, technology integration is modeled by faculty (Blomeyer & Clemente, 1997; Gibson, 2001; Gibson, 2000a). The core tenets of constructivism, including the ideas of cognitive dissonance and negotiation of meaning (Savery & Duffy, 1995), are integral components of this program. Program graduates acquire an understanding of the impact of information technology on their roles as visionary leaders of schools of the future and experience the transformational potential of technology on their own learning process (Gibson, 2000b). Students engage in interactive (online) reflective dialog centered upon specific school leadership topics. This mediated dialog will be assessed on a continuing basis for evidence of leadership insight, reference to the integration of theory and practice, content knowledge, and meta-cognitive development.

References

Blomeyer, Robert & Clemente, Rebecca. (1997). Technological Competencies: Implications for Educational Leadership. *Technology and Teacher Education Annual*. Houston, TX: Association for the Advancement of Computing in Education

Boud, D., & Feletti, G. (Eds.). (1991). *The challenge of problem based learning*. St. Martin's Press.

Bridges, E. M. (1992). *Problem based learning for administrators*. ERIC Clearinghouse on Educational Management.

De Grave, W. S., Boshuizen, H. P. A., & Schmidt, H. G. (1996). Problem based learning: Cognitive and metacognitive processes during problem analysis. *Instructional Science, (24)*, 321-341.

Gibson, I. W. (2000a). Information technology and the transformation of leadership preparation programs: A response to calls for reform in educational practice. *Technology and Teacher Education Annual 2000*, Charlottesville, VA: Association for the Advancement of Computing in Education.

Gibson, I.W. (2000b). At the Intersection of Technology and Pedagogy: Considering Styles of Learning and Teaching. ERSC Seminar Series Paper, University of Keele: United Kingdom.

Gibson, I.W. (2001). Technology standards and reform in educational practice: The role of information technology in the transformation of a leader preparation program. In Theodore J. Kowalski and George Perreault (Eds.), *21st Century Challenges for School Administrators: Ninth NCPEA Yearbook, 2001 (p. 203-220)*. Lanham, MD: Scarecrow Education Division

Savery, J. R., & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology, (35)5*, 31-38.

AN INTERACTIVE INTRODUCTORY PROGRAMMING ENVIRONMENT USING A SCRIPTING LANGUAGE

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Abstract: This paper provides the rationale and description of a unique programming environment to teach the fundamental concepts of programming (data types, input/output, control structures, functions, arrays, files, and the mechanics of running, testing, and debugging programs) to introductory students using either VBScript or JavaScript. This environment is earmarked for courses that precede the first programming course in computer science. Students can compose and execute scripts from within a text editor that has been configured to invoke the Windows Script Host (VBScript), or a web browser (JavaScript). This creates an interactive environment that matches the functionality of an integrated development environment. The target audience includes students with little or no programming background who need a brief introduction to programming before immersion in their first rigorous course in C++, Java, C#, or Web programming. The advantages of using a scripting language are many: text-based code-writing requires students to construct each programming component rather than setting check-boxes or using drag-and-drop strategies; the syntax is often friendlier than the aforementioned languages; the interpreted environment, where partial execution can take place, can encourage both comprehension and debugging skills; the scripts may be executed directly or embedded within an HTML template file and viewed through a browser with a single click. A complete description and downloadable sample files may be found at http://www.uwsp.edu/cis/dgibbs/EDMEDIA2002/index.htm

Introduction

Students emerging from today's secondary schools have more experience with computers than ever before. That experience, however, is typically limited to software applications (word processors, spreadsheets, database managers) and Internet browsing. Too few have received instruction in how computers work from the point-of-view of software instructions. Even fewer know how to create a program and execute it. Those with some exposure to programming often struggle with the breadth of material encountered in the first course in programming (CS1) at the university or community college. The reasons for the struggle are understandable when one stops to consider all that is taking place in the typical CS1 course: the semantics of introductory programming, the syntax of the language, the software development life-cycle (analyze, design, code, test and debug, maintain), use of built-in data structures, algorithm development, and problem solving. In order to write, test, and debug programs, students must also learn a programming environment.

To make matters worse, facets of the CS1 course mentioned above have evolved in the wrong direction, i.e. they have been made more difficult rather than easier for a variety of reasons. Demands of the marketplace and availability of programming tools have resulted in educational institutions adopting syntactically complex languages in their introductory courses. C, C++, and Java all fit in this category. Mastering their difficult syntax actually interferes with the learning of programming fundamentals. LOGO and Pascal, both much friendlier syntactically, were fine languages for *learning* how to program but have fallen by the wayside because they are not used to any significant degree in industry. Further, the programming environments of C, C++, and Java, currently in use in instructional situations are those provided by the major language developers. They have been created for professional programmers and as such include many powerful features that the novice may never use.

Solutions

What about Visual Basic? While it is true that VB does retain the friendly syntax of its predecessor (BASIC), the graphical environment encourages users to "point-and-click" their way to applications, which is exactly what novices should not be doing. Computing educators have long resisted using graphical programming environments for teaching the fundamental concepts. The fear is that in using forms, drag-and-drop, and check-boxes, students do not learn the fundamentals of input/output, decision structures, looping, subprograms, files, arrays, and data structures.

One of the solutions to the problems outlined above has been to insert a course into the curriculum designed to ease entry into the CS1 course. Described as CS0 ("see-es-zero") the course typically includes the concepts of computing and information processing, algorithm development using pseudocode or flowcharting (often with paper-and-pencil techniques), and implementing simple programming concepts in a user-friendly environment. The CS0 concept has grown to the point where the recent release of the Association for Computing Machinery's Computing Curricula 2001 (ACM 2001) included exactly such a course in its description.

Why a Scripting Language? Why an Interactive Environment?

Why learn introductory programming with a text-based scripting language rather than a graphical forms-based language? To construct a program in a scripting language, students must enter the instructions, usually by keying them in (although copying and pasting can be encouraged later on) rather than pointing and clicking. There are no mysteries; both the code and any error-messages are apparent from the interpreted environment. The programming environment is very easy to use. A freeware text editor can be used to prepare the programming statements. The editor is configured to invoke the Windows Script Host (VBScript) or the web browser itself (JavaScript). Error messages are quite accurate, and generally indicate the line and character position of the error.

Interaction with an electronic text is made possible through the use of hyperlinks within a Word document. (A hypertext document would achieve the same functionality.) Script files saved with a .vbs or .js extension are *associated* through the Windows operating system with the editor, meaning that double clicking the hyperlinked files from the Word document invokes the editor and loads the file. The scripts can be executed by clicking the configured menu pick.

In summary, the interactive environment includes an electronic text with clickable links that load code samples right into the editor where they can be modified and executed. Students can view, modify, and execute existing code samples, and then create solutions to problem exercises, link them to their own etext thus forming an e-portfolio of their work.

Benefits for the teaching and learning of CS0

The case for the introductory course (CS0) has been made in the computing curricula throughout universities and community colleges. This paper argues that the scripting languages of VBScript or JavaScript meet the programming needs of these courses, and does so in a manner fruitful for students and teachers. In addition to the arguments already made, there are other benefits to using scripting and the interactive environment described here. All software is free; there are no compiler or interpreter licensing costs. (The editor is freeware. The "interpreter" is provided in the web browser which is also free.) VBScript has become the default scripting language for writing server side code in the Microsoft (Active Server Page) environment, and JavaScript is the default scripting language for client side code. While beginning students may be a few semesters away from client-server programming, the initial experience will be beneficial. Students can use the electronic book as the basis for building their programming e-portfolio, a collection of programming concepts and their VBScript implementation. In creating their own version of the electronic text, students are linking files, copying and pasting code samples, and developing skills in managing a hypertext document.

References

ACM (2001). ACM Computing Curricula 2001. http://www.acm.org/sigcse/cc2001/

ACM (2001). ACM Computing Curricula 2001. The first course in imperative programming. http://www.acm.org/sigcse/cc2001/1111.html

That's My Story and I'm Sticking to It: Promoting Academic Integrity in the Online Environment

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Abstract: Academic dishonesty is a concern at any educational level. However, many faculty members feel uncomfortable with delivering courses in the online environment due to a concern that students may find it easier to participate in academic dishonesty than they would in a traditional classroom. This paper looks at factors that are considered to influence academic dishonesty and how these factors can be considered in the design of online courses to promote academic integrity.

Introduction

Academic dishonesty is a concern for many instructors whether they teach in high school, two-year or four-year institutions. Academic dishonesty may include cheating on examinations, plagiarizing, falsifying sources or bibliographies, knowingly helping other students cheat, working together on projects that should be completed independently, or turning in the same assignment for more that one course (Dean, 2000). With the advent of the Internet and the World Wide Web, there seems to be an attitude among instructors that academic dishonesty is easier because of the availability of material that can easily be cut and pasted (Renard, 2000). Course delivery through the online environment may also make it easier for students to cheat since students and instructors do not have the same relationship in an online course as they do in a face-to-face course. Investigating reasons for academic dishonesty in face-to-face and online environments may help shed some light on ways to develop online coursework that encourages academic integrity rather than leaving students to their own devices in which they may be tempted toward academic dishonesty. This paper will investigate the following: 1) reasons for academic dishonesty; 2) academic dishonesty in the online environment; 3) possible ways to design online courses so that academic integrity is encouraged and academic dishonesty is discouraged.

Reasons for academic dishonesty

Measuring the incidence of academic dishonesty is usually done through self-report surveys given to students. McCabe and Trevino (1996) reported that from a sample of 1,800 students at nine different state sponsored universities, seventy percent of students surveyed admitted to cheating on exams. Additionally, it was reported that eighty-four percent admitted to cheating on exams and almost fifty percent admitted to working with others on assignments intended to be independent (McCabe & Trevino, 1996).

Several factors seem to be associated with the incidence of academic dishonesty. Dean (2000) has identified four of these as patterns seen in the literature: individual characteristics, peer group influences, instructor influences, and institutional policies.

Individual characteristics include ideas such as age, gender, social activities and level of academic achievement (Crown & Spiller, 1998; McCabe & Trevino, 1997). Peer group influences indicate that general student disapproval of cheating is most likely to discourage it while peer group acceptance of cheating is likely to encourage it (Crown & Spiller, 1998). Students who take courses with instructors who are perceived as being actively involved and concerned about students are less likely to be involved in academic dishonesty (Crown & Spiller, 1998). Institutional policies that are communicated clearly to students along with the penalties for academic dishonesty are likely to reduce the occurrence of academic dishonesty (Crown & Spiller, 1998; McCabe & Trevino, 1996).

Considering these factors in regular academic classrooms, it would seem that the same kinds of academic dishonesty would occur in the online environment for the same reasons. Additionally, it may be more tempting or easier to engage in academic dishonesty in an online course than in one that is face to face. Renard (2000) states that although plagiarism is not new, Internet "cheat sites" have made cutting and pasting written sections or even entire papers easier. Students involved in an online course would be using the Internet consistently so the ease of using these sites could be tempting. Additionally, the perception of the instructor being less involved in an online course could encourage academic dishonesty since that is one of the factors that can influence a student's decision to cheat.

Academic dishonesty in the online environment

In recent years the popularity of the Internet has continued to grow among the general population around the world. In the United States alone, what was once considered a communication novelty is rapidly being perceived as an educational necessity in many homes. Along with the increased popularity of the Internet, especially the World Wide Web, many institutions of higher education are rushing to convert an increasing number of courses to online delivery. With the rush to offer courses online, there has arisen questions as to the reasons for both higher education institutions and their students to desire this type of course delivery. Many of these questions devolve down to a question of the quality versus quantity.

There are varied opinions about the correct answers to the questions that arise from the use of the Internet to deliver online courses. In order to be able to answer these questions, we must have a basis of understanding of what both students and instructors perceive and desire about the use of online course delivery. Many of these perceptions are nothing more than myths or folklore taken from past popular beliefs and science fiction. Others come from a misunderstanding of the perceptions held from the various entities (students, instructors, and administrators) associated with online course delivery (Moore & Kearsley, 1996).

Faculty who design courses to be delivered online may evaluate the time a student should spend in a traditional classroom for an equivalent course, add to it time that should be spent outside of class, and in some cases, add extra requirements due to the student not having to physically drive to a campus-based classroom. Faculty may see these students as being able to connect to the online course and go right to work with the course materials. Often faculty do not consider that the physical environment in which the student is taking the course may not be the optimal environment for student success. As student work begins to be turned in, possibly at a level below the expected standard, the instructor may feel that the rigor of the course is being challenged and therefore try to compensate by adding additional work. On the other hand, if the work submitted by the student is of a higher than expected standard, the faculty member may suspect that the student may be using inappropriate aids in completing course assignments.

In contrast, students may see themselves as being somewhat timid with the technology needed for a particular course. Additionally, these students may not see themselves as having the time to make traditional classroom courses, especially since many online students manipulate their course schedule around work or family obligations (Gibson, 1999). Some students feel that the online courses may be easier than a campus delivery due a perception about having to only interact with course content, not with the instructor. Students who have done poorly with a particular class may feel that taking the professor out of the loop will in some way help them pass the course. In this case, students who may not have the strongest work ethic may be enrolled in courses requiring a stronger work ethic. With all cases, it is easy for the student to become overextended in their time and commitment to the course. This can lead to a situation where students feel that they are required to do too much work for the credit earned in the course.

The above mentioned scenarios for both faculty and students set the stage for many of the factors that can lead to discomfort and the temptation for academic dishonest. Faculty members who are working to move to the online environment may feel detached from their students, feeling that they really do not have the kind of relationship that they would have if the same students were in a traditional classroom. In a traditional classroom, faculty can "look-in-the-eyes" of their students and make some determination about a students feelings and needs. Not having this direct contact may lead the faculty member to begin to be suspicious about the rigor of the course and then ultimately the quality and originally of student assignments.

The lack of direct contact and a feeling of detachment also may profoundly affect students. Students who already have very busy schedules may be compelled to take online courses due to the belief that they can add their academic work on top of an already busy lifestyle. Once the demands of the course become overwhelming, especially in cases where the instructor may feel that the rigor of the course is being challenged, the student may feel that the course requirements are unreasonable for the credit to be awarded. Once students begin to feel that the course requirements are unreasonable, the temptation to use inappropriate resources to complete course assignments may begin to grow. The temptation can become even stronger when students develop the feeling that they are all alone in their course with little contact or interaction with the instructor of peers.

Designing online courses that promote academic integrity

The scenario and concerns mentioned above should not be considered a simple reality of online course deliver. In truth, academic integrity is something that all faculty members must work to promote in any instructional environment. However, with regard to online course delivery, there are design features that can specifically promote academic integrity in this environment.

First, online course materials should clearly state that academic dishonesty is not acceptable and then clear examples should be given to illustrate the kind of activities that the student should avoid. Since institutional policies are seen as one factor that has an influence on a student's view of academic dishonest, it is important to clearly outline for the student what the policy is in all online courses. Further, by giving specific examples, faculty can help students avoid misunderstandings about what the policy actually means. While many students would never turn in someone else's paper as their own, these same students may be tempted to copy and paste sections of their assignments from the Internet, justifying this activity as research.

Secondly, online course materials should include a high degree of interaction. Interaction may be developed in several ways and should work to increase the student's contact with the content, the instructor, and peers. A variety of tools can be used to increase interaction such as chat, bulletin boards, MOOs, email, etc. Faculty using these tools can achieve variety in their courses and decrease the perception by students that the instructor is really not there or is not paying attention to the work they are doing. Further, an instructor can use these tools to facilitate cooperative instructional strategies where students work in peer groups. Using cooperative strategies in online courses help to enculturate the student into the course by developing a support structure where students can become knowledgeable of course norms. In interactive, well-supported cooperative environments, student peers help to encourage academic integrity and adherence to course policies. Faculty who make good use of interaction strategies will reduce the temptation of the student to seek outside help and increase student satisfaction with the course.

Lastly, online courses should be designed to include a variety of evaluation methods. With a single evaluation method, a multiple-choice test for example, a true picture of a student's understanding is difficult to achieve. By using multiple evaluation methods, a trend can be identified with regard to student performance and understanding. This is equally true in both online and traditional environments. In a traditional classroom where a student may be very quiet during the semester and three multiple choice exams and a final examination are used for the course grade, it can be difficult to determine if the student understands the material, simply is good at memorization, or cheats. In courses that use multiple evaluation methods, the trend for a student's work can be compared to individual assignments. If a situation occurs where one paper is turned in at a higher level of understanding or quality than has been seen in other course interactions, the possibility of academic dishonesty may be present. Likewise, a student's work trend can be used to guide the student to higher levels of understanding. As students come to realize that their work is being viewed and evaluated, and that feedback is being given, they will feel more attached to the course environment, and academic integrity will be promoted.

Final thoughts

It has been said that perception often becomes reality. In the context of online course delivery, a person's perception about this type of delivery can directly shape the satisfaction and performance in the course. With regard to academic integrity, there are many different views as to the type of activities that students should or should not be allowed to use to complete their course assignments. Likewise, there are differences of opinion as to the ease in which students could chose to use inappropriate aids to complete course assignments online as compared to traditional courses. However, this paper has attempted to outline three components of online course design that may promote academic integrity. Courses that clearly specify the institution's and instructor's policy about academic dishonesty, along with examples, help students to be knowledgeable and understand the need for academic integrity. Courses that have a high degree of interaction between the student and course content, the instructor, and peers can promote a sense of being connected and will help encultureate students into acceptable norms for course performance. And finally, courses that use a variety of evaluation methods can mark trends in a student's performance that can help a faculty member assist in a student's growth while at the same time helping to identify potential dishonesty.

There are no easy answers to the many questions that are associated with online course delivery. It is important to understand that many different people who become involved in online learning do so for many different reasons. By understanding these reasons, courses can be designed in a manner that can facilitate a faculty members satisfaction as well as the success students. Through the process students will have greater opportunity to grow, be successful, and have a high degree of academic integrity.

References

Crown, D. F., & Spiller, M. S. (1998). Learning from the literature on collegiate cheating: A review of empirical research. *Journal of Business Ethics*, 17, 683-700.

Dean, G. R. (2000). Academic dishonesty and the community college. ERIC Digest: EDO-JC-00-7.

Gibson C. C. (1999). *Distance Learners in Higher Education: Institutional responses for quality outcomes*. Atwood Publishing, Madison, Wisconsin.

McCabe, D. L. & Trevino, L. K. (1996). What we know about cheating in college: Longitudinal trends and recent developments. *Change*, 28 (1) 28-33.

McCabe, D. L. & Trevino, L. K. (1997). Individual and contextual influences on academic dishonesty: A multi-campus investigation. *Research in Higher Education*, 39

(3), 379-396.

Moore, M. G., & Kearsley, G. (1996). *Distance Education: A systems view*. Wadsworth.

Renard, L. (2000). Cut and paste 101: Plagiarism and the net. *Educational Leadership* 57(4), 38-42.

Introduction to Information Technology and its effects on Organisational Control

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Abstract: The explosive growth in IT capabilities and extensive use of IT systems has satisfied the increasing desire of organizations to gain competitive advantage. Advances in information technology and its inherent devices have led to profound changes in organizational rules. This study attempts to build an introduction to evaluate IT effects on control as a functions of management. Modern organizations, based on using modern technology, have to make major modifications to the entire organizations. This study begins by examining concepts of control in organizations following a short review of past work on IT effects on concept of hierarchy. Then present a comparison of conventional control and new attitude in traditional and modern organization.

Introduction

According to management literature one of the most important and constant functions of management is controlling. Controlling is the process of establishing objectives and specifying how they are to be accomplished in an uncertain future (Cook & Coffey, 1997). Researches have indicated that in the organizational hierarchy, each level of management tends to place a different emphasis on the functions of management. However controlling is a function that is widely applied by managers at all levels of management (Rue & Byars, 1997). Unfortunately formal control may have some side effects (Schermerhorn, hunt, & Osborn, 1991) such as imbalance, lack of patience, confusing documentation with action (concern for performance may lead to a stack of impressive-sounding plans but no result), panic and so on. These reasons have forced managers to consider other control mechanism that is social control. The purpose of social controls is to get people to commit themselves to the organization. For social system control to work, people need to know that someone in authority knows what they are doing and is willing to call attention to gaps between performance and objectives. Based on a survey and information gathered from 22 manufacturing and service firms in the UK, Li (1997) highlights a radical change in a basic rule of organizational design. He argues, most existing organizational designs are based on a series of compromises (for example, between central control and empowerment). Researchers have identified two categories of control methods: *behaviour or personal control* that is based on direct, personal surveillance (Rue & Byara, 1997). First-line supervisors usually apply this kind of control. *Output* or *impersonal control* is based on the measurement of output, e.g. monitoring sales figures. IT advances facilitate and improve both control method.

Control and hierarchy, traditional view versus modern approach

Miles and Snow (1992) identified four broad forms of organization: 1) The functional organizational: this encouraged internal production of parts and components to assure control. The logic of that is centrally coordinated specialization. 2) The divisional form: The operating logic of the divisional form is the coupling of divisional autonomy with centrally controlled performance evaluation and resource allocation. 3) The Matrix Form: The operating logic of the matrix form is assure control and centrally coordinated specialization. 4) Network organization: the combination of central evaluation and local operating autonomy is reflected in the dynamic network where independent firms are linked together for the one-time (or short-time) production of a particular good or services. From their viewpoint underlying all of the positive characteristics of network structure is the dynamic of Voluntarism. Applegate (1994) identified two major differences of control issue in traditional and modern company: a) In traditional company the role of control was standardizing behaviour and supervisory control of people, but now in modern firm, the role of control is to sharing information, which enabled control of the operating processes directly. b) In traditional hierarchical organizations, managers automatically inherited responsibility and accountability for decisions made by subordinates, but in modern organization all the employees are responsible for decision making.

Summary and conclusion

Over the past decade a great number of papers have been written about organisations in advanced IT age. One major characteristics of IT is separating work from location (Groth, 1999), IT devices such as email, the Internet, and etc permit tight coordination of geographically dispersed workers across time zones and cultures. Much attention must be placed on trust and coordination mechanism rather than control mechanisms. Here we distinguish some reasons: 1)As organisations perform most of their processing using electronic forms and images, workflow systems will be used to route documents electronically to individuals and work groups that need access to them. 2) Number of employees has reduced so it is much easier to control them by informal ways. 3)The other reason for trust arises from this fact that the nature of work and naturally employees' expertise have changed. In the IT age, *an individual who contributes value by adding or interpreting information is called a knowledge worker*. 4)The structure and functioning of the organization will no longer be determined only by living patterns. Programmed patterns, will increasingly influence the structure and functioning of the organization (Groth, 1999), 5) Outsourcing: Successful organisations in 21st firstly must identified new imperatives and then build a proper organisational structure to cope with them. One of these imperatives is outsourcing.

References

Applegate, L. M. (1994). *Managing in an information age: Transforming the organization for the 1990s.* Transforming Organizations with Information Technology, North-Holland, Amesterdam.

Cook, H., & Coffey. (1997). *Management and Organizational Behavior* (Second ed.). London: IRWIN.

Groth, L. (1999). *Future Organizational Design: The scope for the IT-based enterprise.* New York: John Wiley & Sons, LTD.

Li, F. (1997). From Compromise to Harmony: Organisational Re-design Through Information and Communication Technologies. *International Journal of Information Management, 17*(6), 451-464.

Miles, R. E., & Snow, C. (1992). Causes of Failure in Network Organizations. *California Management Review, 34*(4), 53-72.

Rue, & Byars. (1997). *Management: skills and application* (Eighth ed.). London: IRWIN.

Schermerhorn, hunt, & Osborn. (1991). *Managing organizational behavior* (fourth ed.). New York: John Wiley &sons,INC.

Rambling Through the Wilds: A Concept of Jagged Study Zones

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Abstract

The jagged study zone model helps designers to create educational environments which challenge the learner and make the learner to commit to the learning process. The characteristics of a jagged study zone can be explained by showing how its features are related to traditional closed and open learning environments. The requirements for a jagged study zone are identified by extracting the strengths and opportunities of the closed and open learning environments, and by combining them to the opposites of weaknesses and threats of those traditional environments. We show examples how the jagged study zones can be supported and discuss the role of the teacher when considering the jagged study zone model.

1. Introduction

In the recent discussion concerning meaningful technology for learning, the concept of "learning landscape" or open learning environment seems to refer to an environment that provides a learner with an activating, yet safe learning experience. The learning itself has become slightly dull and unexciting. From the arctic Finnish perspective, generations before us have considered learning not an easy or simple fun-like activity, but rather a painful experience that changes the learner at a fundamental level. Instead of referring to a tamed, village-like landscape with occasional woods and meadows for lovely picnics, learning can also be a process of blood, sweat, and tears. In our experience these dull learning landscapes rarely offer enough excitement and realistic challenges for every student. We do not argue that learning or education should always be extremely exciting, but on some occasions the appropriate amount of exhilaration might motivate the student to cope with very difficult domains.

At the same time the learning landscapes or open learning environments do not necessary offer enough guidance and counseling to the poorly motivated student. If the student is not capable of making the right choices, the learning environment most likely will not help her. Hence, the jagged study zone should take also care of a poor student; facilitating her with efficient learning products and support.

In this paper we will propose a model for building educational environments by introducing the concept of jagged study zones. Applying a jagged study zone one can cover most of the demands listed above.

2. Definition of the Jagged Study Zone

We begin our definition of a *jagged study zone* by examining the properties of two well-know learning contexts: a closed learning environment and an open learning environment. In a *closed learning environment* the teacher sets the goals and dictates for the tools used, pace, materials, schedule and the learning goals. Wilson (1995) characterizes the closed environment to be a construct, in which the students work by using facilities to collect and interpret information. The closed environment is restricted and rigid; the students are not able to work or express themselves freely. The metaphor for closed learning environment could be a product line of a factory. Student is a product traveling through the product line and the factory (educator) provides him with all the necessary information and knowledge.

To get free from the limitations of the closed learning environment Miller (1997) and Levi (1994) proposed an *open learning environment*, which is characterized by

1 being learner centered,
2 rich communication,
3 exploratory learning,

4 the use of learning goals, and
5 possibilities to make decisions individually and in groups as they encounter problems.

Learning is directed and scaffolded, but not controlled or enforced to a certain model (Wilson 1995). The advocates of open learning environments claim that the motivation for learning comes from the learner herself.

We can combine the strong points of the closed and open learning environments into a novel concept. We begin by making a SWOT analysis of the closed and open learning environments (see tables 1 and 2) and combining the strengths and opportunities identified with the analysis. Then we will reinforce our concept by incorporating the *opposites* of the weaknesses and threats found in both approaches by introducing supporting facilities.

Strengths	**Weaknesses**
+ goal awareness	- does not support initiative
+ skill learning	- suppresses creativity
+ efficient in closed tasks	- narrow applicability
Opportunities	**Threats**
+ learning by gaming	- trains learners into robots
+ utilizes external motivation	- promotes tunnel vision

Table 1: SWOT-analysis of a closed learning environment concept.

Strengths	**Weaknesses**
+ creative problem solving	- hard to teach (lack of teacher control)
+ own choices	- can be boring
+ variety of tools	- lack of plot or narrative organization
+ individual paths	
Opportunities	**Threats**
+ develops autonomy	- traps, deadlocks
+ coaching - tutoring guidance	- dependent variables
+ challenging for a motivated student	- learning topologies
+ internal motivation	

Table 2: SWOT-analysis of an open learning environment concept.

Learning environments based on adaptive hypermedia (Brusilovsky 2001) are good examples when closed learning environments have been transformed to be more flexible. Despite the introduction of adaptation, systems based on adaptive hypermedia are still confined environments, where system designers or learning material authors have to decide the rules by which educational materials are presented to the learner.

The *open market model* (Meisalo, Sutinen & Tarhio, 2000, 69-71; Meisalo & Lavonen, 2000) is a typical construct based on the open learning environment paradigm. This model structures the open environment and the activities of the learner therein. In the original market model, the student is considered to be a consumer in a large supermarket (computer). In the supermarket the customer makes highly individual choices that are relevant only for her. In the supermarket you can forget all the other customers or people, and the only important thing is to think about your own welfare and choices. In the open market model, referred above, both positive interaction of learners in the environment and the access to the world outside the supermarket, even wild nature, electronic workshops, etc., are emphasized. In the original field of application the interest has been primarily in science and technology education. Both the nature and the technological applications show often features that are far from smooth and ideal. This demonstrates that the idea of jagged study zones brings about new features to learning tools, like in our example of extending the original market model into the open market model.

The jagged study zone concept

We see Vygotsky's (1978) zone of proximal development as a component for jagged study zone, in which the student is encouraged to take the learning experience to the outer limits. The jagged study zone can be a harsh environment for the student, and demands serious efforts to explore and reach its limits. The characteristics of the jagged study zone are derived from the closed and open learning environments. We identify four main requirements for a jagged study zone by combining the strengths and weaknesses of the closed and open learning environments and by countering their weaknesses and threats.

Features derived from closed learning environments:

The goal awareness and skill learning identified as strengths of a closed learning environment and the corresponding opportunities of learning by gaming and utilization external motivation translate into collaborative tools for achieving meaningful goals in the jagged study zone (first requirement). The tools help students to understand their goals and to scaffold them in reaching the goals. External motivation and the competitive gaming element can be attained by introducing a collaborative element into the learning process, where the students help each other and may get inspired by each others' progress and skills.

The closed learning environment tends not to support initiative and it suppresses creativity. From this emerges the threat of training students into tunnel-visioned robots without inquiring minds. To counter these weaknesses and threats the jagged study zone promotes the students to learn creative problem solving and versatile meta-skills for survival such as self-evaluation in a harsh learning environment. This can be conducted by allowing the students the opportunities to solve fuzzy problems and to deal with uncertainty in the jagged study zone (second requirement).

Features derived from open learning environments:

When combining the best features of open learning environments, we can extract the third requirement for jagged study zones. The open learning environment promotes creative problem solving by letting the students to make their own choices and select their own paths. In jagged study zones the student must take challenging actions by self-initiated and self-regulated construction during the learning process.

The weakness of the open learning environment is that it often leaves the student alone with his choices. There is plenty of space to go, but there is no guidance for a student who gets lost. To counter this threat we need adaptive methods for getting out of deadlocks and traps (fourth requirement). If we do not want to rely on automated methods, it is always possible to use peer-help in identifying the traps. This can be achieved for example by social navigation (Munro 1999), i.e. making the actions of every individual visible to other individuals.

Summary of requirements for a jagged study zone:

1. In the jagged study zone there are collaborative tools for achieving meaningful goals.
2. The jagged study zone equips the students with an opportunity to solve fuzzy problems and deal with uncertainty and unexpected phenomena.
3. During the learning process the student must take challenging actions by self-initiated and self-regulated construction.
4. Adaptive methods for getting out of deadlocks and traps, or peer-help based on for example social navigation.

Example of a jagged study zone as a landscape

The jagged study zone concept can be illustrated by a jagged desert landscape where one can find for example following things:

Oasis:
An oasis is a place where learner can stop at to find inspiration, guidance and even amusement.
In the oasis the student can find refugee if she gets lost during her explorations in the jagged landscape. There can be attractions and guides at the Oasis to motivate student. The Oasis can for example include a hut with a mirror, which the student can use as a tool for self-evaluation.

Inspiration points:
Inspiration points provide the student with fresh stimuli, for example as distance thought models operate in idea generation. These can appear to the student as a *mirage* in the desert. Inspiration points may include ideation tools and they can may be created and inserted by a teacher.

Workshops:

The workshop is a place where the student can find tools that help the student in exploration. The tool may include visualization, writing applications and collaborative devices. For example, *learning seeds* (Kurhila and Sutinen 1999) can be processed in a workshop.

Learning seeds:
In the landscape, the learner can find learning seeds, which are planted by the teacher or fellow learners. These can be parts of learning material, exercises, ideas and visual presentations. The seeds can "grow" from the actions other learners make, i.e. the learners work on a written assignment by commenting each other's input. The seeds can also grow by some other function, for example by some pre-defined rules. This is particularly suitable if the seeds are a part of an artificial world consisting simulated events in time and space. It is possible that a prosperous, well-surviving and well-nourished learning seed can grow to be an inspiration point in the landscape.

Viewpoints:
The learner can use the viewpoint to gaze over the landscape. In this way the learner can review his journey in the landscape. It is also possible that a learner can view his journey in respect to other learners' journeys, incorporating social dimension also to the *evaluation* of the learning process. In addition, the more traditional way to exploit the learning history is that the teacher can use the viewpoints to track and possibly intervene (help, guide, advise) learners as they explore the landscape.

3. Examples of supporting jagged study zones

Context 1: Virtual platforms. In the current course delivery systems, such as WebCT or Learning Space, the jagged study zone idea is not supported. The systems offer rigid, often similar, solutions to the design of learning situations. According to the jagged study zone concept, the virtual platforms should offer ways to implement stimulating learning situations. At the current time the construction of stimulating features to learning landscapes remains almost entirely on the hands of the teacher.

Context 2: Computer Science teaching. In the Virtual Approbatur project at the Department of Computer Science, University of Joensuu in Finland, the design and implementation of virtual courses is based on the analysis of students' needs according to the Candle scheme (Haataja et al. 2001). On the other hand, the Candle scheme is derived from the concept of jagged study zones. For example the visual tools, like algorithm animator Jeliot (Haajanen et al. 1997), offer a student a way to actively strengthen the understanding of programming concepts. Visual tools give students the aid for grasping the theoretical aspects of programming. Furthermore, one of the ways to realize the jagged study zone concept would be to use students' unfinished learning materials and blurred learning goals (tasks). In fact, the starting point might be an entirely incorrect version of an algorithm. The following trouble-shooting activity by Jeliot is an utmost characteristic of a jagged study zone. Thus, Jeliot inspires the students to work with the material deeply to make it more suitable for achieving the learning goals.

The Empirica Control environment gives a student tools to study a phenomenon that takes place in his physical neighborhood. Thus, the observed circumstances are far from ideal ones describing abstract models. This *noise* – representing the jagged feature of Empirica – supports him towards his own efforts in the learning process.

Context 3: Adaptive learning environments. Adaptive learning environments have evolved from intelligent tutoring systems (ITS) towards more comprehensive hypermedia-based environments with adaptive presentation and adaptive navigation support (Brusilovsky 2000). Most of the intelligent tutoring systems do not provide the learner with learning materials: the knowledge required is acquired outside the system, and the ITS provides only a platform for helping the learner in the process of problem solving. Today the trend is to offer an environment where the learning material is browsed in an adaptive manner. It should be noted that in reality only a few systems can offer this, since providing adaptation is never a straightforward task to design and implement.

When fitting the jagged study zone model to a hypothetical adaptive learning environment, there is a need to think the concept of adaptive learning environments more broadly. For example, collaboration can be achieved when users are not modeled as individuals but as groups. This poses a noted problem (Beck et al. 1996), but one solution is to use probabilistic models to form or just suggest groups of individuals, where the group has sufficient potential to tackle the learning tasks (requirement 1 of the jagges study zone model). Requirement 2 of the jagged study zone can be supported by standard adaptive navigation support if the learning environment is based on hyperlinked material, or with adaptive scaffolding which can mean intelligent and interactive problem solving support. Requirement 3 can be supported with unpredictable components generated by random algorithm for inspiration points thus bringing up the motivation.

To provide any kind of individual adaptation requires the learner to be modeled in some way. The model is always an approximation of reality and thus imperfect. Therefore, an adaptive learning environment can easily be a "sweatshop" if the environment is too rigid and the modeling is conducted inappropriately. However, slightly imperfect learner modeling is in complete harmony with the fourth requirement listed for the jagged study zone model. If there is a need to shift the emphasis from modeling the learner artificially to human (peer) evaluation, we can incorporate the idea of social navigation to the environment to identify when learners or groups of learners are facing traps and deadlocks.

Context 4: Woven Stories. The concept of woven stories can be briefly described as several authors writing a story in a shared virtual space (Harviainen et al 1999, Gerdt et al, 2001). The difference between the woven stories idea and collaborative writing becomes evident in their functions: the writers of a woven story engage in a dialogue of storytelling rather than concentrating on an effort to produce a joint document. The shared virtual space, where the authors write the woven story is a place where the writers may be inspired by the writings of the others, take part in writing a twist into an existing storyline, compare one's writings to other contributions or simply write a story for others to read.

A system realizing the concept of woven stories can be used as a collaborative learning environment. The concept of woven stories fits well with the jagged study zone model. The shared functions of the virtual space offer tools to authors or learners, with which they can produce and link texts to achieve goals which are of communal or individual importance (requirement 1). Writing and re-writing text is a good way to reiterate an original problem definition and to elaborate better and better solutions via partial or preliminary ones (requirement 2). A system for woven stories can include mechanisms monitoring the students to notice any lost students. These mechanisms, for example periodical reports and alarm triggers, can be used to inform teachers and tutor students that intervention is needed (requirement 4). This information can be relayed to the lost student too, so that she realizes her situation and may benefit from the scaffolding facilities of the environment.

The authors of a woven story may link their story passages to other authors' passages, thus including their contribution into a story that is being written by other authors. From an another point of view they may include a piece of somebody else's story into one's own story. When the students link their stories to others' stories and participate in the creation of a storyline they must make challenging choices (requirement 3). The students must relate their creations to writings of others, maybe adapting their contributions somewhat.

4. The roles of students vs. teachers in learning environments with jagged study zones

It is important that there is a balance between the student autonomy and the teacher guidance in jagged study zones. In principle, there is always a responsibility for a teacher to make sure that the students are working towards the goals set for the course or equivalent. On the other hand, student autonomy, especially the decision making skills and the readiness to take responsibility do not develop if they do not have situations where to get relevant experience. These aspects can be readily observed in certain types of computer games, but in jagged study zones they appear in more realistic ways.

In a modern learning environment it is important, that the learner is able to work creatively and join various teams for brainstorming and other forms of ideation processes. It is also important, that the learner is able to co-operate with a number of specialists, one of them the teacher, but some being fellow students possibly reached over the Web etc. Even motivating and guiding feedback is available in natural forms in workshops of jagged study zones.

The teacher's role in a jagged study zone is that of a wilderness guide, a ranger who is aware of potential threats, risks, opportunities, and challenges meeting all explorers in the unknown. Students can be seen as scouts, at a proximal zone of new findings, reorganizing, and changing earlier knowledge structures. While a single hunter and trapper may sometimes have reasonably good life, high mountain tops or most extreme wilderness can be reached only by teams. Positive group dynamics within the trekking team is essential – collaborative learning of higher order (thinking) skills is dependent truly on the success/survival of every team member. The team makes use of heterogeneous and versatile skills of each one. This metaphor relates also directly to research work, but any learner is equally exploring her environment for knowledge and skills that are new to her.

5. Concluding remarks

Today, in our society indifferent attitudes are common. In many occasions the attitudes towards learning and education are similarly indifferent. The student will not succeed with this type of unconcerned attitude in jagged study zones. The students have to make a stand, form an opinion, to act, to really stick their hands on the mud.

It is possible to identify jagged traces in the existing learning environments, as the examples taken from Empirica, Jeliot, and Woven Stories indicate. However, to bring the idea of jagged study zones not just a feature of a computer-supported learning process, but an all-embracing principle thereof needs determined action. This will be our agenda in both designing novel educational environments as well as evaluating their power and usefulness.

References

Beck, J., Stern, M. & Haugsjaa, E. 1996. Applications of AI in Education. ACM Crossroads, 3(1).

Brusilovsky, P. 2001. Adaptive Hypermedia. User Modeling and User-Adapted Interaction 11 (1/2):87-110.

Brusilovsky, P. 2000. Adaptive hypermedia: From intelligent tutoring systems to Web-based education. In G. Gauthier, C. Frasson and K. VanLehn (eds.) Intelligent Tutoring Systems. Lecture Notes in Computer Science, Vol. 1839, (Proceedings of 5th International Conference on Intelligent Tutoring Systems,ITS 2000), Springer, 1-7.

Gerdt, P., Kommers, P., Looi, C., Sutinen, E.: Woven Stories as a Cognitive Tool. Cognitive Technology 2001, LNAI 2117, Springer, 2001, 233-247.

Haajanen, J., Pesonius, M., Sutinen, E., Tarhio, J., Teräsvirta, T., and Vanninen, P.: Animation of user algorithms on the Web. In: Proc. VL '97, IEEE Symposium on Visual Languages, IEEE, 1997, 360-367.

Haataja, J., Suhonen, J., Sutinen, E. & Torvinen, S. High School Students Learning Computer Science over the Web, *Interactive Multimedia Electronic Journal of Computer-Enhanced Learning (IMEJ)*, 3(2), October 2001. Available at http://imej.wfu.edu/articles/2001/2/index.asp.

Harviainen, T., Hassinen, M., Kommers, P., Sutinen, E.: Co-authoring Stories over the Internet. In Advanced Research in Computers and Communications in Education. IOS Press, Amsterdam, 1999.

Kurhila, J. & Sutinen, E. 1999. Sharing an Open Learning Space with Individualizing Agents. *Journal of Interactive Learning Research*, 10(3/4), 287-300.

Learning Landscape. Internet WWW-page, URL: http://www.dgj.ch/ethworld/ (18.12.2001).

Levi, A.: Learning technology is not only "pushing buttons". *International Journal of Instructional Media*, 21(3): 255-260, 1994.

Meisalo, V. & Lavonen, J. 2000, *Journal of Teacher Researcher* 2, 10-27.

Meisalo, V., Sutinen, E. & Tarhio, J. 2000. Modern Learning Environments. Helsinki: Tietosanoma (In Finnish).

Miller, G. E.: Distance education and the emerging learning environment. *Journal of Academic Librarianship*, 23(4): 319-321, 1997.

Munro, A.J., Höök, K. & Benyon, D.R. 1999. Footprints in the Snow. In Social Navigation of Information Space, Springer, 1-14.

Vygotsky, L. S. Mind in Society: The development of higher psychological processes. Harvard University Press, Cambridge, MA, 1978.

Wilson, B. G.: Metaphors for instruction: Why we talk about learning environments. *Educational Technology*, 35(5): 25-30, 1995.

Never Mind the Quality

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Abstract
Qualitative and quantitative methods are often used for understanding interactions in asynchronous learning spaces. Traditionally researchers in these fields have not collaborated. Research on asynchronous discussions provides an ideal arena for collaboration because of the large volume of data available and the relatively under-theorised nature of the field. The presenters are examining communication and decision making in computer mediated teamwork. They seek to bridge the qualitative/quantitative divide by using both approaches to better understand what is happening.

The Topic

The purpose of this paper is to describe a research project/design, which investigates decision making modes in an asynchronous computer-mediated communication (CMC) environment. The multidisciplinary research team (representing the fields of artificial intelligence, international management and education) will employ a design which has iterative quantitative and qualitative elements.

Research Questions and Motivations

We have three primary research questions:

1. What are the dominant decision making modes used by teams in the computer-mediated environment?
2. What is the mix of process, social and task communication used in computer-mediated teamwork?
3. How can quantitative and qualitative approaches be combined to investigate these phenomena?

There are three motivations for this study: 1) To extend past findings from three predominant models of decision making (rational, constrained and emergent) to the CMC context, 2) to integrate qualitative and quantitative findings in an iterative process to better understand CMC decision making, and 3) to attempt to develop a software tool for practitioners that allows simplified analysis and depth of meaning.

The Conceptual Framework

Asynchronous Computer Mediated Communication: The literature in CMC positively characterises the environment as one of time and space flexibility, many to many communication, computer mediated interaction and text based nature (Harasim, et al. 1996). Contributions have a high degree of plasticity in the sense that they can be reshaped (Hammond, 1998). Garrison et al (1998) theorise that there could be a connection between this text based communication and higher order thinking. There is also the potential for equal opportunity for participation (Eastmond, 1994). The literature has also negatively characterised the CMC environment as including dependence upon technology which may not always work (Hara and Kling, 1999), the absence of physical presence which can result in message ambiguity and lack of clarity (Eastmond, 1994), and perceptions of the medium as an act of publishing, rather than speech, which may result in communication anxiety (Grint, 1989). These features represents a significantly different context for research on decision modes.

Group Decision Making: Over the years, the study of decision making has focused on two primary questions: 'how do decisions get made?' and what is the most effective approach to making decisions?'. This research focuses on the first question of decision making modes rather than performance. There are at least three modes of decision making that can be taken from the literature: the rational (Gulick & Urwirk, 1937), constrained (Simon, 1960), and emergent modes (Allison, 1971). To identify which mode is used in any particular group exchange requires careful analysis of the group's dialogue. Dialogue in face-to-face environments generally contain three types of statements: task, process, and social. These will be operationalised for our study in the methodology section.

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Methods

A group of senior-level university students worked in dyads to analyse and make decisions in a business case solution. In this assessed assignment, the groups were instructed to conduct all their interaction through electronic media which could include e-mails, electronic chats or electronic discussion forums. These CMC media provide a rich and complete transcript of the participants' interaction and these transcripts will serve as the basis of our analysis. The participants in this study have some experience in decision making and less experience in working in electronic environments.

In our qualitative inquiry, content analysis will be used to analyse the CMC transcript data (Henri, 1991) using a 'gestalt' approach (Gunawardena et al. 1997). Statements will be identified as task, process and social and decisions will be identified as rational, resource constained, or emergent. The resultant description will be merged with further quantitative analysis and then used as part of the machine learning cycle of the project. In our quantative inquiry, we will use Knowledge Discovery fom Databases (KDD) as a means of automatic quantitative investigation. KDD includes a broad number of methods for extracting knowledge from data. In this case we are interested in attempting to discover ways of automatically classifying discussions, and identifying key points in the discussion.

We will employ an iterative process of analysis. The quantitative analysis relies heavily on the coding scheme devised for the qualitative analysis. Initially, the quantitative analysis attempts to identify suitable parameters for classification. The results of the initial qualitative analysis are then applied in the development of the quantitative analysis. Similarly, novel relationships or associations revealed by the quantitative analysis can inform further iterations of the qualitative approach by indicating possible classifications or associations between statements and decisions.

Anticipated Results

We anticipate findings relating to decision making modes and the mix of communication. With regard to the decision making modes, we anticipate finding evidence of all three in the asynchronous environment. What will be particularly interesting will be the patterns that come into view. With regard to the types of communication, we expect to find significant attention being given to social comment and to the establishment of identity and team cohesion as compensatory mechanisms. In terms of process, the absence of physical presence may have a positive impact on giving and receiving feedback and metacognitive activity. Some intermediate categories of process related to task and process related to social factors may also emerge. Finally, with regard to methods of analysis, we hope that the dialogue between qualitative and quantitative approaches will provide new insight into CMC decision making and how we conduct research on it.

References

Allison, G. 1971. The Essence of Decision: Explaining the Cuban Missile Crisis. Boston: Little-Brown.

Eastmond, D. (1994). "Adult Distance Study through Computer Conferencing." Distance Education 15(1): 128-152.

Grint, K (1989) Accounting for Failure : Participation and Non-Participation in CMC, in Mindweave : Communication, Computers and Distance Education, Mason, R., and Kaye, A (eds) Oxford Pergamon Press.

Gulick, L. & Urwirk, L. 1937. Papers on the Administration. New York: The Free Press.

Gunawardena, C., (1997). "Analysis of a Global Online Debate and the Development of an Interaction Analysis Model for examining Social Construction of Knowledge in Computer Conferencing." Journal of Educational Computing Research 17(4): 397-431.

Hammond, M. (1998). "Learning Through On-Line Discussion : what are the opportunities for professional development and what are the characteristics of on-line writing." Journal of Information Technology for Teacher Education 7(3): 331 - 346.

Hara, N. and R. Kling (1999). "Students' Frustrations with a Web-Based Distance Education Course." First Monday 4(12).

Harasim, L., R. Hiltz, et al. (1996). Learning Networks : A Field Guide to Teaching and Learning On Line. Cambridge, England, MIT Press.

Henri, F. (1991). Computer Conferencing and Content Analysis. Collaborative Learning Through Computer Conferencing. The Najaden Papers. A. Kaye. Berlin, Springer-Verlag 117- 136.

Merriam, S. (1998). Qualitative Research and Case Study Applications in Education. San Fransisco, Jossey-Bass.

Sallis, P. and D. Kasabova (2000). "Computer-Mediated Communication, Experiments with e-mail readability." Information Sciences(123): 43-53.

Simon, H. 1960. The New Science of Management Decision. New York: Harper & Row.

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SPLACH: a Computer Environment Supporting Distance Project-Based Learning

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Abstract: Our research deals with collaborative learning at a distance and takes place in the field of CSCL (Computer-Supported Collaborative Learning). To promote communications between people learning in a distance context, we think that it is important to involve these learners in collective activities. We suggest to set-up activities using project-based learning in order to stimulate and facilitate collective learning. In order to support distance project-based learning, we designed and developed a computer environment called SPLACH. This environment comprises specific tools for different actors: the project designer, the learners and the project leader. SPLACH was investigated in two different contexts: with pupils in a secondary school in the domain of technology and with adult students learning programming at the Tele-university of Quebec. This article presents the computer environment SPLACH and some of the results of its evaluation.

Introduction and Context of Work

A major interest of computer-supported distance learning is to allow communication among students and to employ a constructivist approach for learning: according to the CSCL (Computer-Supported Collaborative Learning) research domain (Bannon 1989). Our main hypothesis is that conditions have to be created to stimulate interesting interactions between learners. A study of numerous distance learning environments made us realize that the main attention revolves around computer tools that must be provided for distant learners to communicate. Learners working together would theoretically need only communication tools. However, tools that simply offer technical possibilities for communication would appear to be insufficient to ensure collective learning. We feel this is not always sufficient. Indeed, although the learners are offered a possibility to communicate, there is no reason for them to do so if there is no common interest bringing them together. The lack of social cohesion renders truly collective learning impossible.

In order to create social cohesion in distance learning, our main concern is to concentrate on the instructional activity and to the computer environment to support collective learning. Thus, distance should not be seen as an obstacle to which the computer tools provide a solution, but rather as an interesting learning situation in which the computer tools are designed to support new learning activities. These were the principles governing the development of our distance collective activities based on project-based learning practices. Project-based learning (PBL) is an educational method of creating collective classroom learning situations which has been tried and tested for many years (Dewey 1902, Kilpatrick 1918, Johnson and Johnson 1991). It is particularly interesting to use in a distance learning context to encourage collective learning. However, existing distance learning platforms are not really suited to support PBL. Even if there are several experiments of PBL for platforms like WebCT or FirstClass (Christiansen and Dirckinck-Holmfeld 1995), these platforms distort the pedagogical situation (only tools to communicate and to exchange data, lack of tools for the teacher, lack of synchronous work tools, lack of group awareness tools, etc.). We stress the importance of two interdependent conditions for the success of distance PBL: (1) projects need to be set up carefully in order to promote interdependence in a distance learning situation (2) the computer environment has to support all the actors involved in PBL. In this way we decided to create a specific computer environment dedicated to PBL, founded on particular projects and team organization. The organization of each of our projects is structured around a *project designer*, role played by a teacher, a *project leader*, role played by a tutor, and a *team of learners* sharing tasks in the same project. The *project designer's role* is to define the projects by providing specification documents, structuring the projects and forming the teams, tasks usually pertaining to an instructional designer. The subject of each project should provide the learners with the opportunity to share tasks among themselves.

Indeed, in a distance learning situation it is not advisable to make the learners collaborate all the time, that is to say carry out all the tasks together (Henri and Lundgren-Cayrol 2001). The project subject is presented as a list of tasks specifications, chosen so that it can be subdivided by the learners into separate parts which should, of course, not be independent from each other but, on the contrary, closely dependent. Moreover, in order to take into account the synchronous and asynchronous aspects of any distance work, the project is divided into stages where each stage is broken up into an asynchronous work phase followed by a synchronous phase. The intention of structuring collective work is to facilitate the learners' collective work and to stimulate the learning of how to work collectively. More information about the instructional design for the collective activities can be found in (George and Leroux 2001). The work of the *project leader* consists in monitoring the evolution of the project and helping the learners both technically and pedagogically. The project leader is seen as the facilitator and consultant. The *teams of learners* work to reach the goal set for the project. Each team was composed of three learners in order to promote high involvement in the project (Caplow 1968). In this paper, we focus on characteristics of the computer environment enhancing collective project-based learning (PBL).

Development of a Computer Environment to Support Distance Project-Based Learning

The main aim of our work is to provide tools for the different actors involved in project-based learning. The actors defined in the previous section should have computer environments allowing them to do their specific tasks: setting-up the projects for the project designer, carrying out the project in team for the learners and monitoring and intervening for the project leader. So the SPLACH [1] environment was developed to support PBL; it includes three computer environments which is customized for each of the actors, that is the project designer, the project leader and the learner. SPLACH is entirely developed in Java and is built on a client/server architecture (George 2001). We use the Java Shared Data Toolkit (JSDT) library for the data exchange between applications (Burridge 1999). We describe thereafter the three specific SPLACH environments.

Project Designer's Environment

With SPLACH, the project designer has tools to define and to set-up projects for learners. Firstly, the project designer can create new projects and specify teams of learners and their project leader who will monitor the learners. Then, the project designer structures each project in steps according to the pedagogical objectives to be reached. The project designer defines preformatted documents that will appear as a project progresses. Finally, the project designer plans project giving a preliminary schedule that could be discussed among the learners and their project leader (Fig. 1). Indeed this environment can be viewed as a project editor facilitating the creation of project-based learning in a distance context.

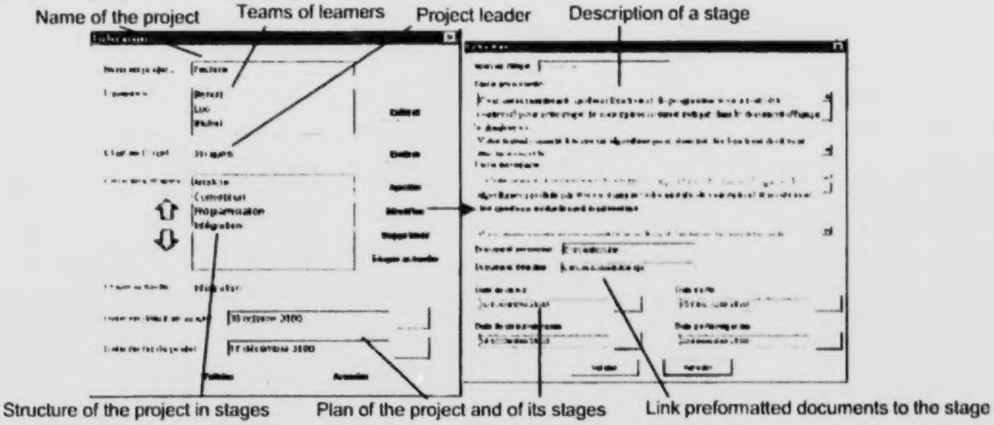
Name of the project
Teams of learners
Project leader
Description of a stage
Structure of the project in stages
Plan of the project and of its stages
Link preformatted documents to the stage

Figure 1: Interface of the project designer

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[1] SPLACH is the French acronym for "*Support d'une pédagogie de Projet pour L'Apprentissage Collectif Humain*" which can be translated as "Support Project-Based Learning for Collective Human Learning".

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Learner's Environment

Concerning the learner's environment, our aim was to design an environment that incorporates all the tools necessary for the learners' collective activities. While common practice dictates the use of different tools (for instance Word® for editing documents, Eudora® for E-mailing and Netmeeting® for synchronous meetings) when learners have to use numerous software products at the same time, the cognitive workload will be increased. In a learning context, this extra load would not be favorable. The simpler the interface and use of the tools, the more learners will be able to concentrate on their activities. This simplicity calls for an environment comprising all the necessary tools to be designed and available in one environment. The amount of time and energy spent on the development will of course be greater, but this is the only way to develop a system that any learner can use, irrespective of his/her competence in computing. Moreover, there is another advantage to this investment. Existing software is often quite prohibitive, and difficult to analyze in terms of usage traces. Another of our aims was to facilitate collective learning based on information obtained from the computer system. The design and development of our own tools allow for collection of data concerning the learners' and the teams activities. These data are then analyzed and used by the system to promote the collective activities (Després and George 2001).

Thus the learners' SPLACH environment integrates asynchronous communication tools (E-mail and discussion forum), a synchronous meeting tool which allows textual discussion and application sharing, a scheduling tool in the form of a team calendar which provides the learners with coordination of the project, a tool to write reports during the project (documents are preformatted by the project designer) and, finally, specific tools of the subject matter. These specific tools are the only part of SPLACH that varies from one subject matter to another. A lot of attention was particularly paid to the design of the synchronous meeting tool, intending to support awareness (Dourish and Bellotti 1992) among the participants of a synchronous distance meeting and to stimulate the teamwork. Since good quality multipoint videoconference tools are not yet accessible with standard networks, we chose to display photos of participants during the meeting sessions. Moreover, participants can share a document and work collectively on it using an easy visual system of turn taking (Fig. 2). During a meeting, participants communicate within a semi-structured interface that helps to keep threads of discussion visible.

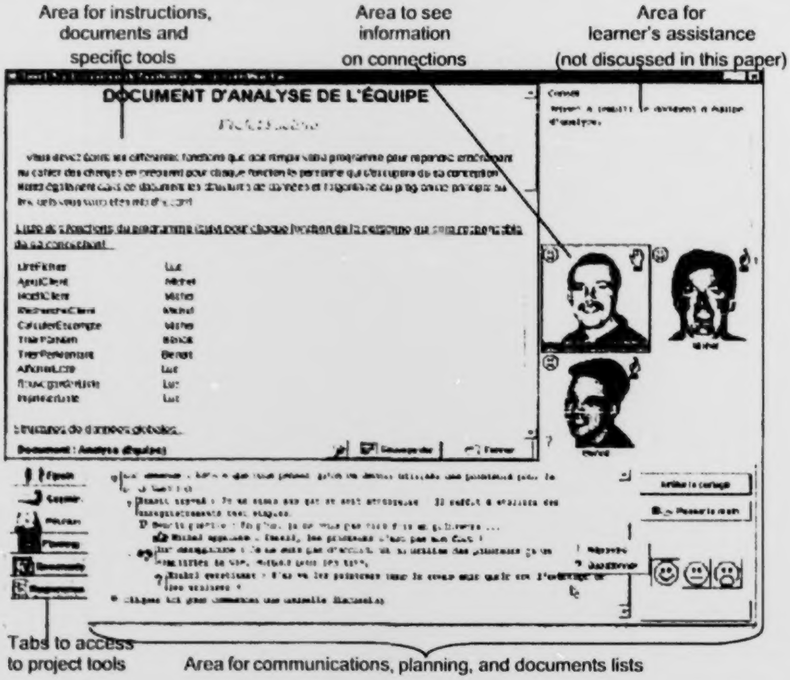
Area for instructions, documents and specific tools
Area to see information on connections
Area for learner's assistance (not discussed in this paper)
DOCUMENT D'ANALYSE DE L'ÉQUIPE
Tabs to access to project tools
Area for communications, planning, and documents lists

Figure 2: Interface of the learners

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Project Leader's Environment

The project leader is a central key in our conception of distance PBL. S/He has to have tools to communicate with learners and to monitor their activities. For the moment, the project leader's environment is very close to the learner's environment; however including some additional functionalities and specific rights. Thus, the project leader can modify the planning of a project, manages rights of turn taking during synchronous meeting. We are presently researching and investigating specific tools to assist the tutor in monitoring both individual and collective learner activities. To reach our objectives to refine the leader/tutor environment, an iterative design process is employed by implementing the SPLACH environment, interview and keep traces of how tutors use it, and then adapt and enrich the SPLACH environment accordingly. One of these tools is a system designed to assist the tutor in his monitoring tasks (George 2001).

Evaluation of SPLACH

One of our major concerns was to develop a computer environment, which can support projects in a large range of educational fields. In order to prove the reusability, SPLACH has been investigated in two different contexts: with junior high school students in the technology field and with adult students learning programming. In the following sections, we discuss some results focusing on the use of SPLACH. These results are based on observations, questionnaires and automatic data traces recorded by the computer system.

With Junior High School Students in Educational Robotics

Each year a robotics competition is organized for junior high school students in the department of the Sarthe (France). All teams taking part are given a list of specifications at the beginning of the school year; during the year the students work on designing robots in order to compete in the festival at the end of the school year. This festival provided an interesting situation to design the collective distance projects. The students on each team usually come from the same school. For our investigation, we created two teams made up of students from geographically remote schools. These teams of learners used our SPLACH environment from their classroom to work collectively on the robotics project. We assumed the role of project designer and project leader ourselves from our laboratory in order to better understand how it felt to supervise and monitor teams of learners at a distance. For these evaluation, we added specific tools from the educational robotics fields to SPLACH: a tool to view electronic course books that embed all notions introduced in the technological context, a tool to describe micro-robots [2] to computers which automatically generates elementary programs, and a tool to program and drive micro-robots. The Fig.3 shows screen shots of these different tools.

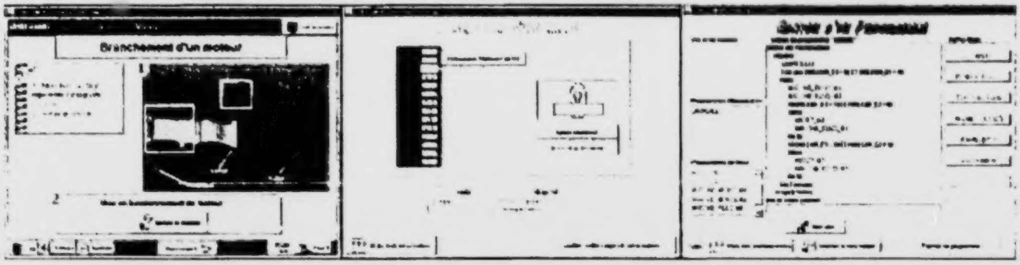

Figure 3: Specific educational robotics tools integrated in the SPLACH environment

The evaluation was conducted with fifteen students (aged 13/14) in three different schools. The list of specifications for this project, defined by the organizers of the robotics challenge, required the teams to design a robot which could carry out several functions (follow a black line, knock over a skittle, put a ball into a hole, etc…). The students defined the modules it would take to build a robot and then determined who was going to do what. Obviously, the modules were interrelated, which in turn promotes collective learning, since they depended on each other to bring the modules together as one robot, which would enter the competition.

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[2] The robot used are Fischertechnik© micro-robots.

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The evaluation lasted for about three months, with the students using the SPLACH environment for about two or three hours each week. Every Friday lunchtime, ninety minutes were set aside for synchronous meeting sessions with the teammates. Outside these sessions the teams could work on the project whenever they wanted to by communicating asynchronously via Email or the discussion forum. Two weeks before the competition, the students met physically for the first time in order to assemble the different parts of the robots. On the day of the festival, one of our teams shared first place in the competition. The results of a post-questionnaire show how the learners felt the importance to work collectively, and that they found this type of collective work highly motivating. Moreover, the results of the questionnaire show that the learners perceived that they were part of a team throughout the project, which was also apparent during the competition. We can therefore say that our main educational goal, which was to create social cohesion and interdependence among distance learners, has been achieved. The learners had no particular difficulty to use SPLACH even if they were children. It was one of our concerns to make SPLACH so user-friendly that it would cater to a wide public of learners, including young ones.

With Adult Students Learning Programming

A second evaluation of SPLACH was carried out at the Tele-university of Quebec. Six adult students in a programming course used SPLACH during six weeks to work in teams, each student working from her/his own home. The list of specification of the projects corresponded to a practical work of their course. The main goal was to permit the students to work collectively on a program in Pascal, each student being responsible for specific functions of the program. A tutor at the Tele-university assumed the role of project leader.

We have integrated to SPLACH a specific tool to allow the learners to work in team on a same computer program. This tool makes a link between SPLACH and the Delphi® environment. Thus the computer functions and procedures found in a source program written with Delphi® are automatically added into SPLACH. In this way learners share their programs. The Fig. 4 shows this tool during the display of a programming procedure in SPLACH. In the lower part of the screen, the learners can access the main program, their personal programs or their teammates programs.

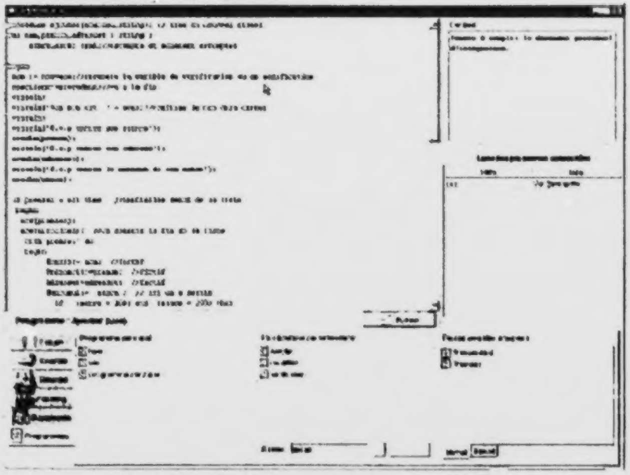

Figure 4: Specific tools to program in team

Altogether, students connected to the SPLACH server for a total of 70 hours. Students' answers to the questionnaire bring out the fact that they appreciated the possibility to communicate and to help each other. Furthermore, the students considered the synchronous phases to be necessary to the organization of the collective activity even if they place temporal constraints not always easy to solve. This type of project appears to help students better understand the necessary conditions to a good cooperation. They like the environment because it allows them to easily gather documents and programs together in the same place. Furthermore, they felt that the project leader had a crucial role, although some of them regretted that he was not more actively involved and more directive. Moreover, some of the students would like to take on the role of the project leader. It's an option that we foresee for future investigations.

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Outcomes From the Evaluations

For the two evaluations, the goal of the projects were reached: building and programming a robot for the junior high school students, writing a computer program for the students of the Tele-university. An observation of the students' activities shows that final products have really been the result of collective work. These evaluations also made it possible to substantiate the validity of the SPLACH environment from both a pedagogical and technical point of view. This environment is capable to adequately supporting distance project-based learning. The students found it easy to use, most likely because it integrates all the tools necessary for collective work. We have also shown that the SPLACH environment can be used in different context.

Conclusions and Futures Directions

The SPLACH environment was developed to support project-based learning at a distance. It adapts its tools according to the actors: the project designer, the learner and the project leader. For a distance learning designer, SPLACH can be seen as a computer platform facilitating the setting-up of project based-learning in which you only have to integrate the tools pertinent to the subject-matter. If existing specific tools are developed in the java language, they could easily be integrated to SPLACH. In other cases, a link can be made in SPLACH to launch external specific tools. For learners, a strong integration of the collective work tools leads to make SPLACH accessible to a wide public of learners as the evaluations corroborated. It was noticed from our evaluations that the project leader/tutor had a much more active role compared to traditional tutoring of individual distance learning. The collective activity is more complex to supervise and monitor, which is more time consuming for the tutor. Thus, a future direction of our work lies in providing particular tutor tools to assist her/him in the supervising and monitoring of learners' collective activities. In this way, we work on integrating a multi-agent system into SPLACH aiming at helping both the learners and the project leader.

Acknowledgements

The author would like to thank the France/Quebec cooperation commission for their support. It is realized inside the LEA project concerned by the tele-assistance in the context of practical work in technology. The LEA team is composed of researchers from the LIUM (France) and the LICEF (Quebec). The author wishes to express his gratitude to the schoolteachers, tutors and students for enabling him to carry out the evaluations in real-life situations. The author also wishes to thank Karin Lundgren-Cayrol for her helpful comments on an earlier version of this text.

References

Bannon, L. J. (1989). *Issues in Computer-Supported Collaborative Learning*, O'Malley, C., (Ed.), NATO Advanced Workshop on Computer-Supported Collaborative Learning, Maratea, Italy.

Burridge, R., "*Java Shared Data Toolkit User Guide*" (Sun Microsystems, 1999).

Caplow, T. (1968). *Two Against One: Coalitions in Triads* (Prentice-Hall, 1968).

Christiansen, E., Dirckinck-Holmfeld, L. (1995). *Making Distance Learning Collaborative*, O'Malley, C., (Ed.), International Conference on Computer Support for Collaborative Learning (CSCL'95), Indiana University, Bloomington, IN, USA.

Després, C., George, S. (2001). *Supporting Learners' Activities in a Distance Learning Environment*, International Journal of Continuing Engineering Education and Life Long Learning (IJCEELL), vol. 11 (3), p. 261-272.

Dewey, J. (1902). *The Child and The Curriculum* (Chicago: University of Chicago Press, 1902).

Dourish, P., Bellotti, V. (1992). *Awareness and Coordination in Shared Work Spaces*, ACM Conference on Computer-Supported Cooperative Work CSCW'92, Toronto, Canada, p. 107-122.

George, S. (2001). *Distance collective learning, SPLACH : a computer environment support of project-based learning (in french)*, PhD in Computer Science, Université du Maine.

George, S., Leroux, P. (2001). *Project-Based Learning as a Basis for a CSCL Environment: An Example in Educational Robotics*, European Conference on Computer-Supported Collaborative Learning (Euro-CSCL 2001), Maastricht, Netherlands, p. 269-276.

Henri, F., Lundgren-Cayrol, K. (2001). *Apprentissage collaboratif à distance* (Presse de l'université du Québec, 2001).

Johnson, R. T., Johnson, D. W. (1991). *Learning together and alone, Cooperative, Competitive and Individualistic learning* (Englewood Cliffs : Prentice Hall, 1991).

Kilpatrick, W. H. (1918). *The Project Method*, Teachers College Record, vol. 19 (2), p. 319-335.

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Utilizing Electronic Portfolios in Teacher Education Programs

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The School of Education at Northern State University in Aberdeen, South Dakota has implemented the electronic portfolio as an assessment tool and as a means of integrating technology throughout teacher education. The electronic portfolio offers a unique opportunity to build preservice teachers' proficiency with technology as well as showcase their expertise in teaching.

The portfolio concept is very popular in education today – and for good reason. First, today's educators have embraced constructivism – the belief that teaching is an active and learner-centered process. This philosophy recognizes that students build their own understanding of the world by using what they already know to interpret new ideas and experiences. Constructivists emphasize not only what students know, but what they do.

Secondly, the growing interest among colleges of education in performance assessment makes a transcript of grades and a score on the National Teachers' Exam (NTE) seem inadequate indicators of competence. A wise person once said: "There is a lot of difference between naming the tools and building the house."

And thirdly, there is stiff competition for teaching jobs in most areas of the country. It is imperative that prospective teachers be able to demonstrate their teaching competence in concrete ways – to university faculty, to prospective employers, to policy makers at the state and national levels, to parents, the media and the general public.

Why electronic portfolios rather than the paper versions? Electronic portfolios emphasize process as well as product and are multi-sensory in nature, including images, sound, video, text, and multimedia products. It's more fun to see a great bulletin board than to read about it, and it's more effective to hear a university supervisor talking about a preservice teacher's strengths than to read a letter of recommendation. In addition, electronic portfolios facilitate the integration of technology throughout the teacher education program; they provide students with exposure to a wide variety of technology experiences – all in the context of teaching and learning.

The critical phases of portfolio development are collecting, selecting, and reflecting – but the process actually has many phases. Burke, Fogarty, and Belgrad (1994) proposed ten: projecting, collecting, selecting, interjecting, reflecting, inspecting, perfecting, connecting, injecting (and ejecting), and respecting.

As students think about what entries they will collect, how to select those that best convey their abilities, and how to present what they have learned, they are constantly reflecting. Reflective thinking (as defined by Dewey, 1933) is the ability to give serious and persistent consideration to a subject in order to act deliberately and intentionally rather than routinely and impulsively. If teacher educators want preservice teachers to move beyond non-reflective reliance on impulse, tradition, and authority, opportunities for reflection must be provided throughout the teacher education program.

After piloting the use of electronic portfolios with twelve teacher education students during the 1998-1999 academic year, the School of Education at NSU began implementing electronic portfolio components into teacher education methods courses. The model used for electronic portfolio implementation solicited proposals from faculty members interested in integrating electronic portfolio components into their methods classes. Faculty received monetary compensation for the creation and integration of electronic portfolio components into their courses.

Each student-created electronic portfolio is original; portfolio components are designed to address one or more of the ISTE National Educational Technology Standards (NETS) and performance indicators for teachers. In addition, students must address each of the five categories of the knowledge base for teacher education at NSU: Knowledge of Self as an Individual, Knowledge of Content, Knowledge of the

Learner, Knowledge of Pedagogy, and Knowledge of Self as a Teacher and Member of a Learning Community.

Electronic portfolios have been a part of the teacher education programs at Northern State University for four years; current efforts have focused on assessment of the electronic portfolio process and product. Teacher education graduates are asked to complete a self-assessment survey of their technology expertise and their comfort level with technology integration. During their professional semester, preservice teachers showcase their electronic portfolios and receive feedback from university faculty members. Electronic portfolio components are then assessed to determine whether appropriate opportunities have been provided for students to meet the ISTE National Educational Technology Standards (NETS) and performance indicators for teachers as well as the required program outcomes for teacher education graduates of NSU.

This presentation will focus on data collected from the self-assessment surveys as well as the results of the electronic portfolio assessment. Specific components of original student-created electronic portfolios addressing one or more of the ISTE standards and meeting one or more program outcomes will be shared along with accompanying assessment tools, including a newly-developed holistic rubric.

Burke, K., Fogarty, R., & Belgard, S. (1994). *The mindful school: The portfolio connection.* Arlington Heights, IL: IRI/Skylight.

Dewey, J. (1904). *The relation of theory to practice in education.* The Third National Society of Education Yearbook (Part I). Chicago: University of Chicago Press.

Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process.* Boston: Heath.

Dr. Constance Geier is an Associate Professor of Education at Northern State University in Aberdeen, South Dakota. She has been at NSU since 1991 and has taught courses in Educational Psychology, Educational Assessment, and Educational Research. She currently serves as NSU's LOFTI Coordinator. LOFTI is a $10 million federal technology challenge grant administered by the United States Department of Education. LOFTI standards for Learning Organizations for Technology Integration, and NSU is one of numerous partners in the five -year grant.

Teaching Programmers/Designers Flash/ActionScript

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Abstract: This demonstration presents a constructivist approach to teaching web design skills, 2D animation, basic scripting and programming concepts using Macromedia Flash and ActionScript. The overall curriculum is discussed followed by an examination of two courses that focus on teaching Flash and ActionScript accompanied by demonstrations of tutorials and projects, which incorporate meaningful content provided by on campus institutions. The teaching approach is informed by theories of multiple intelligence and address different styles and rates of learning by featuring learner centered, hands-on tutorials, which emphasize learning by doing.

Background

In the fall 2001 Quinnipiac University introduced a new major in Interactive Digital Design to complement the major in Computer Science. Both programs are under one department in the College of Liberal Arts. The Computer Science Majors are provided with a foundation in Computer Science within the framework of a traditional Liberal Arts education that prepare graduates for success in a wide variety of Internet and computer related fields.

The Interactive Digital Design major provides students with in-depth hands-on experience in creating, designing and authoring original interactive media for CD-ROM, DVD, the World Wide Web, and desktop presentation. This major emphasizes artistic creativity, experimentation and technological competence grounded in a critical understanding of the arts, design and related areas of the humanities.

Approach

The program features a core set of requirements open to majors, minors and qualified non-majors. Because of this diverse clientele, the tutorials must address different styles and rates of learning. Teaching is informed by Howard Gardner (Gardner, 1985) theory of multiple intelligences and Robert Sternberg's Triarchic Theory of Intelligence (Sternberg et al., 2000). Tutorial projects incorporate content based on university-affiliated institutions, which develop Sternberg's triad of practical, creative and analytical skills. Demonstrations include sample projects created for the Albert Schweitzer Institute and the Service Learning Program at Quinnipiac, which is part of the national Campus Compact. Experience shows that the integration of this value rich content leads to a greater student engagement and commitment. Students enrolled in IDD 301 *2D Animation* thereby develop cognitive tools for working with image, text, motion, sound and interactivity guided by design principles. Project based learning is incremental trial and error i.e. learning by doing. IDD: 315 *Scripting for Interactivity* introduces advanced scripting including control structures, objects and classes, properties and methods, expressions and variables, conditionals, arrays, functions, handlers, smart movie clips, while using debugging and content management tools of FLASH.

Each new programming concept is always incorporated in a tutorial as part of a larger design problem. In turn the final goal is to instill an overall cyberliteracy such as advocated by Laura J. Gurak (Gurak, 2001). This instills recognition that: "on the internet, communication is a blend of oral, written, and visual information." This cyberliteracy is matched an critical awareness that is fostered by working with real world content such as that provided by the Albert Schweitzer Institute as part of a true liberal arts education.

References

Gardner, H. (1985) *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic Books, Inc.

Sternberg, R. J., Forsythe, G.B., Hedlund, J., Horvath, J., Snook, S. Williams, W.M. Wagner, R.K., Grigorenko, E.L. (2000). *Practical Intelligence*. New York: Cambridge University Press.

Gurak, L. J. (2001) *Cyberliteracy: Navigating the Internet with Awareness*. New Haven & London: Yale University Press.

Reducing the Cognitive Load on Novice Programmers

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Abstract Computer programming is a domain of knowledge that is generally considered difficult by students, many of whom experience low levels of achievement and become disillusioned. This paper suggests that cognitive load theory needs to be taken into account when designing instructional materials for this domain. The cognitive load that is experienced by a student can be considered to be made up of three types: intrinsic, extraneous, and germane. Computer programming has a high intrinsic load and it is therefore necessary to reduce the extraneous bad as much as possible by using techniques such as the study of programming examples. Germane cognitive load can then be applied by removing certain parts of the solutions to the examples and then requiring students to complete these part -complete solutions thereby encouraging schemata creation in longterm memory. A new software tool called CORT (Code Restructuring Tool) has been created which utilises this part-completion method.

Introduction

In education, certain subjects require problem solving skills and are considered by many students to be inherently difficult. An example of such a subject is software development and this requires students to be able to analyse problems and then design and implement solutions in a computer programming language. It has been observed that a large number of students achieve only low grades and become disillusioned with the subject, for example Perkins, Schwartz, & Simmons (1988) state that:

> *Students with a semester or more of instruction often display remarkable naivete about the language that they have been studying and often prove unable to manage dismayingly simple programming problems.*

Also, King (1994) states:

> *Even after two years of study, many students had only a rudimentary understanding of programming.*

One of the reasons for the above is that students experience a very high cognitive load during their learning and this paper proposes that cognitive load theory needs to be carefully taken into account in the design of learning materials and tools for such problem solving domains. The paper then describes a software tool called CORT (Code Restructuring Tool) that has been built by the author and used with novice programmers at a university in Australia.

Cognitive Load Theory

Cognitive load theory is built upon the idea that working memory is limited to around seven chunks of material (Miller, 1956) and that people can only deal with two or three elements simultaneously. The degree of interactivity between the elements also affects the capacity of working memory.

Chess playing can be considered a problem solving domain and research (Chase & Simon, 1973) showed that the main difference between novices and experts was the fact that the latter had thousands of board configurations, as many as 100000 (Simon & Gilmartin, 1973), stored in long-term memory within schemata. The consequence is that, unlike less-skilled players, experts do not have to spend as much time searching for good chess moves using their limited working memory. Similarly, research into problem solving (Carroll, 1994) confirmed that, compared to novices, experts have knowledge of an enormous number of problem states and their associated moves. Such states are within long-term memory and such research indicates that human problem solving comes from stored knowledge and not from complex reasoning within working memory. It is suggested that humans are poor at complex reasoning unless most of the elements with which we reason are already in long-term memory, working memory being incapable of highly complex interactions using novel elements (Sweller, van Merrienboer, & Paas, 1998). This means that novices who are attempting a problem must engage in complex chains of reasoning using their working memory and in doing so it is likely that working memory will be overburdened. In other words the cognitive load on novices is too great.

Ways in which cognitive load can be reduced for novice problem solvers are therefore very important. In the schema theory of model representation, a schema can be anything that can be treated as a single entity or element such as a mathematical formula or a particular programming algorithm. Schemata have the function of storing knowledge and reducing the burden on working memory.

Experts can process information relevant to their domain automatically, novices however having to process information consciously (Schneider & Shiffrin, 1977; Tindall-Ford, Chandler, & Sweller, 1996). An example of such automatic processing is that of the expert driver who can drive their car without apparently thinking, whereas a learner driver has to consciously think of several things at the same time such as depressing the clutch and shifting to a new gear, observing the road ahead, moving the steering wheel etc. Any instructional design for a domain has to therefore not only encourage the construction of sophisticated schemata but also encourage the automatic processing of those schemata. This is important because of the limited capacity of working memory that can only deal with a few schemata at the same time. The ease with which information can be processed in working memory is the main thrust of cognitive load theory.

Working memory may be affected by intrinsic cognitive load and extraneous cognitive load (Sweller, 1994). In recent research, a further distinction is made with the inclusion of germane cognitive load (Sweller et al., 1998).

Intrinsic Cognitive Load

Intrinsic cognitive load is determined by the mental demands of the task (Chandler & Sweller, 1996). Some material has very low cognitive load and an example is the learning of the basic vocabulary of a foreign language. Each element or schema is independent from the others with no interactivity and subsequently the required mental processing, or intrinsic cognitive load, is low. Tasks that have low element interactivity can be learnt serially rather than simultaneously. Tasks with a high degree of element interactivity have a heavy intrinsic cognitive load and an example is the learning of the grammar of a foreign language as all the words in phrases need to be considered, that is processed, at once.

Computer programming is a domain with a high intrinsic cognitive load and this needs to be recognised in any instructional design. The intrinsic cognitive load cannot be reduced, however something can be done about the extraneous cognitive load.

Extraneous Cognitive Load

Extraneous cognitive load is generated by the instructional format used in the teaching and learning process and poor design leads to a high extraneous cognitive load. If a high extraneous cognitive load is combined with a high intrinsic cognitive load then this can lead to working memory overload. This is often what happens with novice programmers when the instructional design is poor.

The important point is that when the intrinsic cognitive load of the material is high, then it is incumbent on the instructional desgner to think very carefully and ensure that the extraneous cognitive load is as low as possible. A lot of research has been done in looking at ways of reducing extraneous cognitive load, for example (Chandler & Sweller, 1991; Kalyuga, Chandler, & Sweller, 1998; Marcus, Cooper, & Sweller, 1996; Sweller, 1994; Tindall-Ford et al., 1997). These include: integrating diagrams and text so as to reduce the "split-attention" effect; goal-free problem solving; and the use of worked examples in problem solving.

Germane Cognitive Load

More recently, the concept of germane cognitive load has been introduced into cognitive load theory (Sweller et al., 1998). It is thought that if the instructional design is such that the extraneous cognitive load is kept to a minimum, and the intrinsic cognitive load is not too high, then there may be some unused working memory available. This could then be used by learners, with appropriate instructional design, to engage in conscious processing that helps in the construction of schemata in the particular domain of interest. This conscious processing is the germane cognitive load. An example is the use of part-complete solutions in the learning of problem solving (Paas, 1992; van Merrienboer, 1990; Van Merrienboer & De Croock, 1992). The studying of complete worked examples by students is seen as one way of reducing the extraneous cognitive load. When students have to complete an incomplete worked example then they have to "mindfully abstract" the schemata from the example in order to understand it. That is, they have to consciously process it and this increases the germane cognitive load. Figure 1 shows the relationship between the various cognitive loads in the domain of programming.

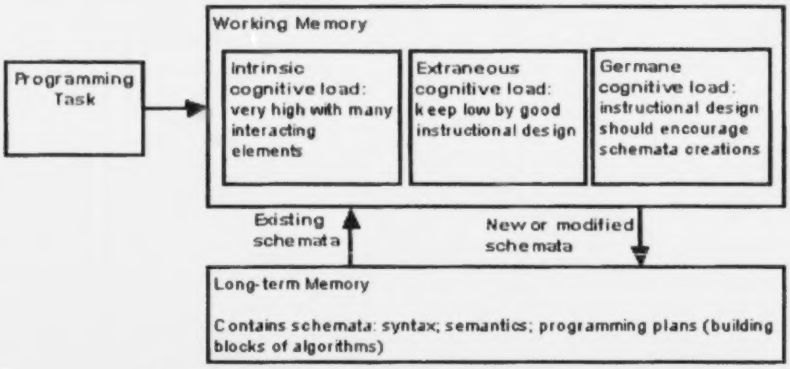
Working Memory
Programming Task
Intrinsic cognitive load: very high with many interacting elements
Extraneous cognitive load: keep low by good instructional design
Germane cognitive load: instructional design should encourage schemata creations
Existing schemata
New or modified schemata
Long-term Memory
Contains schemata: syntax; semantics; programming plans (building blocks of algorithms)

Figure 1: Cognitive load relationships in programming

Use of Worked Examples and Part-Complete Solutions in the Teaching and Learning of Programming

The "Reading" approach to the learning of programming makes use extensive of worked examples in an attempt to reduce the extraneous cognitive load on novices. A lot of the work in this area has been carried out by van Merrienboer and his colleagues (van Merrienboer, 1990a; van Merrienboer, 1990b; van Merrienboer & Paas, 1990c; van Merrienboer & De Croock, 1992; van Merrienboer, Krammer, & Maaswinkel, 1994). They argue that the traditional approach to the teaching and learning of programming is ineffective and that the "Reading" approach is a better one to follow. However, they also suggest that presenting worked examples to students is not sufficient as the students may not "abstract" the programming plans from them. Programming plans can be considered analogous to the chess of board configurations mentioned earlier. "Mindful" abstraction of plans is required by the voluntary investment of effort and the question then arises as to how we can get students to study the worked examples properly. In practice, students tend to rush through the examples, even if they have been asked to trace them in a debugger, as they often believe that they are only making progress in their learning when they are attempting to solve problems.

Such conscious processing by students places germane cognitive load upon them. One suggestion is that students should annotate worked examples with information about what they do or what they illustrate (Lieberman, 1986). Another suggestion is to use incomplete, well-structured and understandable program examples that require students to generate the missing code or "complete" the examples. This latter approach forces students to study the incomplete examples as it would not be possible for their completion without a thorough understanding of the examples' workings. An important aspect is that the incomplete examples are carefully designed as they have to contain enough "clues" in the code to guide the students in their completion. In other words, the germane cognitive load must not be made too large. It is suggested that this method facilitates both automation, students having blueprints available for mapping to new problem situations, and schemata acquisition as they are forced to mindfully abstract these from the incomplete programs (van Merrienboer & Paas, 1990).

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In one study, two groups of 28 and 29 high-school students from grades 10 to 12 participated in a ten lesson programming course using a subset of COMAL-80 (van Merrienboer, 1990b). One group, the "generation" group, followed a conventional approach to the learning of programming that emphasised the design and coding of new programs. The other group, the "completion" group, followed an approach that emphasised the modification and extension of existing programs. It was found that the completion group was better than the generation group in constructing new programs. It was found that the percentage of correctly coded lines was greater and that looping structures were more often combined with correct variable initialisation before a loop together with the correct use of counters and accumulators within the loop. It would appear that the completion strategy had indeed resulted in superior schemata formation for those students within that group. In addition, the completion group used superior comments in connection with the scope and goals of the programs, indicating that they had developed better high-level templates or schemata. It was noted in the study however that both groups were equal in their ability to interpret programs and that this might indicate that students in the completion group do not understand their acquired templates.

A side effect of the research was also noted. The drop-out rate from the completion group was found to be lower than for the generation group, particularly for female students with low prior knowledge. It was suggested that perhaps the generation of complete programs is perceived as a difficult and menacing task and that the completion strategy overcomes this difficulty.

CORT (Code Restructuring Tool)

A tool has been designed by the author that is based upon the above ideas of the completion of part-complete programming solutions. Three methods of using CORT have been identified that allow various degrees of germane cognitive load to be applied and the tool has been utilised with students at Edith Cowan University in Australia, student feedback being extremely positive.

CORT has been used within a software development unit in a Business degree course. This unit is an introductory unit to programming in Visual BASIC, the majority of students having no previous programming experience. The unit runs over a period of 14 weeks, the students having a two-hour lecture and a one-hour computer laboratory session in which they attempted various "CORT" problems. The students would then finish their problems if necessary in their own time.

A Typical "CORT" Computer Laboratory Session

At the beginning of a computer laboratory session, the students are given a hard copy of a problem statement that they have to try and solve using CORT. The students would then run the CORT program and load in the CORT file corresponding to that particular problem. Two windows display a part-complete solution to the problem together with possible lines to be used as shown in figure 2.

The part-complete solution on the right is then completed by moving certain lines from the left hand window. Lines can also be moved up or down, and indented or outdented in the right hand window. Some problems may have too many lines in the left hand window, some of those lines being incorrect. In addition, there is a simple editor to allow the amendment, addition, and deletion of lines of code.

When the solution has been completed, the code from the right-hand window is copied to the Windows clipboard. Visual BASIC is then run and a file is loaded which contains no programming code but does contain the necessary Visual BASIC interface for the problem under consideration. The CORT code is then pasted into Visual BASIC and the program tested. Use is made of the trace and debugging facilities of Visual BASIC, these facilities providing an insight to the workings of the notional machine.

If the program does not work, a student can switch back to CORT and make any necessary changes before retesting that code in Visual BASIC.

Methods of using CORT

Three methods of using CORT were identified and these different methods were varied throughout the unit so that different levels of germane cognitive load could be applied. The first method is to supply all the missing lines of code in the left-hand window without any extra lines. The second method also supplies all the missing lines of code but also includes extra "distracter" lines of code that are not required to complete the program solution. Finally the third method is to supply only some of the lines of code in the left-hand window, students having to key-in some lines themselves.

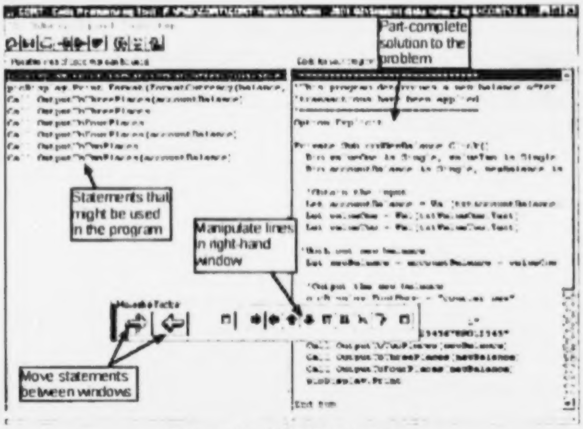
Part-complete solution to the problem
Statements that might be used in the program
Manipulate lines in right-hand window
Move statements between windows

Figure 2: CORT interface

Preliminary Feedback from Students

Data was collected on the use of CORT during semester 2, 2001. Preliminary results suggest the following.

- Students commented on the fact that CORT provides a starting point for solving a problem. Many suggested that they would not know how to go about tackling some of the problems if CORT was not provided.
- Method 2 of using CORT proved to be most popular. Method 1 was seen by students as being too easy while method 2 required students to think a great deal about the problem solution. Method 3 was not as popular as that required students to have knowledge of the exact syntax of statements.
- It was observed that students engaged in significant reflection and higher order thinking when using method 2.
- Students commented that they were encouraged and motivated by the fact that they could get their programs to work in a relatively short time frame.

Conclusions

This paper argues that cognitive load theory needs to be carefully taken into account when designing instructional materials for computer programming. Programming has a very high intrinsic cognitive load and therefore the extraneous cognitive load should be made as low as possible. However we still need to ensure that students "think" and are encouraged to create the necessary schemata in long term memory and this can be done by applying germane cognitive load upon them. One way of doing this is to carefully design solutions to problems that are only part complete and that require completion by students. This approach has been built into a new software tool called CORT (Code Restructuring Tool) (Garner, 2000) that reduces the extraneous cognitive load by supporting the completion approach to learning programming. Three methods of CORT have been identified and preliminary results suggest that method 2, in which all missing lines plus distracters are available in the left-hand window, has great potential for providing the necessary amount of germane cognitive load to help students develop the necessary programming schemata.

References

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Carroll, W. (1994). Using worked examples as an instructional support in the algebra classroom. *Journal of Educational Computing Psychology, 86*, 360-367.

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction, 8*, 293-332.

Chandler, P., & Sweller, J. (1996). Cognitive Load while Learning to use a computer program. *Applied Cognitive Psychology, 10*, 151-170.

Chase, W. G., & Simon, H. A. (1973). The Mind's Eye in Chess. In W. G. Chase (Ed.), *Visual Information Processing*. New York: Academic.

Garner, S. (2000, 21-24 Nov). *A Code Restructuring Tool to help Scaffold Novice Programmers*. Paper presented at the International Conference in Computer Education, ICCE2000, Taipei, Taiwan.

Kalyuga, S., Chandler, P., & Sweller, J. (1998). Levels of expertise and instructional design. *Human Factors, 40*, 1-17.

King, J., J. Feltham, et al. (1994). "Novice Programming in High Schools: Teacher Perceptions and New Directions." Australian Educational Computing(Sep 1994,): 17-23.

Lieberman, H. (1986). An Example Based Environment for beginning Programmers. *Instructional Science, 14*(3), 277-292.

Marcus, N., Cooper, M., & Sweller, J. (1996). Understand instructions. *Journal of Educational Psychology, 88*, 49-63.

Miller, G. A. (1956). The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity to Process Information. *Psychological Review*(63), 81-97.

Paas, F. G. W. C. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive load approach. *Journal of Educational Psychology, 84*, 429-434.

Perkins, D. N., Schwartz, S., & Simmons, R. (1988). Instructional Strategies for the Problems of Novice Programmers. In R. E. Mayer (Ed.), *Teaching and Learning Computer Programming: Multiple Research Perspective*(pp. 153-178): Hillsdale, NJ: Erlbaum.

Schneider, W., & Shiffrin, R. (1977). Controlled and automatic human information processing: Detection, search and attention. *Psychological Review, 84*, 1-66.

Simon, H., & Gilmartin, K. (1973). A Simulation of memory for Chess Positions. *Cognitive Psychology, 5*, 29-46.
Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and instruction, 4*, 295-312.
Sweller, J., van Merrienboer, J. J. G., & Paas, F. G. W. C. (1998). Cognitive Architecture and Instructional Design. *Educational psychologyreview, 10*(3 SEP 01 1998), 251-.

Tindall-Ford, S., Chandler, P., & Sweller, J. (1997). When two sensory modes are better than one. *Journal of Experimental Psychology: Applied, 3*, 257-287.

van Merrienboer, J. J. G. (1990a). Instructional Strategies for Teaching Computer Programming: Interactions with the Cognitive Style Reflection-Impulsivity. *Journal of research on computing in education, 23 Fall 1990*(1), 45-.

van Merrienboer, J. J. G. (1990b). Strategies for Programming Instruction in High School: Program Completion vs. Program Generation. *Journal of educational computing research., 6*(3), 265-.

van Merrienboer, J. J. G., & Paas, F. (1990c). Automation and Schema Acquisition in learning elementary computer programming. *Computers in Human Behavior*(6), 273-289.

van Merrienboer, J. J. G., & De Croock, M. B. M. (1992). Strategies for computer-based programming instruction: program completion vs. program generation. *Journal of Educational Computing Research, 8*(3), 365-394.

van Merrienboer, J. J. G., Krammer, H. P. M., & Maaswinkel, R. M. (1994). Automating the planning and construction of programming assignments for teaching introductory computer programming. In R. D. Tennyson (Ed.), *Automating Instructional Design, Development, and Delivery (NATO ASI Series F, Vol. 119)* (pp. 61-77): Springer Verlag, Berlin.

CardioMeeting: A Learning Environment to Support the Discussion of Scientific Papers in Cardiology

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Abstract

In a Medical School the future cardiologist's education is made being considered theoretical aspects of the specialty and of the medical practice. In what it refers to the theoretical aspects of the teaching, an important resource is the discussion of scientific papers in cardiology. These papers describe real researches, approaching the used methodology, obtained results, statistical analysis and works related to the same. This work describes a support environment to the discussion of papers in cardiology, called CardioMeeting. That environment is integrated into an education meta-environment for cardiology, CardioEducar also described in this work.

1. Introduction

Within the medicine course, the cardiology teaching takes place in different moments. In the first years of the course, the student is exposed to the methods diagnoses. In the fifth and sixth year they participate in medical aid in the internship over different areas in a hospital.

Besides that, a fundamental moment in the training of the future cardiologist is the medical residence. After two years of residence in a medical clinic, the resident is linked into a unit of cardiology where they develop health care activities, receiving specific education in cardiology. This education and training feels through patients' care, and the attendance of classes and of sessions where students, residents and cardiologists discuss patients' cases and current themes of the specialty. The Unit of Cardiology and Cardiovascular Surgery / Fundação Bahiana de Cardiologia (UCCV/FBC) of the Federal University of Bahia (UFBA) participates in the cardiologists' education through the Medical Residence, several undergraduate disciplines of the Medical School, and in the internship. Many classes are for discussion of scientific papers previously distributed to the students.

With the purpose of supporting these different aspects of cardiology training, we have launched a project - CardioEducar – whose purpose is to develop a learning environment based on the Internet. CardioEducar, an educational meta-environment, offers an integrated environment where professors, cardiologists, physicians and students have access to several educational environments. As a meta-environment CardioEducar comprises several working environments for cardiology education.

Within these environments of CardioEducar we have a set of environments we call *Learning Environments* that aim to support the different meetings where cardiologists, residents and medical students participate in order to teach and learn.

One of the most important aspects of medical students' education deals with reading and discussion of scientific papers. In our Medical School this education is performed through specific meetings with the following objectives: (i) to teach medical students how to read and to criticize cardiology papers; (ii) to teach the students the information they should look for as a justification (evidence) for their research and medical decisions; (iii) to show the students how to co-relate results from different works and to relate them to medical practice. This kind of meeting takes place every week at the University Hospital and it was ministered without technological support. The students were supposed to read the papers previously to a classroom meeting, to take notes and to prepare some questions for discussion. During the meeting, one of the students makes a summary of the paper and the professor leads the discussion and answers the queries. Usually, the professor relates the paper under discussion with other papers and researches results already discussed in previous meetings. However, there was no registration of the whole discussion and the students of subsequent groups cannot benefit from discussions already accomplished.

This was the motivation for CardioMeeting, an Internet based environment whose main goal is to support medical education on this specific meeting. In the following sections this environment will be described.

2. CardioMeeting

The main goal of the CardioMeeting system is to provide a technology support to the discussion session, since the planning of the discussion to the classroom meeting. It is composed of four main environments: the Authoring Environment, the Discussion Environment, the Meeting Environment and the Tutorial Environment (Figure 1).

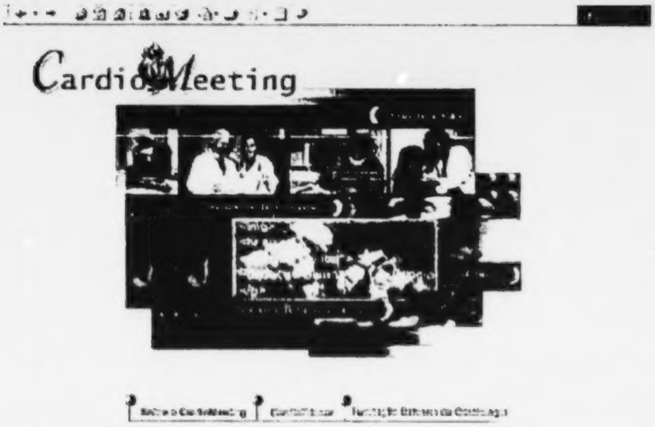
CardioMeeting

Figure 1: The homepage of CardioMeeting with the four environments

The ***Authoring Environment*** supports a professor (the coordinator of a paper discussion meeting) in the organization of a discussion meeting. It offers facilities for introducing data of a single paper or a theme that involves more than one paper related to a subject. These data concerns in indicate the papers (by its reference) and to prepare some questions for discussion. The coordinator may also assign a student to use this environment to provide more details about the papers to other participants (for example, the abstract). Figure 2 shows a screen of the Authoring Environment.

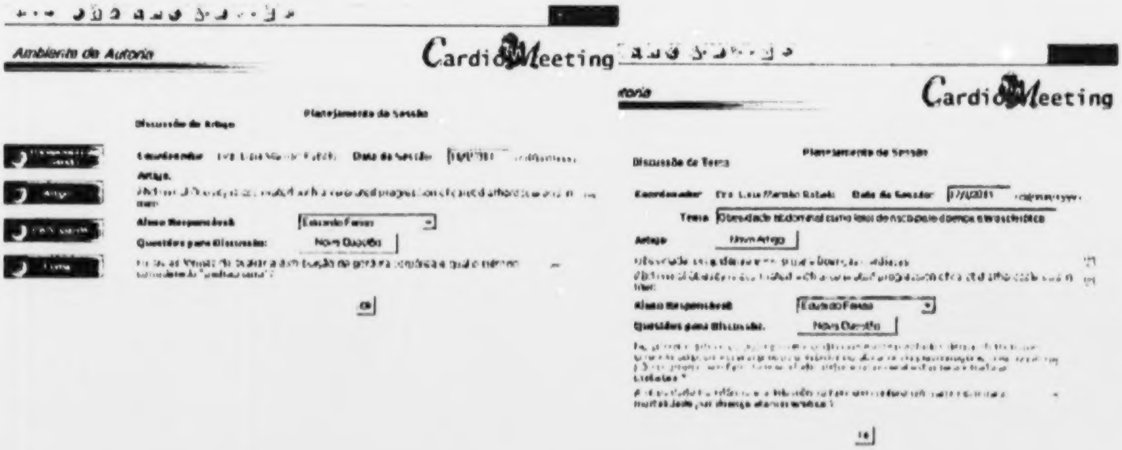
Ambiente de Autoria
CardioMeeting
Planejamento da Sessão
Discussão de Artigo
Nova Questão
CardioMeeting
Planejamento da Sessão
Discussão de Tema
Tema
Novo Artigo
Nova Questão

Figure 2: Authoring Environment: Sessions' Planning

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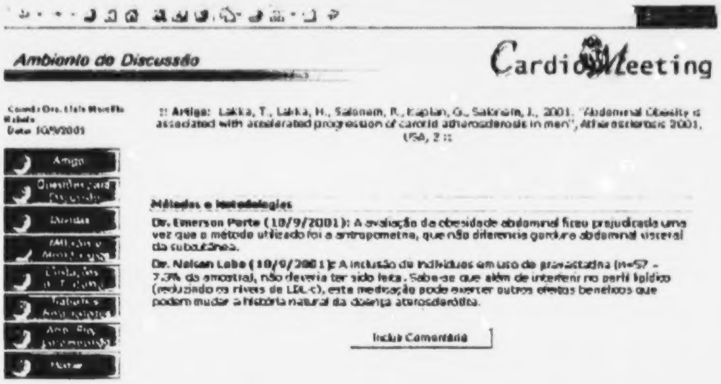
The ***Discussion Environment*** monitors an asynchronous discussion among the students and the professor for a certain period of time as a preparation for the classroom meeting. This discussion may involve the questions posed by the professor, doubts, and debate about the limitations of the work presented in the paper, comments about the methodology and indication of related works. The discussions are asynchronous to provide more flexibility for the students to use the environment according to their possibilities and preferences. Figure 3 shows a screen of the Discussion Environment.



:: Artigo: Lakka, T., Lakka, H., Salonen, R., Kaplan, G., Salonen, J., 2001. "Abdominal Obesity is associated with accelerated progression of carotid atherosclerosis in men", Atherosclerosis 2001, USA, 2 ::

Métodos e Metodologias

Dr. Emerson Porto (10/9/2001): A avaliação da obesidade abdominal ficou prejudicada uma vez que o método utilizado foi a antropometria, que não diferencia gordura abdominal visceral da subcutânea.

Dr. Nelson Lobo (10/9/2001): A inclusão de indivíduos em uso de pravastatina (n=57 - 7.3% da amostra), não deveria ter sido feita. Sabe-se que além de interferir no perfil lipídico (reduzindo os níveis de LDL-c), esta medicação pode exercer outros efeitos benéficos que podem mudar a história natural da doença aterosclerótica.

Figure 3: Preparation for Discussion Environment: methods and Methodologies

The ***Meeting Environment*** supports the classroom meeting, which aims to synthesize the discussion that took place during the preparation stage, and to reach a conclusion about the paper or the theme proposed. In this sense, this environment permits to register the final analysis of the discussion and also to retrieve information of past discussions. Figure 4 shows a screen of this environment

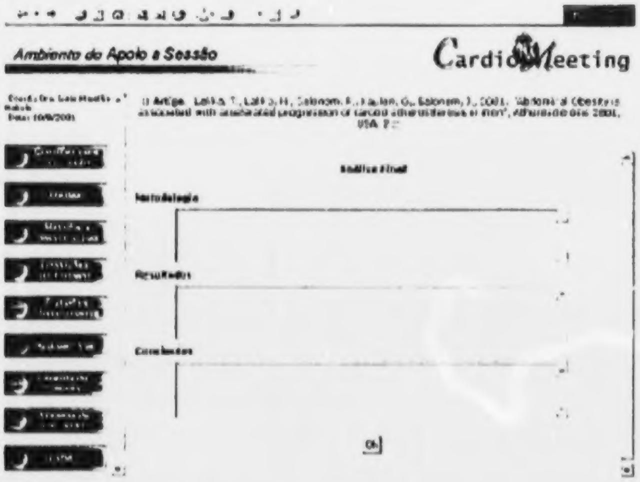


Figure 4: Discussion Environment: Final Analysis of a paper

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The ***Tutorial Environment*** organized in html pages supports medical students' education giving directions on how to read medical papers and is specifically concerned on topics related to the material and methods used in the research being described in a the paper.

3. Conclusion

CardioMeeting was developed by a multidisciplinary team of cardiologist, and computer science specialists, as part of a collaborative project (CardioEducar) sponsored by the Brazilian government. Other Learning Environments developed and integrated to the meta-environment CardioEducar are already in use with great acceptance (Gama et al., 1997), (Rocha et al., 2000), (Rabelo et al., 2001)

All the environments were implemented using ASP (Active Server Pages) as the web programming language. The cases are stored in a Microsoft SQL Server Database. CardioMeeting was developed according to a software process with an evolutionary approach, specifically defined for the CardioEducar project. A first prototype was built and after its evaluation by faculty members, cardiologists and students we have implemented the first operational version that is now in use in our University Hospital.

The utilization of the CardioMeeting showed us an increase of the participation by the students. The promotion of a computer-based discussion demonstrated more acceptances for some people than the one face-to-face. This aspect encouraged some of students to raise more questions before the classroom meeting. This environment also permitted some physicians of the institution to participate of the discussion, in case of they were not able to be present on the classroom meeting.

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References

Gama, C.A., Souza, J.M., Rabelo Jr., A. HyperClinic: Cooperative Hypermedia System for Medical Education. *Educational Multimedia and Hypermedia*, ED-MEDIA 97, Calgary, CA. 1997

Rabelo Jr, A. et al CardioSurgery: an environment to support decision making and follow-up in cardiovascular surgery, 2nd International Congress on Heart Disease, Washington, USA, The Journal of Heart Disease, vol2, number 1, July 2001

Rocha, C; Montoni, M, Sampaio, L.C.; Rocha, A.R.; Rabelo Jr, A. CardioSurgery: An Environment to Support Surgical Planning and Follow-up in Cardiology; WebNet 2000; San Antonio, Texas, USA; November 2000

"What You Do (in teams) Speaks Louder than What You Say": Establishing Rapport in Software Development Projects

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It is ironic that often the biggest problems computer information system students encounter in graduate school is not with their software development projects. This paper addresses one of the biggest problems that computer information system students encounter...how to work with other members of a group on a project. Research was conducted over eighteen months with two instructors, one from the computer information system department, and one from the instructional technology department of a public university located in the southwestern United States. This is an ethnographic research project, with qualitative methodology. The authors chronicled the events of each team and analyzed the events and results of each group studied throughout that period. The results of the study can contribute to further research on how collaborative teamwork can facilitate better understanding and comprehension of the requirements for graduates of computer information systems graduate programs.

The two instructors decided to monitor graduate students in the computer information systems capstone graduate projects. These students must complete a major software program development project in lieu of a masters' thesis, and they must do so while working in teams, much like they will do in the realm of commerce after they graduate.

The instructional technology instructor served on each of the four teams over the eighteen-month period, acting as a mentor to a capstone group each semester, and participating in the dialogue and development processes of the project. Both instructors learned that, despite the programming and management information system classes taken by the students, the actual integration of what the students' studied often did not relate to what they were doing in these "social" development team projects. The instructors observed that the computer information systems students (CIS) often entered the collaborative team environment with a preconception that their knowledge would be received without question, as a "top down" event. Seldom did students enter the group with an open-minded, receptive mind set. It quickly became clear to the students, however, that to survive the group and emerge with a product for the project, a shift would need to occur in the minds of the CIS students with respect to actually applying what they learned to the social context of software development teams. At the end of each semester, students would somberly admit that there was much more to working in software teams than simply developing software in the protected environment of university labs.

The two instructors would meet several times a month and compare notes as to how the students were progressing and whether they were working satisfactorily with other group members. In one instance, over a summer semester, the group actually fell apart due to the inability of the members to coordinate their schedules. In this instance all of the group members' efforts were frustrated because they were not able to meet together on an ongoing basis. As a result their project suffered and so did their grades. The instructional technology researcher chronicled the discussions and decision-making processes of each group, then, at the end of the semester, convened with the CIS instructor to assess what worked successfully versus what could be done better with the next crop of students the next semester.

What the researchers discovered was that: first, each group dynamic was truly unique and the products created were unique, even though the same assignment was given to a new group at the start of the new semester; second, the more flexible and willing the CIS students were to work with other team members often determined how much was accomplished on the project and how quickly it was done; third, when collaboration did not emanate from members in the team context, less work on the project was accomplished; when a CIS student had a positive attitude and was willing to be flexible about discussing how the programs could be created, it seemed that she/he enjoyed better rapport with the group and the group also seemed to accomplish more on the project.

By working together and demonstrating that collaboration worked between the two instructors from different departments, the students had an example of how people from different environments can come together and work toward a common goal. This point was missed at times by the students, but by the end of the semester when they were accountable for their grades, they quickly figured out how to work collaboratively, as best they could under the circumstances. The two instructors also presented a united front when reviewing the projects for completeness and for the decision of the students' final grades. The students emerged from the experience with knowledge gained from the collaborative process, both in their collaborations with their development team, and with the development team instructors.

Software engineering programs have utilized the collaborative team approach for years, but computer information systems programs are now beginning to understand the importance of collaborative modeling for their students. Collaboration in development teams could also offer insights to other academic disciplines, like Instructional Technology, because each team member brings a unique perspective as well as expertise to the team project.

Future studies of the role of collaboration and team-building in postsecondary environments, particularly in the computer science and instructional technology areas, could greatly contribute to the body of knowledge on mentoring and collaboration for computer information systems' studies.

References:

Crawford, C., Gannon Cook, R., Varagoor, G. (1998). Three researchers investigate the role of collaboration across academic disciplines.

Del Rio, P. & Alvarez, A. (1995). Changing architectures of mind and agency. In J. Wertsch (Ed.) Sociocultural studies of mind. Cambridge, England: Cambridge University Press.

Giarratano, J., Gannon Cook, R. (2000). Spiders and Avatars: The role of collaboration in the development process.

Haverschmidt, Smith. (1998). The importance of the role of collaboration in higher education instruction. AERA Journal of Research, p. 10-16.

Teaching Online Courses: Faculty Experiences

by

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Today, the Internet is a part of a new educational culture with its own unique characteristics. Online education is attempting to fill a niche in the changing the nature of education around the globe specifically in the area of higher education. Consequently, many traditional educators are either considering or making the transition to the online medium. Educators are coming under increasing pressure to adapt their teaching to accommodate the new technologies.

This study focuses on a single, but arguably the most important area – teaching via the Internet. Towards this focus, faculty members from various universities and departments were interviewed to look at the many different ways the Internet is being used for teaching, and faculty experiences in that regard. The lessons they have learned over the years provide valuable insight into new, more effective ways of teaching students in the online environment. The term 'Online teaching' here means teaching and learning that takes place over a computer network of some kind (e.g. an Intranet or the Internet) in which interaction between people is an important form of support for the learning process (Goodyear, et. al. 2001).

This study is an investigation of the perceptions of higher education instructors about teaching courses via the Internet. Qualitative methodology was used to determine issues important from the perspective of the participants (Bogdan & Biklen 1992). Analysis was conducted using the grounded theory methodology, also referred to as constant-comparative method (Glaser & Strauss, 1967). Through this study, several themes emerged - Time, Instructional tools, and student-faculty relations. The findings and possible implications in teaching will be presented at the Conference.

References

Bogdan, R. & Biklen, S. K. (1992). *Qualitative research for education: An introduction to theory and methods.* Boston: Allyn and Bacon.

Collison, G., Elbaum, B., Haavind, S., & Tinker, R. (2000). *Facilitating online learning: Effective strategies for moderators.* Madison, WI: Atwood Publishing.

Cyrs, T. (1997). Competence in teaching at a distance. *New Directions for Teaching and Learning, 71*, 15-18.

Drucker, P. (2000, May). Putting more now in the Internet. *Forbes Global*, May 15, 2000.

Glaser, B.G., & Strauss, A.L. (1967). *The discovery of grounded theory: Strategies for qualitative research.* Chicago: Aldine.

Goodyear, P., Salmon, G., Spector, M., Steeples, C., & Tickner, S. (2001) Competencies for online teaching. *Educational Technology Research & Development 49* (1), 65-72.

Kearsely, G. (2000). *Online education: Learning and teaching in cyberspace.* Belmont, CA: Wadsworth.

Salmon, G. (2000). *E-moderating: The key to teaching and learning online.* London: Kogan Page.

A Web-Based Tandem System for Language Learning in South Tirol

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Abstract: In this paper we introduce a Web-based tandem system which helps to establish language learning partnerships between people who prepare for the exam in bilingualism in South Tyrol. The system will be integrated as a module into the ELDIT language learning system which already includes a small text corpus and a learner's dictionary. The new module supports the formation of partnerships and the exchange of information including exercises between learning partner for the purpose of error correction and feedback. Adaptation technologies are applied in order to support autonomous use of the program.

Motivation

South Tyrol is a bilingual province located in the north-east of Italy with two official languages, German and Italian. Due to a rather strict geographical and social separation of the two ethnic groups, only a few people consider themselves truly bilingual [Cavagnoli & Nardin, 1999]. Passing the so-called examination of bilingualism, however, is a prerequisite for employment in the public sector.

Learning a language via tandem means that two learners with different native languages try to learn the language of their partner by having controlled conversations with each others. Such contacts and conversations can also occur via electronic media such as e-mail, chat, or video conferencing. These media offer new possibilities to overcome problems like spatial and temporal distances.

The eTandem System

To overcome some of the above mentioned problems and to facilitate language learing in South Tyrol, we are currently developing a Web-based tandem system, called eTandem. The eTandem system will be integrated into the ELDIT language learning system which already contains a learner's dictionary and a text corpus [Abel & Weber, 2000, Gamper & Knapp, 2002]. In this way, eTandem provides access to the preparation material for the exam in bilingualism and provides opportunities to establish language learning partnerships between the German and Italian population.

The eTandem system can be accessed via the following pages:

- *Advertisement page*: This page serves either to advertise interest in a learning partnership or to contact somebody else who already announced interest in a partnership. Furthermore, information about the preferred date of the exam or personal learning interests can be indicated.
- *Text page*: On this page the user can practice a text. Every word in a text unit is linked to the corresponding ELDIT dictionary entry. This facilitates to check unknown words or to lookup for words which the learner may need to answer the queries in the target language. Each text contains a couple of questions which the learner has to answer, producing in this way complete sentences in the target language. As long as no partnership is established, the texts can be saved as drafts and sent later.

- *Mail page*: This page provides a communication forum between learning partners. After working through a text unit, the learner can send the anwers to the partner for correction. Similar, the messages from the learning partner arrive on this page. Furthermore, short messages such as comments on the work done or organisational aspects can be exchanged in this forum.
- *User profile page*: On this page each learner can inspect and change the parameter values set in the user model. Evaluations of adaptive systems revealed that it is extremely important that the user has control about the system. Therefore, we want to make the modeling and adaptation process as transparent as possible.
- *Help page*: This page eplains the exam in bilingualism and the usage of the program. Depending on the learner's familiarity with the use of computers the online help is more or less detailed. Moreover, for a novice a number of direct links to the corresponding help sections are provided.

Unlike other tandem systems, eTandem is intended to be used fully autonomously via the WWW. Therefore, a variety of users will access it. The eTandem system adopts adaptive technologies in order to cope with the problem of user diversity. A user model stores information about the users and his/her interaction with the system, which allows the system to adapt to the individual learner. When accessing eTandem for the first time, an introduction page will be shown and substituted by a link later on. Advertisements and the exam level are adapted to the indidvidual learner, and a "What shall I do next?" suggests the best next step to be carried out. Adaptive features are also included in the other modules of ELDIT and are described in [Gamper & Knapp, 2002].

Discussion

Computer-assisted language learning is a widely explored research field. Language learning via e-mail conversations has been explored in several successful projects. Since 1994, universities and other educational institutions from many different countries work together in the "International Tandem Network" in order to help their students to learn languages via tandem, primarily via the Internet [Brammerts, 1994]. "Number2.com" is an Internet site which provides online preparation for college admission and placement tests. A coaching system is included. Teachers and parents can register as coaches. Their job is to provide encouragement and to help students to set goals. Coach and student can also work together on the tutorials and practice sessions [Crespi et al., 1995].

According to our opinion, the eTandem system will provide a great opportunity for the population in South Tyrol to learn and improve the second language. As computer-assisted langauge learning has been proven to be motivating for langauge learners, especially for young peolple, this could also be a contribution to overcome geographical and social separation of the two ethnic groups. The eTandem system is currently under development together with the other modules of ELDIT. A preliminary version of ELDIT can be accessed at http://www.eurac.edu/Eldit. A systematic evaluation of the overall system and in particular of the eTandem module remains future work.

References

[Abel & Weber, 2000] Abel, A. and Weber, V. (2000). ELDIT, prototype of an innovative dictionary. In *Proceedings of EURALEX'00*. Preliminary version at http://www.eurac.edu/Eldit.

[Brammerts, 1994] Brammerts, H. (1994). International tandem network. http://www.slf.ruhr-uni-bochum.de/servers.html.

[Cavagnoli & Nardin, 1999] Cavagnoli, S. and Nardin, F. (1999). Second language acquisition in South Tyrol: Difficulties, motivations, expectations. *Multilingua*, 18(1):17–45.

[Crespi et al., 1995] Crespi, V., Loken, E., Millet, J., and Cushing, L. (1995). Number2.com. http://www.number2.com/.

[Gamper & Knapp, 2002] Gamper, J. and Knapp, J. (2002). Tutoring in a language learning system. In *Proceedings of SCI'02*.

Virtual Tutor

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Abstract: Based on the research of [Stil 1998] [Maurer 1992] [Lennon 1994] [Elliot 1995] [Colbourn 1995] [Reeves 1997] [Lugner 1997], the application of an expert system as an interactive multimedia knowledge module with explanation features named Virtual Tutor (VT) was developed. For students, the individual dialogue based session with the VT, provides the possibility to apply the knowledge acquired in combination with indirect assessment. The VT was further embedded in the Web-based on-line learning environment. The reported research merges qualities of an expert system with advantages of multimedia, thus creating a variety of innovative ways of knowledge mediation.
Based on the evaluation results the conclusion can be drawn that dialog based system meets more accurate the requirements of the students in case of solving problems. Problem solution can be found easier and faster than using conventional literature. The possibility of accessing additional information related to the subject domain and explanation on request, VT is an interesting and different tool for knowledge transfer.

Introduction

Higher education has entered a transition from the Teaching Paradigm to the Learning Paradigm. Emerging from this process are powerful new teaching styles founded on principles of active-learning and improved insights on the cognitive development of learning. As outlined in [Buckley 1999], learning environments that exploit interactive multimedia are of special interest. The educational potential of this technology closely parallels the pedagogical goals of the Learning Paradigm. According to [Buckley] a simple pedagogical set of features that can foster transition to the Learning Paradigm is as follows: (1.) Interactivity fosters active learning, (2) The sensory-rich nature of technology facilitates the engagement of additional powerful cognitive processes, and (3) Integration of assesment tools into the environment can provide students with feedback and encouragement etc.

"From a pedagogic point of view, learning requires "a deep understanding of the subject content" through a cognitive re-elaboration of the information" [Colbourn 95]. Inspired by the work of Mark&Greer 1995, Chan 1996, Youngblut 1994, Nunez concludes [Núñez 1999] as follows: *"Knowledge-based learning environments have offered significant potential for fundamentally changing the educational process."*

In general, classical Web-based tutoring systems rely on memory and do not take into account the cognitive information treatment process. In order to overcome this problem, the intelligent tutoring systems came into being, as described in [Han 1999]. The use of multimedia objects in educational systems can enhance their efficacy to a great extent in facilitating cognitive skills besides other components of domain competence as shown in research by Kinshuk [Kinshuk 1999].

Idea of the Virtual Tutor

The aim of the research presented in this paper was to apply an expert system as a knowledge module within the on-line learning environment. There are many benefits for the students within the on-line learning environment independent from the course content and style, like e.g. tools for asynchronous and synchronous communication and collaboration, search facility within a background library, a progress indicator monitoring the learning success etc. The application of ES makes it possible to use different knowledge representation and explanation approach. The individual session with the VT provides also the possibility for students to apply the knowledge acquired in combination with indirect assessment.

With interactive sessions with the VT, various students' activities could be increased as follows: raising the learning motivation, research work, stimulating the creativity by carrying out analysis and synthesis, searching for solutions, interdisciplinary learning.

VT system requirements are as follows: (1) the interaction and the communication should be performed by a question-answer dialog, (2) the system has to explain why a particular question is asked (i.e. why a certain fact is questioned) and the influence of the fact on the problem solution, (3) the VT must be capable of explaining reasons for the suggestion of a solution or a particular ranking of possible solutions, (4) descriptions and illustrations of items concerning the problem domain have to be provided by hyperlinks connecting the multimedia infomation within the static and dynamic background library, (5) the system has to run at least under Netscape 4.x and MSIE 5.x, (6) the VT has to be designed and implemented considering the possibility of the easy change of the problem domain as well as easy enhancement within the same problem domain.

The Concept and the Architecture of the VT System

Following the requirements stated so far, we have decided to combine the properties of expert systems with the advantages of Web-based information transforming and multimedia information structures. Because of this, as well as following also the ideas of platform independence and usage without installing the VT, the system was implemented in Java. The VT is built on JESS (Java Expert System Shell), a Java implementation based on Clips. [JESS] This makes it possible to provide the VT system as a Java applet within the GENTLE-WBT environment. It must be mentioned that the entire system (VT system, UI and the JESS system) has to be loaded by the client. To reduce network loads, a future implementation will be done by splitting the VT into a client-server architecture.

Within the following sections, the system and the working principle are discussed.

The Working Principle

The aims of the VT system within the course "Knowledge processing" are: (1) To provide Decision support of using proper AI techniques related to a particular problem. The first implementation takes into account expert systems, neuronal nets, fuzzy logic and neuro fuzzy. (2) An interactive system has to be provided. (3) The suggestion has to be explained by the system. (4) Additional descriptions and illustrations have to be provided by a static and dynamic background library of multimedia information.

To meet the aims stated above, the VT - in generalexpert systems - has to comprise three types of knowledge: Problem Domain Knowledge (PDK), the Description Knowledge (DK), and the Subject Domain Knowledge (SDK). Within the PDK the system has to know about various problem types that can be covered by the four AI systems, and thus to provide the proper questions (collect information about facts) for the user interaction. The DK is used to describe the results (suggestions of AI systems) and influences of facts on the particular problem. The SDK is responsible for reasoning and building suggestions. Furthermore, it controls the sequence of the questions related to already known facts[Pivec 1997].

The procedure of the working principle can be subdivided into three tasks (see also Figure 1): (1) Dialog between the user and the VT system. The student has to answer questions about the problem domain. (2) Internal representation of the problem. Related to the problem domain, an internal image of a particular problem is built by a set of attributes. For the first implementation the following properties are used to describe the AI problem domain: modularity, extensibility, mathematics model, expert knowledge, training sets, explanation, adaptive system, uncertainty, black box. The PDK and SDK components control the sequence of questions and change the internal representation. Weightiness of the attributes are changed (increase, equal or decrease) depending on the questions and the answers. That means that the properties are changed with respect to the facts questioned and the answers given by the students. (3) Suggestion of possible solutions. Based on the internal representation of the problem, the SDK determines a ranked output of the AI techniques. It is to be mentioned that it is easy to extend (e.g. enlarge the subject domain) or change the knowledge (e.g. to use the system for another course placed in another subject domain), because of the use of a knowledge-based system (expert system JESS). This makes it possible to change and maintains knowledge without changing the entire program.

The Architecture

The architecture of the VT system is illustrated in Figure 2. The JESS system contains three types of knowledge (PDK, DK, SDK) and manages the internal representation of the problem as well as processes the input and output stream of information. The parser within the output stream handles hyperlink information for the user interface (UI) of the applet. The hyperlinks are references to the static and the dynamic background library. For further work, it is planed that the pre-knowledge of the students is taken into account. This will make it possible to provide background information related to the current knowledge level of each particular student. A novice in AI will receive basic information, and an advanced student will get much deeper information. The UI represents the dialog between the students and the VT system.

As already stated, the VT system is integrated in the GENTLE-WBT [GENTLE] learning environment, as illustrated in Figure 3. The learning environment allows compiling courseware (lecture notes, exercises, etc.) and provides also diverse communication features (asynchronous discussion forum, chat, etc). The decision was made to place the static background library into the GENTLE-WBT system. The static background library contains descriptions, definitions and illustrations concerning items of the AI techniques handled by the VT system. The information is prepared in multimedia modules using textual information, graphics, video files, and flash presentations. The later presentation form is used for an interactive information transfer.

Figure 3 also shows the interaction between the VT system and the lecture notes. For the first implementation of VT the existing lecture notes of "Knowledge processing" were applied. Hints at proper pieces of information refer to the VT system. Vice versa, explanations by the VT system also provide hyperlinks to subjects of AI techniques within the lecture notes. Students are enabled to work with the VT system and can get information or re-read topics of the lecture notes to get familiar with the relation and influences of a particular (given) problem.

The third part of referred information provided by the VT system is the dynamic background library. A huge amount of useful information is available on the Internet. The intention is to collect trustworthy information from university institutes, research centres, online libraries, company information, etc. related to the subject of the course. One of the advantages of including such a dynamic background library is that the students are supplied with up-to-date information. The xFIND (extended Framework for Information Discovery) system, an open source project developed also at the IICM, perfectly meets the requirements for such a dynamic background library. The dynamic background library has already been used in the course "Knowledge processing" for more than a year. The xFIND system is a highly scalable and distributed system for the management of online resources that consists of three components, the Gatherer, the Indexer and the Knowledge Broker. The system manages the content of Internet resources, and in addition a broad spectrum of meta information (xFIND quality metadata) about the resources. Thus, e.g. the topics, target audience, quality level, etc. of Web pages or entire structures of Web pages can be managed [xFIND]. The VT system requests information by a somewhat predefined dynamically compiled search query related to the topic or subject of interest. It is planed that the dynamic background library should provide different information related to the student overall performance. Such a feature has been already implemented in the xFIND system.

Evaluation of the System and Conclusions

The evaluation of the VT was carried out with students, as a part of the practical work within the course Knowledge processing at the Graz University of Technology. The students were divided into two evaluation groups: one group worked with a printed version of lecture notes, whereas the other group used VT to provide the solution to the presented problem. The group that worked with the VT had also access to the background library. The evaluation was carried out in parallel sessions.

The evaluation showed that the application of the VT is easy and the on-line help is sufficient. The most often applied system features were as follows: (1) - application of the explanation component, (2) - inquiring about rules. All students that worked with the VT solved the task correctly. Taking into the consideration the students' comments outlined later in this chapter, the conclusion can be drawn that when using the VT students have the possibility to interact with the knowledge in a different way as when using only the classical lecture notes. This makes it possible to provide different points of view of a problem domain and introduce more complex ways of reflection.

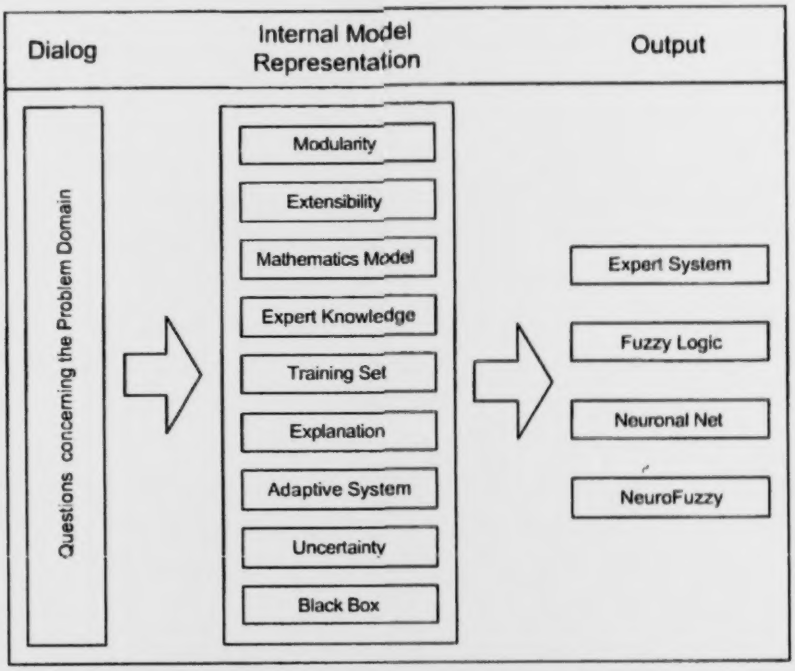
Dialog
Internal Model Representation
Output
Questions concerning the Problem Domain
Modularity
Extensibility
Mathematics Model
Expert Knowledge
Training Set
Explanation
Adaptive System
Uncertainty
Black Box
Expert System
Fuzzy Logic
Neuronal Net
NeuroFuzzy

Figure 1: Working principle of the VT concept presented on the example of the AI domain of the course "Knowledge Processing". Students have to answer questions about facts, which describe the problem within the AI domain. The answers are used to build an internal knowledge representation. Based on the internal representation of the problem, the VT ranks suggestions of AI systems to be used for a particular problem.

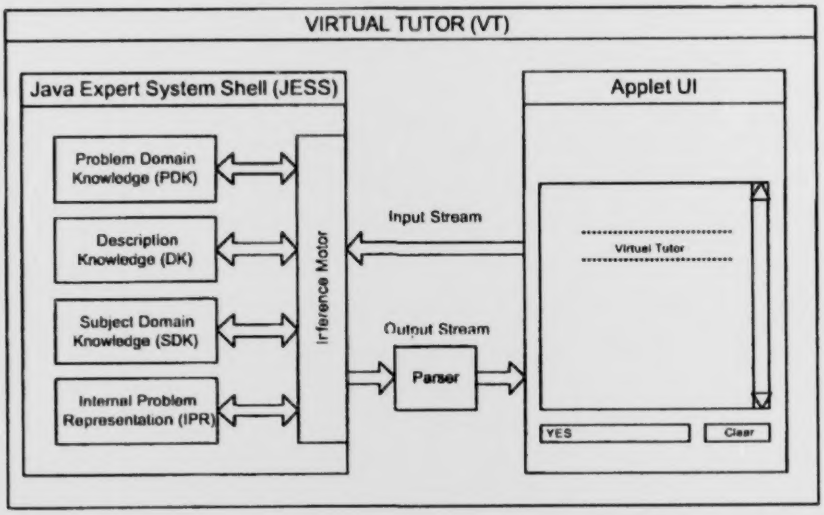
VIRTUAL TUTOR (VT)
Java Expert System Shell (JESS)
Applet UI
Problem Domain Knowledge (PDK)
Description Knowledge (DK)
Subject Domain Knowledge (SDK)
Internal Problem Representation (IPR)
Inference Motor
Input Stream
Output Stream
Parser
Virtual Tutor
YES
Clear

Figure 2: The architecture of the VT system. The expert shell JESS manages the knowledge (PDK, DK, SDK, and IPR) of the system. The parser handles the hyperlink management referencing information from the static and dynamic background library. The applet represents the interface to the user.

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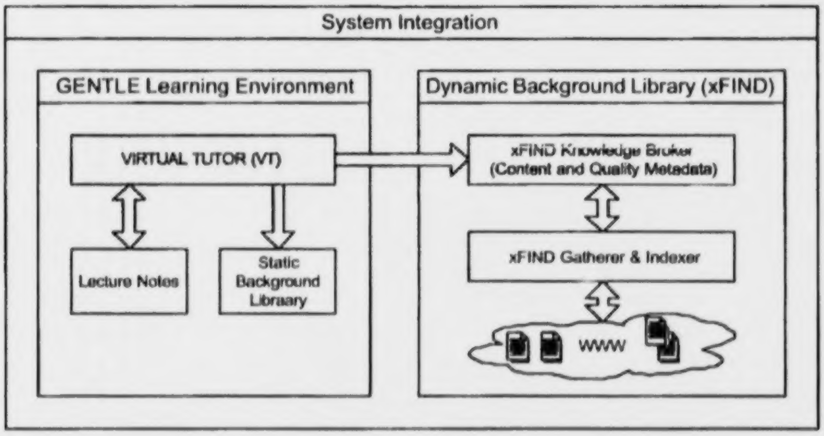
System Integration
GENTLE Learning Environment
Dynamic Background Library (xFIND)
VIRTUAL TUTOR (VT)
xFIND Knowledge Broker (Content and Quality Metadata)
Lecture Notes
Static Background Library
xFIND Gatherer & Indexer
WWW

Figure 3: System integration. The VT system is embedded in the GENTLE-WBT learning environment. It is rendered via the GENTLE-WBT Web gateway as a Java applet.

From students collected comments indicated that the group that worked with the lecture notes had time problems. They expressed that within the time given it was very difficult to find various parameters that were necessary to solve the task. In general, the comments reflected that because of the time limit, the knowledge processing was insufficient and relatively shallow.

Based on the evaluation carried out, the conclusions can be drawn as follows. Dialog based system meets more accurate the requirements of the students in case of solving problems. VT is an interesting and different way for knowledge transfer that provides help by problem solving. Problem solution can be found easier and faster than using conventional literature. VT provides explanation of solutions suggested and makes it possible to access additional information related to the subject domain. Besides conventional lecture, speeches and lecture notes, a VT-based subject domain presentation proved to be very helpful. To improve the knowledge transfer a range of exercises that have to be solved by the VT should be provided to students.

Literature

[Buckley 1999] Buckley, D.; Coleman, W.; Cohen, M.; Stewart, R.: Interactive Multimedia Learning Environments: Tools to Foster Transition to the Learning Paradigm; In Proceedings of WebNet'99,

[Colbourn 1995] Colbourn, C.J.: Constructing Cognitive Artefacts: The Case of Multimedia Learning Materials; In Proceedings of the 1st International Conference on Cognitive Technology, 1995

[Elliot 1995] Elliot G.J., Jones E., Cooke A., Barker P.: Making Sense: A review of Hypermedia in Higher Education. Proceedings of ED-MEDIA 95

[GENTLE] GENTLE-WBT; official Homepage, last visited 2001-12-10, http://wbt.iicm.edu/

[JESS] JESS: The Java Expert System Shell; official Homepage, last visited 2001-12-17, http://herzberg1.ca.sandia.gov/jess/

[Kinshuk 1999] Kinshuk, Oppermann R., Patel A., Kashihara A.: Multiple Representation Approach in Multimedia based Intelligent Educational Systems; In Proceedings of AI-ED'99

[Lennon 1994] Lennon, J.; Maurer, H.: Lecturing Technology: A Future With Hypermedia. Educ. Tech. 34, 4 (1994), pp. 5-14

[Lugner 1997] Lugner,G.; Stubblefield, W.: Artificial Intelligence; Structures and Strategies for Complex Problem Solving (3rd Ed.), Addison Wesley Longman, Inc., 1997 ISBN 0-805-31196-3

[Maurer 1992] Maurer H.: Why Hypermedia Systems are Impotrant. ICCAL'92, LNCS 602, Springer (1992)

[Núñez 1999] Nunez,G.E.; Sheremetov, L.: Virtual Learning Spaces in the Web: an Agent-Based Architecture of Personalized Collaborative Learning Environment; Proceedings of WebNet'99

[Pivec 1997] Pivec, M., Rajkovic V.: Knowledge Based Tools: An Example in Knowledge Modeling; Proceedings of ICCE97

[Reeves 1997] Reeves, T.C.: Using the WWW as a Cognitive Tool in Higher Education; In Proceedings of ICCE97

[xFIND] xFIND: extended Framework for Information Discovery (xFIND); official Homepage, last visited 2000-12-17, http://xfind.iicm.edu

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Designing Multimedia Presentations for the *Learning Content*

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Abstract: This paper argues for changing design priorities in multimedia based e-learning design. Current multimedia research is media oriented, questioning which media to select for presenting information in general. The focus on media in this kind of research is converging at the same results: dynamic media are rarely reported more effective than static media. An important reason for the weak support for dynamic media could be that it often is implemented for unsuitable information contents. Multimedia design should start with a thorough analysis of the information content. We tested and found support for the following hypothesis in two experiments: *information content and media should match on static and dynamic descriptions.*

Introduction

Information presentation with multimedia is a challenge compared to traditional teaching and publishing methods. New information technology offers easy access to development tools for dynamic and visual ways of presenting information. Consequently, easy access to guidelines for how to employ dynamic media is important. Successful multimedia design does not result from the employment of dynamic media as such, but depends on a number of factors, of which effective media combinations, relationship between media and information content, individual characteristics of the learner and implementation and design of the presentations must be considered. This paper addresses particularly the employment of *dynamic* media (e.g. video, animations, voice) and the fit between media and information content. Static media (e.g. pictures, graphics, text) has a long tradition, hence recent research has focused on new dynamic presentation forms.

We hold that a central part of information presentation is to first analyse the information and then select the media that fit. In order to accomplish this we need descriptions of information, which are objective and topic independent. Objective descriptions must also be reliable, enabling different people to identify the same information class. Very few such information classifications exist for the e-learning context. Merrill (1983) suggests four useful information classes, which fit our criteria: facts, concepts, principles and processes.

Recent multimedia research gives remarkable little attention to the information content. Current multimedia research is media oriented, questioning first which media to select for presenting information in general, and eventual with which media combinations. Common co-research factors are various individual factors like ability, aptitude and experience, as well as design and didactical aspects. Experimental research in this context often employ similar design; information is presented with selected media, learning performance is tested and a conclusion related to success of the tested media is drawn. Information content is mostly not treated systematically. A discussion or meta-description of the presented information is almost entirely lacking. Various definitions of information contents are employed, which makes a systematic evaluation of the interaction between media and information content from the different studies literally impossible. A review analysing 25 studies revealed that the tested information contents or learning tasks belonged to seven different meta-categories (i.e. cognitive skill, short term recognition, procedural skill, concept understanding or learning, rule learning, fact memorisation, self assessment), of which all studies tested different example tasks (Park & Hopkins, 1993).

The focus on media in this kind of research seems to have reached a boundary, converging at the same results: few studies find dynamic media effective, mostly dynamic media are reported equal or less effective than static media. Hence, a new approach is necessary to evaluate how to employ dynamic media effectively.

Relevant research

We suggest starting multimedia design with a thorough analysis of the information content. The applied media should reflect the information characteristics. Both media and information content can be described in terms of static and dynamic characteristics. The static and dynamic aspects of media are addressed when media are described as modalities of communication e.g. as visual, auditory, verbal or non-verbal coded information (Paechter 1996). In the media context, static vs. dynamic refers to whether or not we can perceive the information with a self-chosen speed. A representation is static when it enables us to decide how long the information shall be presented (e.g. text, picture). A representation is dynamic when the information flow proceeds automatically (e.g. voice, video). Also information can be described in terms of static and dynamic characteristics. Static information remains stable in its context e.g. states, descriptions, concepts, facts. Dynamic information is not stable over time, but refers to variable interactions between certain variables or factors, e.g. processes which can be described as a sequence of steps necessary to accomplish some goal, solve a particular class of problems, or produce a product.

We inferred that an important reason for the weak and varying support for dynamic media in research is that dynamic media often is implemented and tested for information contents for which it is not suited. Although dynamic media is often appreciated as a "nice" feature, a disharmony between information characteristics and media representation may hinder optimal learning. Studies, that tested various dynamic information contents confirm a bound between dynamic information and dynamic media. The tested information was defined as complex, dynamic and spatial, procedural texts (Large, 1994; Large, 1996), complex structural, functional, and procedural relationships among objects and events (Park, 1992), Newton's law of motion (Rieber, 1990).

We tested the following hypothesis in two experiments (Guttormsen Schär, in review): *Information content and media should match their respective static and dynamic descriptions.* Our experiments also addressed the complex relationship between information, media representation and test of knowledge. Relevant results are:

- There is a close relation between information content and knowledge acquisition. Test of dynamic knowledge should reflect causal, procedural and eventual interactive aspects of the information. Tests of static knowledge should reflect the stable information aspects.
- It is difficult to acquire static information embedded in a dynamic context.
- There is a close relationship between information presentation and knowledge acquisition. Visual media supports visual knowledge. Verbal presentations relate to verbal knowledge.

Conclusion

Our results show that static and dynamic information qualities should guide media selection on an initial level. A simple key to multimedia design is to first select media according to basic static and dynamic information qualities. Further differentiated characteristics of the information content should guide the didactical media design and set the information in an appropriate learning context. An overview over multimedia in e-learning is given in Guttormsen Schär (2000).

References

Guttormsen Schär, S., Zimmermann, P., Zuberbühler, H-J., Widmer, R.M., Krueger, H. (In review). *Presentation of Process Oriented Information Content with Multimedia: empirical studies with a differential approach*

Guttormsen Schär, S. and H. Krueger (2000). Using New Learning Technologies with Multimedia. *IEEE MultiMedia Magazine* July-September 2000.

Large, A., J. Beheshti, et al. (1996). Effects of Animation in Enhancing Descriptive and Procedural Texts in a multimedia Learning Environment. *Journal of the American Society for Information Science* 47(6): 437-448.

Large, J. A., J. Behesthi, et al. (1994). Multimedia and Comprehension: A cognitive study. *Journal of the American Society for Information Science* 45: 515-528.

Merrill, M. D. (1983). *Component Display Theory. Instructional-design theoried and models. An overview of their current status.* C. M. Reigeluth. Hillsdale, Lawrence Erlbaum: 61-95.

Paechter, M. (1996). *Auditive und Visuelle Texte in Lernsoftware: Herleitung und empirische Prüfung eines didaktischen Konzepts zum Einsatz auditiver und visueller Texte in Lernsoftware.* Münster, Waxmann.

Park, O.-C. and R. Hopkins (1993). Instructional conditions for using visual displays: a review. *Instructional Science* 21: 427-449.

Park, O. and S. S. Gittelman (1992). Selective use of animation and feedback in computer-based instruction. *Educational Technology Research and Development* 40(4): 27 - 38.

Rieber, L. P. (1990). Animation in computer-based instruction. *Educational Technology Research and Development,* 38: 77-86.

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Cognitive user profiles for adapting multimedia interfaces

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Abstract: An user does not achieve optimum performances if he uses pre-defined interfaces that misfit with his cognitive abilities. Our goal is to build cognitive profiles of users and adaptation techniques of HCI. We briefly present cognitive indicators and styles that are used in our filtering process of the output medias. We have chosen XML and ASP technologies to implement the system.

Introduction

In e-learning systems, each student is confronted to lessons and exercises which are relevant to his/her needs and preferences i.e. educational level, domain knowledge (expert or novice) but which do not take into account his/her abilities for assimilation, memorization, etc. The aim of our project is to build an adaptation technique of multimedia interfaces where cognitive abilities are considered. This dynamic process tries to estimate what combination of small media can compose the most suitable document for each user.

The context

In collaboration with SBT company, we work on an interactive web site for a supervised cognitive training: www.happyneuron.com (Tarpin-Bernard et al, 2001). During each training session (i.e. each connection), the user executes a set of exercises that the system suggests. Presented into a playful and cultural dimension, the exercises vary in difficulty's level, speed… in order to train the user (Habieb-Mammar et al, 2001). A database stores normalized data (means and standard deviations) for each variant of exercise and family of population distinguishing gender, level of education and age. The current statistics show that since the web site has been opened to the public, on may 2002, the number of performed exercises exceeds 750.000. Comparing the trainee's results and the normalized data we progressively build his/her cognitive profile. Thanks to it, the system advises the elderly user in the choice of exercises.

In this context, we built an evaluation module composed of ten precise exercises that allows to quickly build a cognitive profile. Then, this profile, which is quite stable, can be used in very different context. Our first purpose is to elaborate an adaptive multimedia course explaining how the brain is working.

Cognitive styles

Cognitive styles refer to a person's habitual, prevalent, or preferred mode of perceiving, memorizing, learning, judging, decision-making, problem-solving (Dufresne, 1997). Individual differences about how people carry out tasks involving these functions may constitute a style if they appear to be: pervasive, which means that they emerge consistently in different contexts, independently of the particular features of situation; or stable, that is, they are always the same at different times. They are one of the most stable user characteristics overtime. They are consistent across a variety of situations, as opposed to user knowledge or experience that are more specific and evolving. Cognitive styles induce persons to adopt similar attitudes and behaviors in a variety of domains they concern. They are important in determining the most effective interface for a particular category of user, especially in the formative stages of an interaction (Fowler et al, 1985).

Cognitive user profile

The cognitive user profile is composed of numeric indicators representing cognitive abilities and styles:

- The cognitive indicators are dispatched into 5 sectors: *memory, attention, executive functions, language and visual & spatial capacities*. In detail, 25 indicators have been determined. We can mention several of them as an illustration: cultural memory, recent memory (verbal, visual or musical), working memory, lexical spelling, categorization, comprehension, planning, reasoning, form recognition, etc ;

- The style indicators reveal some cognitive styles such as field dependence. These indicators are determined by a combination of cognitive indicators or through the comparison of the results obtained in several exercises. For example to determine whether the subject is field dependent or not, we use an indicator which measures the difference in performance after running the same exercise with two different images (the first with significant context and the second with non-significant context) then we adjust it with other cognitive indicators such as recent memory (verbal, visual or musical) and comprehension.

Adaptation Process

This user profile enables the selection of the outcomes modalities. The multimedia document is defined into an XML document. To illustrate the adaptation process, here is an example of a page dealing with the following subject : "The main parts of a language : the vocabulary and the syntax". In the XML document, the page contains 2 elements. Each one could be presented according to different modalities:

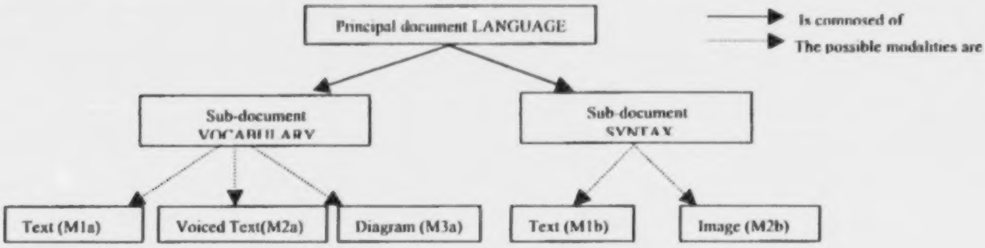

Figure 1: an XML document structure

The problem is to find the "best" combination of medias according to the willing of the designer and the abilities of the reader. In this XML structure, the possible combinations are: (M1a ; M1b), (M1a ; M2b), (M2a, M3a ; M1b), etc. Thus, we can build a matrix whose lines corresponds to compatibility criteria (e.g. capacity to manage of multimodality, respect of preferred modality, field-dependence…) and whose rows are the possible combinations of medias. For each combination and each criteria, a compatibility factor is calculated using an arithmetic formula that combines the profile and the characteristics of the combination. The combination of medias that obtains the biggest sum is considered as the most compatible. Hence the medias are selected by enabling relevant tags before applying the stylesheet.

Conclusion

The first working track has been defined, experimentations and validation work are currently in progress especially to determine the compatibility factors. Our aim is to build a reliable user profile in order to exploit it not only in our site but in other coming applications. All this work has been possible by adopting multidisciplinary approach (computer sciences, cognitive psychology and education sciences).

References

Dufresne, A. & Turcotte, S. (1997). *Cognitive style and its implications for navigation strategies.* In Artificial Intelligence in Education: Knowledge and Media in Learning Systems, B. Boulay, & R. Mizoguchi (Ed.), Amsterdam: IOS Press. AI-ED'97 Conference, Kobe, Japon. 287-293

Fowler, C. J. H., Macaulay, L. A., & Fowler, J. F. (1985). *The Relationship Between Cognitive Style and Dialogue Style: An Explorative Study*, HCI'85, 186-198.

Habieb-Mammar, H. Tarpin-Bernard, F. Croisile, B. Noir, M. (2001). *User cognitive model for adaptive interfaces.* 2nd International Conference NimesTIC 2000 Maîtrise des Systèmes Complexes et la Relation Homme-Système, Nîmes France December 2001.

Tarpin-Bernard, F. Habieb Mammar, H. Croisile, B. Noir, M. (2001). *A supervised Program for Cognitive e-Training.* WebNet'2001, World Conference on Web technologies. Orlando. Octobre 2001.

Supporting Online Video-based Correction for Language Learning through Markup-based Video Editing

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Abstract: This paper focuses on an online video based correction system for language learning. The prototype system using the proposed model supports learning between a native English teacher and a non-native learner using a videoconference system. It extends the videoconference system so that it can record the conversation of a learning scene. If a teacher edits the video to include explanations, the video can become very useful as teaching material. However, in ordinal video-editing systems, it is difficult to show edited parts. Therefore, this paper proposes a video correction system and focuses on the online video-editing model.

Introduction

With fast development of the Internet, people around the world have more chances to communicate directly with CMC (Computer Mediated Communication) tools, such as e-mail, chat and bulletin board systems. By applying the CMC tools to language learning, it is possible for learners to communicate with native speakers in foreign languages. In fact, many approaches, which may lead to improved exchanges among different cultures and language learning with the CMC tools, have been proposed. Hanson et al. (1998) used the CMC tools for improving international collaboration and comprehension among university learners around the world. The experiment showed that a learner's ability to comprehend and express themselves in foreign languages was highly improved. It also pointed out direct communication with native speakers was very important for foreign language learning. An approach that emphasizes foreign language study through communication is known as the communicative approach (Johnson & Morrow, 1981). In this approach, grammatical rules and vocabularies are of secondary importance. Recently, the communicative approach has attracted much interest in CALL (Computer Assisted Language Learning).

From a technical point of view, the high-speed and broadband network has realized rich, smooth and synchronous communication and collaboration using not only text but also audio and video materials (LeeTiernan et al, 2001). For example, in an English conversation school in Japan, Japanese learners attempt to master English with a distant teacher (native speaker) using a videoconference system. The interactive video makes learning more effective (Dalton, 1990). What seems to be lacking, however, is reuse of the conversational video for language learning by reviewing and editing the video of the past lesson.

This paper proposes an online video-editing model for language learning, which allows the teacher and the learner to revise and edit their conversational video. If the videoconference system records their conversation into video files, the teacher can edit the videos using a video-editing tool. However, it may be very difficult for the learner to understand the teacher's task in the original video because the ordinal tools create quite a different video from the original one. Therefore, we propose a markup-based video-editing system called Vicllc (Video-based Communicative Language Learning Support System) through the proposed model, which provides a similar environment to a real one where texts are corrected using red-pen on paper. Using this system, a learner can correct their conversational video, e.g., a teacher inserts a new video segment and annotations with correction marks. Using this system, it becomes easier to understand the teacher's correction comments. The features of Vicllc are as follows:

(1) A teacher can correct a video recorded by the videoconference system in Vicllc.

(2) The system uses VCML (Video-based Correction Markup Language) to describe the contents of the video correction.

(3) A learner can see what the teacher has just corrected. This is based on WISIWYS (What I See Is What You See).

(4) A learner can study by interacting with this system based on the correction marks.

(5) The revised/explained video can be generated from an original video and a VCML document.

This paper is organized as following. First, related work is introduced. After that, a video correction and an online video-editing model are described. In the next section, a VCML is used to describe the video correction and the implementation system is shown. Finally, concluding remarks are given.

Related Work

Recently, wide ranges of authoring systems have been developed, which allow both text and media annotations. Among them, a multimedia annotation environment for young children using Java has been developed (Bouras, et al., 2000). It is used to provide children with the opportunity to reflect upon and annotate episodes from their everyday life. This system can lead to arguments with many learners. However, it has no functions to learn with the inserted annotations.

The approach used in the project of ACTS082 called DIANE (Benz, et al, 1997) recorded an arbitrary application output of the basic content of a multimedia document and to annotate it with all kinds of media available to the user. This system defines the annotation framework, however, the target for usage is not defined clearly. Therefore, it can cope with the ordinal video but cannot deal with two videos recorded by a videoconference system. It has no players to show these synchronously.

The classroom 2000 (Abowd, et al, 1996) project focused on teaching material. There is a hypothesis; tools to aid in the capture and subsequent access of classroom information will enhance both the learning and teaching experience. Therefore, the teacher can make teaching materials with various media and show it to the learner. The learner can annotate on the teaching material. However, the learner cannot study with his/her own video.

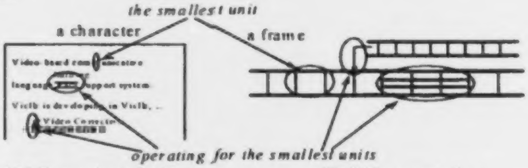
Lieberman et al (1994) have developed a system to use video as a tool for procedural knowledge representation. However, this system is not suited to language learning because it can only annotate still pictures extracted from the original video by drawing.

Language Learning using Video Correction

Video Correction

Conventionally, texts have been corrected using a red pen to highlight errors. Thus, rectified contents are made clear. According to such a traditional correction manner, an online markup-based collaborative writing support system, called CoCoA (Communicative Correction Assisting System) (Ogata et al, 1997) and CoCoA-J (CoCoA for Java) (Ogata et al, 2000) has been developed, which is very similar to the real correction environment with a pen and paper. This system has been used for language learning, and it can automatically generate the original text and the revised one from the corrected text. However, it cannot deal with multimedia contents such as video and audio. Therefore, it cannot correct a video like a text, exactly.

In order to rectify a video, one should focus on each of the smallest units. A text consists of many characters. The correction of a text operates on a character. Similarly, a video consists of many frames. It can operate like a text if a frame is treated like a character. [Figure 1] shows text correction and video correction. The correction of a text in (A) shows deletion and insertion for characters. Video correction in (B) shows them for frames.



(A) Correction of a text (B) Video correction

Figure 1 : Comparison between correction of a text and video correction.

Online video-editing model

Several editing systems aid teachers when reviewing and correcting learners' drafts. Farkas & Poltrock (1995) classified an online text-editing model that considered four models; the silent editing model, the comment model, the edit trace model, and the traditional markup model. In the silent editing model, the teacher overwrites and corrects the learner's document. In the comment model, annotations are inserted in the original document. In the edit trace model, the teacher works in the manner of an author, deleting, adding, and moving text. The computer can compare an editor's new version with an original one. It allows learner to view the draft that contains teacher's changes. Microsoft Word accepts this model. The traditional markup model employs correction marks to the computer screen, for example, deletion, insertion, and move. According to this classification, this paper proposes an online video-editing model as follows: (See [Figure 2])

(A) *The silent model:* After correcting the wrong parts of an original video with a general video-editing tool, the teacher creates a new video file. This is the simplest model, however, it is very difficult for the learner to check the teacher's work. This model is destructive because the teacher cannot readily recover the original video once he/she has made a revised video.

(B) *The comment model:* This model employs pop-up notes, temporary footnotes, hidden text, and special symbols placed within the original video. A system based on this model is developed with SMIL. It often takes a considerable amount of time for teachers and learners to obtain a revised video from comments on the original video.

(C) *The Mark-up model:* This adapts the traditional marks used with pen and paper to video editing on the computer screen. The symbols are both familiar and intuitive for teachers and learners: for example, deletion, insertion, and move. For instance, MATE (Hardock et al, 1993) that is a text-based collaborative writing tool, allows teacher to use both digital ink and voice commands toward pen and voice computing. In this model, both learners and teachers can interpret the teacher's modification with markings much more readily than in the other models. Moreover, they can easily derive both the original video and the revised one from a marked-up video.

Many systems employ a traditional mark-up that allows multiple users to mark-up an electronic document as if they were marking up a printed copy of the document. However, no studies have ever tried to adapt a markup model into a video-editing system. Therefore, this paper proposes a video mark-up model for supporting language learning. In addition, a correcting system has also been developed.

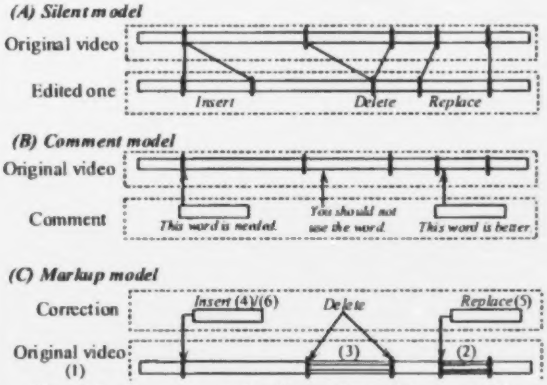


Figure 2 : Taxonomy of online video editing models.

Learning process using Viclle

In order to learn a video through video correction, the video to be revised by a teacher is needed. Then, the teacher can correct it and the learner can study with it. The learning flow shown as [Figure 3] is as follows.

(1) *Recording with a videoconference system:* A teacher gives lessons in speaking a language. The videoconference system in Viclle records a video of both the teacher and the learner. The learner and the teacher share the files via network. The video is used as a basal video for later operations.

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(2) *Correcting video:* The teacher corrects the recorded video with Viclle Editor. The instructor makes the data for correction and rectifies the video with it. The teacher sends the VCML file (made by Viclle-Editor) to the learner after correcting. The VCML file shows only the contents of the correction but the video is shared in (1) so the teacher does not need to resend the original video.

(3) *Learning by correction:* The learner studies using the corrected video with Viclle-Viewer. According to the VCML file and the learner's process, Viclle-Viewer plays the contents. When learning, the student reviews and repeats places that are different to understand on the corrected video.

(4) *Entering questions:* If the learner has some problems and questions, s/he can describe them. In addition, if there is a question from the teacher, s/he can answer it. After that, the Viclle-Viewer generates a VCML file and sends it to the teacher. The VCML file contains the learner's question and feedback. The data relates the correction to the original VCML with a link.

(5) *Grasping learner's feedback:* The teacher grasps the learner's feedback from the VCML file with the Viclle-Editor and refers to that work for the next time. The Viclle-Editor shows the feedback for each correction.

The above is repeated when learning. The learner and the teacher repeat the learning process and solve the learner's problem. As a result, the learner may improve his/her communicative skill.

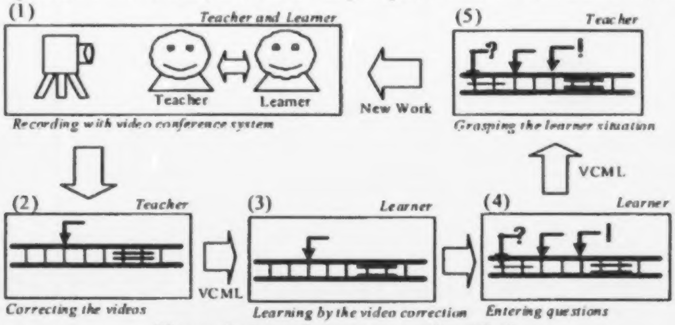


Figure 3 : Learning process using Viclle.

VCML: Markup Language for Video Correction

Video-based Correction Markup Language (VCML) is proposed to describe video correction. In addition, it can represent the learner's condition after studying. This markup language is based on XML. XML is a markup language used to exchange the corrected contents on network. Therefore, a teacher and a learner can exchange the correction only with VCML because the original video is linked by VCML. Some of the advantages of VCML are as follows:

(1) It does not edit the original video.
(2) It uses the correction marks shown as [Table 1].
(3) It becomes a revised video by applying the tags of revised corrections.
(4) It becomes the explained video by applying the tags of explained corrections.
(5) It is possible to represent the condition of the learner's studying.
(6) It is independent of the kinds of computer and software.
(7) It is possible to send and receive by e-mail because of the text format.

Correction	Icon	Contents
Insert		Inserting media for explanation
Overlap		Composing comments
Replace		Replacing with other media
Delete		Deleting part
Repeat		Repeating the part
Pause		Pausing the point
Annotation		Inserting media as comment

Table 1: VCML tags for video correction.

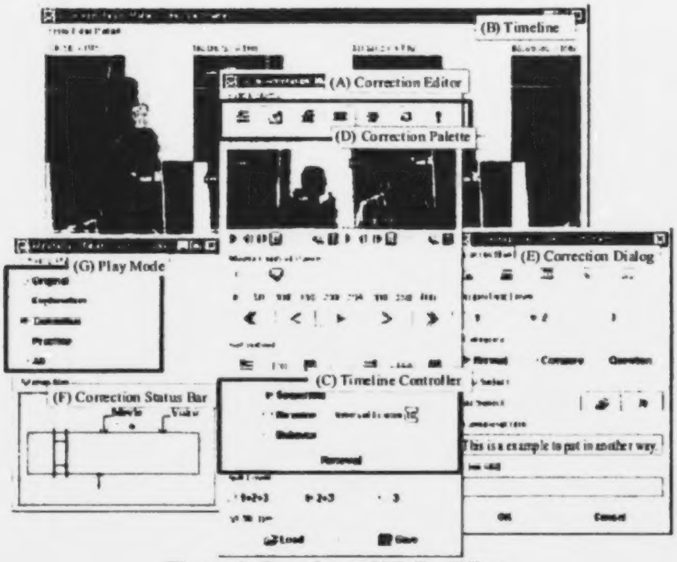
Implementation

Viclle has been developed on Windows 2000. The development language is Java SDK1.3.1. Java Media Framework (JMF) 2.1.1a is used as a framework to deal with media, JAXP (Java API for XML Parsing) is used as a XML Parser, RELAX (Regular Language description for XML) to analyze XML documents, and Relaxer as a parser of RELAX are also used.

A snapshot of Viclle-Editor and its pop-up windows is shown in [Figure 4]. In the (A)Correction Editor, a teacher can edit the original video with correction marks. The videos for the correction and the operation buttons are shown on it. When the teacher wants to correct the original video, s/he can rectify by choosing the correction mark on the (D)Correction Palette. The correction mark is inserted by clicking the palette. An example that inserts replace correction is shown. When the replace button is clicked, the (E)Correction Dialog appears. Then, the user selects the media type; text, audio, video, picture or link. In this case, the user selects video as the media and inputs the text to the comment box. After that, the correction of replace is completed. Similarly, the user can insert other corrections. In order to confirm or select the correction frame, the frames of the original video are shown in the (B)Timeline. The display method can be altered by the (C)Timeline Controller. In order to affirm the correction condition, the (F)Correction Status Bar is used. The inserted corrections are shown by the marks on the bar. In order to change the contents for playback, the (G)Play Mode is used. According to the attribute of correction marks, the playback contents can be changed.

Conclusions

This paper proposed an online video-based correction model for language learning. No studies have ever tried to adapt a markup model into a video-editing system. The prototype called Viclle can correct videos recorded by the videoconference system. In addition, VCML is proposed to exchange corrected contents and learner's condition. A video was used as a tool for commentating or giving lessons. However, as the video correction uses the markup model, it can discover information required by a learner in real time. Thus, a video through video correction can be used as teaching materials. Although Viclle was used for language learning in this paper, the video correction is independent of the domain. For instance, it can use sports training for the form; acquire gestures in different cultures like that between Japanese and Americans. In future work, a VCML document will be used to retrieve video databases that are stored VCML documents. The data can be used as error databases. Another point under consideration is the examination of a speech recognition system to help the correction work and train learner's pronunciation or intonation.



This is a example to put in another way.

Figure 4 : Snapshots of Viclle-Editor.

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References

Abowd G, Atkeson, C., Feinstein, A., Hmelo, C., Kooper, R., Long, S., Sawhney, N. and Tani, M. (1996). Teaching and Learning as Multimedia Authoring: The Classroom 2000 Project. *Proceedings of the ACM Multimedia'96*, 1996, ACM, NY. 187-198.

Benz, H., Bessler, S., Fischer, S., Hager, M., and Mecklenburg, R. (1997). DIANE: A Multimedia Annotation System. *Proceedings of the Second European Conference on Multimedia Applications, Services and Techniques*, 1997, Berlin, 183-198.

Benz, H., Fischer, S., Mecklenburg, R., and Dermler, G. (1997). DIANE - Hypermedia Documents in a Distributed Annotation Environment, *Proceedings of the Conference on Hypertext - Information Retrieval - Multimedia*, 1997, Dortmund, 293-306.

Bouras, C., Kapoulas, V., Konidaris, A., Ramahlo, M., Sevasti A., Van de Velde, W. (2000). Using Multimedia to Support Reflection on Past Events for Young Children, *ED-MEDIA2000*, 2000, AACE, Montreal, 105-110.

Dalton, D.W. (1990). The effects of cooperative learning strategies on achievement and attitudes during interactive video. *Journal of Computer Based Instruction*, 17, 8-16.

Farkas K. D., and Poltrock, E. S. (1995). Online editing mark-up models and the workspace lives of editors and writers. *IEEE Transaction on Professional Communication*, 38 (2), 110-117.

Hanson, J., Ribold, M. and Weber, P., (1998). Cross Cultural Awareness, *Proceedings of World conference on Educational Multimedia*, Hypermedia and Telecommunications 98, 1900-1901.

Hardock, G., Kurtecbach, G. and Buxton, W. (1993). A marking based interface for collaborative writing, *Proc. of ACM Symposium on User Interface Software Technology*, ACM, 259-266.

Johnson, K. and Morrow, K. (1981). *Communication in the classroom: applications and methods for a communication approach*, Longman press.

LeeTiernan, S. and Grudin, J. (2001). Fostering Engagement in Asynchronous Learning through Collaborative Multimedia Annotation, *Proceedings of INTERACT 2001*, To appear.

Lieberman, H. (1994). A User Interface for Knowledge Representation from Video, *Conference of the American Association for Artificial Intelligence*, Seattle.

Ogata, H. and Yano, Y. (1997). CoCoA: Communicative Correction Assisting System for Composition Studies, *Proc. of ICCE 97*, AACE, 461-468.

Ogata, H., Hada, Y. and Yano, Y. (2000). CoCoAJ: Supporting Online Correction of Hypermedia Documents for CALL, *Proc. of ICCE 2000*, Taipei, Taiwan, Vol.1, 323- 329.

Ogata, H., Feng, C., Hada, Y. and Yano, Y. (2000). Online Markup Based Language Learning Environment, *International Journal of Computers & Education*, Vol.34, No.1, 51-66.

Keeping it Simple: The Case for E-Mail

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Abstract: The Open University of Israel (OUI) is a distance education institution which offers over 250 computer-mediated-courses through the Internet. All OUI students must pass an English reading comprehension exemption exam or take the University's English reading comprehension courses. Because reading instruction differs from content instruction, different considerations need to affect how best to utilize the computer when planning CMC delivered reading courses. The distance courses in English reading comprehension are transmitted via e-mail rather than the Internet. The purpose of this paper is to recommend this "primitive" option, and to explain why it suits courses of this kind. There is a tendency to move on to ever-more impressive modern technologies, and constantly seek new ones. To avoid falling into the trap that Gabi Salomon referred to as the "technological tail wiggling the educational dog", we decided on the e-mail option.

The Open University of Israel (OUI) is a distance education institution which caters to students of all ages who wish to earn an academic degree, in Israel or abroad. There are no entrance requirements, but students must live up to the University's stringent course demands, and all must pass an English reading comprehension exemption exam or take the University's English reading comprehension courses. Though the Open University offers over 250 computer-mediated-courses through the Internet, the distance courses in English reading comprehension are transmitted via e-mail. The purpose of this paper is to recommend this "primitive" option, and to explain why it suits courses of this kind.

The OUI Study Method

The OUI's teaching method is not space- or time-dependent as it is not based on a central campus where lecturers and students gather, or on an established and uniform schedule [1]. Students enroll in specific courses rather than in a faculty or department. They select the courses in their program of study from a varied and wide-ranging selection. The individual program may include a diverse array of disciplines (which in other universities belong to separate departments or faculties), or may be based on a more focused disciplinary format which resembles, to some extent, single-discipline or dual-discipline programs of study in other institutions.

Students' rate of progress is not measured in units of time (years or semesters), but rather in the number of accumulated credits. The individual rate of progress is determined by the students themselves – based on the amount of time available to them. The only constraining time-frame is the semester, as the duration of most courses is one semester of 15 weeks, and the students are required to meet the requirements of the course during the semester in which they are enrolled.

The OUI offers close to 500 courses based on scholarly or scientific works, consisting of one or more volumes written by renowned specialists in their field and produced especially for OUI students. The coursebooks are adapted to self-study: they are usually divided into units, each of which deals with a specific topic to be studied within a fixed period of time. Guiding questions are integrated into the material, as are exercises and self-assessment questions. Each course includes face-to-face components: group tutorial sessions, laboratory work or study excursions. While participation in these sessions is usually not mandatory, it is highly

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recommended, as the sessions contribute considerably to clarification of the study material, and also provide an opportunity to interact with other students enrolled in the course. The sessions are held at the regional study centers throughout the country.

Open University courses have traditionally taken advantage of existing technologies for enrichment. Until the early 1990s, lectures by experts were broadcast daily on Israel radio; with the advent of cable TV, television broadcasts which accompany many OUI courses have replaced the radio. Segments are aired several times a day, every day of the week. With the rapid development of information and communication technologies in the 1990s, it was clear that the integration of state-of-the-art technology into OUI courses would have a significant impact on distance teaching at the OUI.

Technology at the Open University

The main reason for integrating technologies, and the Internet in particular, into OUI courses, was to provide a virtual campus as a substitute for a real campus, to compensate students for what they miss when learning at a distance. A second objective was to take advantage of additional educational resources, beyond what the university provides. These include all public domain educational resources and digital library services, which enables students to access bibliographic and other databanks, electronic journals, computerized encyclopedias, as well as the computerized catalog of the university libraries network in Israel, from their homes. Another aim was to compensate for the lack of face-to-face tutorials for students whose nearest study center is far from their homes, or who are unable to attend tutorial sessions for various personal reasons, by providing virtual tutorials through electronic communication.

The Center for Information Technology in Distance Education (*Shoham*) was established in 1995 to help the Open University enter world-wide academic activity in the field of information technology in teaching and education. The major focus of the Center's activities is on research and development of teaching methods based on state-of-the-art information technologies and incorporating them into OUI courses.

Telem, a department within *Shoham*, specializes in computer-mediated communication (CMC). It has developed an interactive on-line learning environment on the Internet, which is part of the teaching/learning process and serves both students and faculty. Today close to 250 CMC courses are offered, with state-of-the-art technologies incorporated into course development and teaching procedures.

Interactive learning: The computerized teaching/learning environment provides for one-on-one and group interaction among all participants in the course: students, instructors course coordinators and guest lecturers. Every CMC course has its own HTML and Java-based Web site that provides interactive learning materials through electronic asynchronous communication including discussion forums, e-mail, and materials that students can download. The sites can be accessed by students in Israel or abroad through the Internet. All course sites are graphically and functionally similar, and linked to administrative information drawn directly from the OUI's central database: the course schedule and description, the course tutors and the list of students. The academic aspect of the sites includes Hebrew-based applications that were specially developed to enable the course coordinator to easily and independently update the data, without the need for any knowledge of Web programming. With this platform available and widely used at the OUI, the question arises as to why the English reading comprehension courses do not take advantage of it.

English Reading Comprehension Courses at the Open University

Reading comprehension skills in English are necessary for all students for whom English is a foreign language. Without the ability to read in English, students find that sources needed for much of their academic studies, especially in advanced courses, are not accessible to them. As a result, all Israeli universities require a minimum level of reading comprehension in English and students cannot be awarded a degree without passing an exemption exam or taking English reading comprehension courses. Since only 10% of students entering the

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[1] The description of the Open University study method is based in large part on Zippy Erlich, Judith Gal-Ezer, and David Lupo, "Traditional Distance Education vs. Technology Integrated Distance Education" in *Intelligent Internet Based Teaching and Learning*, edited by R. J. Howlett and L. C. Jain to be published in 2002 by Springer-Verlag.

university come with an exemption in English, the reading comprehension courses are among the most highly populated, if not the most popular, at the OUI.

The Open University offers a series of courses in English reading comprehension for academic purposes on five levels: A (advanced); B, C (intermediate); and D, E (beginning). The courses are offered in three study formats: intensive (a semester-long course comprising 14 weekly face-to-face meetings), regular (a semester-long course comprising 7-8 bi-weekly face-to-face meetings), and computer-mediated (a semester-long course which includes 1-3 face-to-face meetings and 9 e-mail sessions, of which 7 are compulsory). Of the three formats, only the latter is a distance education format.

Most university courses are, by nature, content courses. In contrast, learning a language is a process of communication and goes well beyond learning lists of words and practicing grammar exercises. Because the classroom is a more natural environment for language use and social interaction, language courses are traditionally taught in a face-to-face (f2f) format. If we consider reading as a mode of language use, and distance education as a mode of language instruction, distance education for this particular mode of language use seems particularly appropriate. Indeed, we encounter striking parallels: the reader (when reading in "real life") and the learner (when learning to read) both function in isolation when interacting with a text. In both cases, discourse is enacted at a distance, a disassociated first person (the author or the instructor) is actively present, and no reciprocity is manifest, within the interactive context [2]. One could, therefore, argue that reading instruction and distance education are particularly well-suited. It would therefore seem logical to use the available platform for teaching reading comprehension. But because reading instruction differs from content instruction, different considerations need to affect how best to utilize the computer when planning CMC delivered reading courses.

The *Telem* course sites are designed for content instruction, and are intended to afford additional interaction among the participants and to provide technology-based learning aids that increase the effectiveness of and enjoyment from the learning process. Learning materials are based on multimedia and hypertext, and include animations, simulations, multiple-choice exams with immediate feedback; and access to databases on the Internet. These aspects are less relevant when transmitting an existing reading comprehension course via computer. Traditionally, reading comprehension programs rely entirely on pre-defined and pre-produced teaching/learning materials in which the selection and organization of the reading texts and the tasks are determined by the syllabus-writer. In a f2f teaching/learning context, the instructor, in selecting what to teach, turns the abstract syllabus into what s/he considers to be the most appropriate means to activate the learning process. Thus it is the instructor who controls and promotes the learning. In a CMC reading course, while the instructor is responsible for dividing the syllabus into sessions, arranging deadlines for task completion/submission, and making decisions for assessment and evaluation, once the course gets started, the participants take over [3]. In order to explain the choice of technology, it is necessary to briefly describe the course.

The E-Mail Format

The following description is of a B-level e-mail mediated reading course which has been implemented for the last five semesters at the Open University. The objective of the course is for students to reach the level of proficiency expected in the parallel f2f B-level course (intensive or regular formats). The students sit for the same mid-term and final examinations taken by students registered for the course in all formats.

Participants: In order to make the course manageable for the tutor, the number of participants in a group is limited to 20.

Materials: The teaching materials, which are pre-prepared and handed out to the students, comprise the following:

- A collection of reading passages consisting of articles selected on the basis of topic interest and level of difficulty, the same texts used by the rest of the students.
- Workbooks dealing with nine texts, arranged in modules according to test organization patterns (comparison/contrast, description, cause and result, argument, research) including approximately 20 questions to guide the reading process and relevant teaching points (reading strategies and linguistic features). The workbooks are similar, but not identical to the regular materials.

- A "Resource Center" which brings together all the major teaching points dealt with in all modules as a handy reference.

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[2] I am grateful to Dr. Esther Klein-Wohl of the Open University of Israel for pointing out this parallel.

[3] This concept was proposed by Dr. Anita Pincas of the Institute of Education, University of London.

Process: The initial f2f meeting provides the students with the opportunity to get to know each other, to familiarize themselves with the structure of the course and to understand what their responsibilities are. This meeting serves as a "kick off" point for the course and its main focus is to deal with students' queries and technical problems, as well as an introduction to pre-reading activities. The students can attend two additional f2f meetings by joining regular groups near to their homes: one is held a week before the midterm examination, and another is held before the final examination. These serve to prepare the students for the exams by explaining the format of the exam and supplying a practice examination.

The rest of the course consists of asynchronous e-mail sessions. Prior to each e-mail session, students are sent a list of the questions which they are assigned. Each student is assigned 8-9 of the 20 questions which relate either to pre-reading or to close reading, as well as post-reading questions for all students. The date of submission is mandated in advance as a specific day of each week and the questions are sent out one week in advance. The weekly tasks demand active learner engagement rather than passive participation in classroom sessions. The tutor's feedback, which provides the correct answers as well as specific comments regarding language features, useful reading strategies and general and individual feedback relating to students' cognitive and metacognitive awareness, is sent out to all students within three or four days of the deadline for submission, and serves as additional English-language reading material.

Our students have reacted extremely positively to the course, and their achievements have consistently been as good as, or better than those of their peers in f2f groups. Their feedback (provided on an anonymous questionnaire filled out by all students at the end of each course) has invariably emphasized the one-on-one teaching and the close contact they enjoy with the teacher, thanks to the e-mail communication.

Why E-Mail?

In recent years, scholars in various content fields have been grappling with the question of appropriate formats for CMC. Perhaps surprisingly, among the scholars who recommend the simple e-mail format, rather than what Margaret Anderson (1997) calls "new and 'glitzy' technology", are faculty who specialize in Engineering and even in Computer Information Systems [4]. This indicates that the choice of e-mail is not necessarily related to students' assumed computer skills, nor to the technological options available, but rather to the specific needs of the course and its pedagogical context.

As we have shown, our distance education reading courses also do not utilize all the multimedia aspects of what can today be called "traditional Internet teaching" as exemplified by the *Telem* platform. In terms of pedagogy, our reading comprehension students are given the reading texts on paper, and not through the computer, because reading, and especially reading comprehension skills, are dependent in large part on back-and-forth reading, marking the text, and note-taking. Reading from paper is still considered easier than reading from a screen [5]. We also need to consider the purpose of this course. Beyond the formal requirement of English language proficiency, our goal is to enable students to read and understand the required course readings that they are assigned, some of which may be in English. These readings are usually provided to students in a printed booklet. Thus, in "real life" - for their studies - students will be reading on paper.

In terms of technical aspects, the platform utilized by *Telem* (Opus) makes it difficult to mix English and Hebrew within a single message, and students often answer reading comprehension questions in their L1. Another problem relates specifically to the *Telem* platform. After connecting to the Internet, students need to go to their course site, enter a password, and, often, wait. They then need to go into the weekly forum to find the assignment, print it out, leave the computer to do the assignment, and then repeat the process to post their assignment. Having posted their assignment, they need to check the forum to see when the feedback is posted, and repeat the process to get the feedback. Thus students need to remember to go into the course site at least three times a week. Moreover, there are often announcements which relate to administrative aspects of the course which are often urgent messages, and students have no way of knowing that these have been posted unless they go to the course site daily.

In contrast, when the course is transmitted via e-mail, merely by opening their e-mail, which they do anyway, students receive assignments, announcements and feedback. They can post their answers in a combination of English and L1 within the same e-mail message, or send them as attachments in Word or any other word processor. Because there is no need to remember to check the site, students can be sure that they are up-to-date and have not missed anything. The simplicity of e-mail works in both directions: If the student has a problem, s/he can send a "help" message to the instructor by e-mail, and be assured of an immediate response. The price students need to pay, in terms of time on task (or, more precisely, time around task) and dealing with what is often an unwieldy system, is too high for a course that does not utilize the advantages of the course sites available at the OUI. To avoid falling into the trap that Gabi Salomon referred to as the "technological tail wiggling the educational dog,"[6] we decided (to continue with the dog metaphor) that in some cases, a mutt is better than a certified pure-bred, even if less elegant.

Technology in distance education is constantly improving and becoming more user friendly and flexible. There is a tendency to move on to ever-more impressive modern technologies, and constantly seek new options. But our objective is to teach, and we have to be careful not to lose the baby because of the bathwater. Sometimes the simplest, least sophisticated technology makes more sense than state-of-the-art.

Acknowledgements

Dr. Esther Klein-Wohl, Head of the English Unit at the Open University of Israel, introduced me to this mode of teaching, and forced me (kicking and screaming) to teach this course. In retrospect, I'm grateful to her. I am also indebted to the Research Authority of the Open University which enabled me to present this paper.

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[4] Interesting papers in this context are by Margaret Anderson ("An Internet-Based Asynchronous Distance Education Course") and Donna Ehrhart ("Interaction Through Electronic Mail") in the context of CIT '97, Learning with Technologies, May 27-30, 1997 (Brockport, SUNY) and Julie Sharp's paper, "E-teaching Simply with E-mail" presented at the 30th ASEE/IEEE Frontiers in Education conference, October 18-21, 2000 (Kansas City, MO).

[5] See, for example, Andrew Dillon (1992), Reading from Paper Versus Screens: A Critical Review of the Empirical Literature, *Ergonomics, 35* (10), 1297-1326 and *Designing usable electronic text: Ergonomic aspects of human information usage*, London: Taylor and Francis, 1994.

Museum Education in an Age of Wireless Communication

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Abstract: This paper describes the beginning designs for a museum education expansion project. Museums have not only been at the forefront of protecting artifacts, they have been educational initiators, encouraging humans to value and learn from artifacts through exhibits and educational programs. The objective of this project is to advance the meaning of museum education with innovative uses of communication technologies. Web-based artifact databases and handheld communication devices are introduced as promising vehicles for the collaborative construction of modern museums, existing beyond the walls of buildings that house artifacts.

Introduction

Museum educators, like many people, are eager to experiment with the latest technology. Soon after museums started having websites, 'virtual' exhibits began to appear. The virtual exhibit like its on-site counterpart allows a curator or web designer to interpret the contents of the museum to engage and educate the virtually visiting public. Also like their on-site counterparts, virtual exhibits reach their audience with mixed degrees of success.

Beverly Sheppard of the Institute for Museum and Library Services, describing the strengths of msueums, observes that communities and families trust museums as resources, that they act as stewards for collections and ideas, and that they "offer authentic, first-hand encounters with the objects and information they collect" (Sheppard, 2001). Trust, stewardship, and authenticity can be seen as central qualities of museums, qualities as important to the museum learner as the subject-specific knowledge presented by museums.

Unfortunately, web based exhibits have difficulty expressing these very qualities of museums. The difficulty of knowing what to trust on-line has been discussed since its popularization and though some well-known museums might be trusted web resources, smaller museums do not necessarily share in this trust. Web presentation of authenticity also becomes complicated because of the many problems of representing physical objects in a digital media. Clearly, interaction with an artifact in a museum is an "authentic" experience but the authenticity of interacting with a virtual artifact is more problematic. Similarly, despite some efforts to show stewardship on-line it is not clear how well these behind-the-scenes exhibits translate to an appreciation of the stewardship conducted in museums or the question of each individual's responsibility as stewards to objects in their own environment.[1]

The developing tools of wireless communication offer an opportunity to address these qualities of trustworthiness, stewardship, and authenticity. Instead of providing virtual access to distant objects, handheld computers and wireless networks can bring virtual museums' interpretive powers to the authentic objects as they exist in our surroundings. These technologies can be used to help visitors organize their existing knowledge and to deliver the expertise of the museum to learners studying in their own homes and communities. Mobile computing can also be used to facilitate truly interactive educational experiences in and out of the museum. Despite advocates' push for the use of constructivist techniques in museums, only a handful of authors have explored the connection of constructivist theory to museum use of technology.[2] While web exhibits and gallery kiosks provide interactivity separately from the artifacts, mobile technology offers an opportunity to integrate the advantages of instructional computing directly into the gallery visit or out-of-museum activity.

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[1] For example, see the "Conservation Time" section of "Tempus Fugit: Time Flies" << http://www.nelson-atkins.org/tempusfugit/default2.htm)) created for the Nelson-Atkins Museum of Art.

Goals

In this project we redefine the virtual exhibition as an interactive experience of visitors with real objects using mobile communications technology to deliver, organize, and record jointly constructed knowledge (Hewitt & Scardamalia, 1996). Wireless communications through their flexibility and portability offer the opportunity to make the authentic interaction with artifacts part of a complex situated learning experience (Brown, Collins, & Duguid, 1989). We will unite concepts from museum education and educational technology with the strengths of museums to improve learning in exhibitions.

Program Design

Development of the project will involve a test school and museum working within a single exhibition.[3] The design will include two different sections. First, a database driven website developed in coordination with the museum will facilitate collection and organization of content including text, images, and other media Students planning a visit to the museum will use the site as a locus for self-directed study where they will gather information provided by the museum, linked web resources, and off-line resources based on their own research agenda.

The second module delivers information gathered by the students to a handheld computer, allowing access to their existing research. Transmitters within the museum would feed the computers location appropriate information as the visitor traverses the exhibit. Additional tools, such as a digital camera to allow students to photograph details of artifacts or a color wheel to record student observations about color and form, will make the handheld into a data-gathering device. Information gathered during the exhibit would be uploaded to the central database to be made available once the student returns to school for collaborative projects.

Future Directions

The structure of the project will easily adapt to use in any exhibition or subject area. Further development will be necessary to extend the project for home use. Development of the communications aspect of the project is central to the project's vision of fostering shared meaning development between visitors and institutions.

Ultimately, the project will create a series of tools that can be made available to any institution interested in using mobile connectivity interactively within a museum. The tools developed in this project would help museums to teach their core functionality. These qualities of museums: reliable (trustworthy) research, stewardship over cultural and natural objects, authenticity of experience describe a manner of considering the world. Traditionally museums hope to teach us to look more carefully at objects, think more deeply about meaning, and approach our surroundings with a sense of wonder. By helping us put these ideas into practice, mobile communication technology helps us to appreciate more fully not only the artifacts in museums but also the objects in our lives.

References

Bell, B., & Zirkel-Rubin, J. (2001). Goal Directed Inquiry via Exhibit Design: Engaging With History Through the Lens of Baseball. *Journal of Interactive Learning Research*, 12(1), 3-39.

Brown, J., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning *Educational Researcher*, 19, 32-41.

Hewitt, J., & Scardamalia, M. (1996). Design Principles for the Support of Distributed Processes. Proceedings of the American Educational Research Association Annual Meeting. New York, NY.

Sheppard, B. (2001). *The 21st Century Learner*. The Institute for Museum and Library Services. Washington, DC.

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[2] A notable examples of the roughly dozen references found is Bell & Zirkel-Rubin, 2001.

[3] Michael Haley Goldman, currently at the US Holocaust Memorial Museum, will seek a museum partner for the project while Danielle Kaplan, of the Teachers College Communications, Computing, and Technology faculty secures a school partnership.

RECOGNIZING AND CLOSING NEW TECHNOLOGICAL DIVISIONS: A CASE STUDY

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The Problem

The playing field in our nation's public schools is not level and East Carolina University and Newport Elementary are changing that by launching a collaborative project to ensure that students in one second grade class have the technology needed, at home and at school, to master expected North Carolina Standard Course of Study content. The main research question is: how strong is the correlation between achievement gaps and technology gaps in a second grade class in Newport, North Carolina?

The literature is replete with information about the "digital divide." Government reports have measured this divide for the past half-decade. But, by using a conservative definition, it reports a technological "stabilization."

The Study

Researchers are measuring ameliorative factors designed to even the technological playing field in the classroom and the home. Each student has been given a Hewlett-Packard Jornada Pocket PC, equipped with electronic reader, software for word processing, spreadsheet application, email, Internet access capability, a calculator and scheduling/tasking packages for homework, classwork, and communication with parents.

Each is being quantitatively tested for knowledge of the technology and content related to the North Carolina Standard Course of Study. Data has been gathered and is presently being analyzed. Preliminary results are available and are presented in the next section.

Preliminary Results

Preliminary results indicate a tendency for handheld technology and the appropriate software to improve the performance of "at risk" students, especially in the areas of reading, writing, and the practical use of technology.

The digital divide is muted by the use of technology that students can take home with them and parents are generally supportive of the initiative.

Future Studies

Quantitative studies are needed to measure more specifically the impact of technology on students and the digital divide. Studies focusing on subjects such as reading or writing only might shed more light on what works and what doesn't.

Case studies with a larger N, e.g., an entire district, different grade levels, etc. would bolster the literature.

Evaluating Online Instruction: Adapting a Training Model to E-Learning in Higher Education

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Abstract: In this paper, we present our model for the evaluation of postsecondary online distance education courses and programs. To better address the unique nature and audience for these courses and programs, and the related institutional needs for assessing their success or failure, we focus on a model from corporate training that provides a comprehensive, multi-level evaluation of a distance course or program. This model is based on Kirkpatrick's (1975) levels of evaluation. We provide a general description of how this model can be implemented via online means to provide the assessment information required by postsecondary institutions.

Background

Over the past decade, online instruction has been become a popular delivery option in many institutions of higher education (Green, 1997). One criticism leveled against conventional "student evaluations of teaching" suggests that when used alone, these provide limited information about student comfort without addressing significant factors such as student learning and ability to transfer that learning to real-world situations (Trout, 2000). Moreover, many evaluation systems for online learning emphasize usability and reliability of the technology over the value of the instruction to the students (Anglin & Morrison, 2000). Finally, the unique nature of E-learning suggests that traditional course and program evaluation may be particularly deficient in providing necessary data that can help drive further development and support of effective online instruction (Clark, 2000).

The needs driving the evaluation of E-learning in postsecondary education coincide with the classical reasons for evaluating any type of learning experience as well as expand on them. As with any evaluation of conventional instruction, instructors, administrators and other stakeholders in online learning want to know the value of their course and program offerings in terms of student satisfaction and student learning. This includes:

- Student satisfaction with the learning process (interactions with course/program materials, instructor and other students)
- Appropriate level, pace, depth and breadth of instruction
- Accomplishment of intended instructional objectives
- Areas in need of further instructional and pedagogical development

Although most university evaluation systems do not address transferability of learning to any significant degree, since students taking distance education courses are often out in the workplace, and facing real-world demands from clients and supervisors, it is especially important that E-learning assessment activities address whether the learning that takes place is useful to the students. Information collected about this process might include whether:

- The content of the learning provides a basis of knowledge that can be built upon in later instructional situations
- The learning can be transferred to enhance performance in real-world settings

In addition to these basic assessment needs for instructors, other stakeholders in the online learning process (administrators, technical support, designers, etc.) also hope to measure these facts about the technologies used:

- Performance of technologies used
- Usability of the technologies
- Reliability of the technologies
- Compatibility of the technologies with each other and existing student technologies

Because E-learning is generally a new and unproven method of instructional delivery that faces bias against its efficacy, cost efficiency, and quality from those in traditional academia (Ashworth, 1996; Cordes, 1998), it faces additional institutional demands for accountability, such as:

- The costs and benefits of installing and maintaining the technology infrastructure required for distance education.
- Concerns about the effect of distance education efforts to the institutional reputation
- The need to collect data to assist in future institutional decision-making

The Significance of Kirkpatrick's Model to Online Instruction

In general, a rigorous online evaluation system should measure the success of the content, process, and delivery of online instruction in terms of the individual student, the program and/or institution, and/or the field in general. It should also be able to address the efficacy of its chosen pedagogy and technology. This paper seeks to adapt a model for the evaluation of E-learning from the field of training and development that takes into account a number of different aspects of the online learning process. This four-level model of evaluation, developed by Don Kirkpatrick (1975) is currently utilized by 67% of businesses that evaluate their training (ASTD, 1997). However, while there have been a few efforts to apply Kirkpatrick's levels to evaluate distance education in a higher education setting (Essex & Cagiltay, 2001; Hack & Tarouco, 2000), this practice is still far from commonplace.

Once adapted to higher education needs and perspectives, Kirkpatrick's evaluation model can be used to address the many layers of questions that exist about E-learning. Specifically, Kirkpatrick's model consists of 4 levels, each one more extensive in its purview of instructional effectiveness than the one preceding it and each stage relying on achievements gained in the one preceding it for success. Therefore, it is a cumulative model that can be used to provide in-depth information about the value of an online course or program. Within each of the four levels described below, a systematic method of evaluation is integrated into the process that specifies the goals, objectives, criteria, and methods of assessment.

The Proposed Evaluation Model

Level 1: Student Satisfaction

Identify Goals

As the course was being developed, instructors and developers should have identified the goals associated with attaining student satisfaction with the course or program in terms of both instructional design and the delivery technology. These goals are fairly generalized, such as making sure the course is attractive and accessible to students, and that students feel comfortable and competent with the course requirements. Ideally, this is done as part

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of the initial course design process, but if these goals were not previously explicitly identified, the evaluation team will need to work with the course designers to extract them before the evaluation process begins.

Identify Objectives

Objectives need to be based on the overall goals of the course, which are transformed into objectives through specific and concrete definition. The developers of an online course evaluation should measure student satisfaction based on the objectives regarding the instructional materials, the instructional strategies, and the types of interactions provided by the course. In terms of delivery technology, evaluation measures should look at specific objectives in terms of the ability of the hardware, software, and networking to meet student expectations and needs. Again, if these objectives were not previously explicitly identified, the evaluation team will need to work with the course designers to extract them before the evaluation process begins.

Develop Performance Criteria

In the design phase, developers and instructors of online courses need to determine appropriate criteria for measuring the success (student satisfaction) of the instruction, and these criteria need to be based on the course goals and objectives previously decided upon. Furthermore, Clark (2000) points out that it is important to separate instructional technology from delivery technology when evaluating online courses. Some examples of performance criteria for instructional technology are: whether the course met student goals; if the level of instruction was appropriate to the student audience; if the pace was appropriate; if the course covered an appropriate range and depth of content; and if the student-student and student-instructor interactions in the course were considered to be helpful by students to the learning process. Criteria for delivery technology might include whether it was compatible with student equipment and existing institutional systems, and its reliability, usability, and speed.

Specify Data Collection Method

Evaluation at Kirkpatrick Level 1 can be done on either a summative (end-of-term) or formative (midterm) basis, or both The most common method of collecting Level 1 data is through a survey instrument, usually administered as a summative student course evaluation that asks student opinions on whether the course fulfilled their objectives. Document analysis is also a popular method of evaluation with online courses, since the unique nature of an E-course is that a record of all discussions, assignments and group work is maintained. Other statistics, such aswhen, how often, and how long students access various aspects of the course, are also available in server log documents. There are also options to collect formative data that can be used during the course of the instruction to guide changes in course delivery and design. Focus groups provide students a forum in which to build on each other's impressions of the course, and these can be implemented in secure online forums, where students can provide open and honest feedback that is later summarized anonymously for the instructor.. Individual student interviews, while more time-consuming, can allow for deeper exploration of student attitudes and experiences with the course. Observations of the course by a faculty colleague or instructional consultant (attained by allowing them access to the course discussion forums and other documents and communication) can also reveal much about student engagement, levels of interaction, and general conduct of the course.

Level 2: Student Learning

Identify Goals of the Instructional Effort

Cross & Angelo (1993) identify five basic areas of higher education from which instructional goals are drawn. They are: higher order thinking skills (problem solving, analysis, synthesis);basic success skills (reading, writing, listening, speaking); field dependent knowledge and skills (methods, materials, tools); academic perspectives and values (objectivity, rigor, collaboration);and personal development attitudes and skills (responsibility, leadership, commitment). Theoretically, the student learning goals for an online course do not differ from those of a traditional course. However, competency with the technology itself always, whether implicitly or explicitly, comprises part of the online instructional process and the basic requirements for success in an online course.

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Identify Objectives of the Instructional Effort

Some objectives related to higher order thinking skills might be: identifying the important elements of a problem; understanding the relationship between the elements; and determining what changes in which elements need to be made to solve a problem. Basic success skills objectives might include: understanding what is important and what is secondary in written information; articulating ideas in written format; listening to others' opinions and ideas; and articulating ideas in verbal interactions and presentations. Objectives relating to field-dependent knowledge may encompass: understanding which methods are appropriate and their uses in the field; identifying appropriate materials and their characteristics; and selecting the best tools for the task(s) and knowing how to utilize them. Objectives developed under academic perspectives and values might be: learning how to approach intellectual problems with objectivity; understanding the thoroughness required for rigor; describing and defining practices that lead to teamwork and accomplishing collaborative goals. Personal development attitudes and skills objectives might include: responsibility to one's work within the discipline; leadership in the field; and commitment to one's own values.

Develop Performance Criteria

Defining performance criteria for assessing student learning is normally part of any instructional module or course, and leads the evaluation of student learning. Specifically, criteria generally fall into two categories of student performance (demonstrating learning): those that pertain to understanding of content; and those that pertain to the mastery of a process.

Specify or Review Existing Assessment Methods

Except for evaluation of the student's mastery of technology, this level of evaluation may borrow heavily from established course materials and evaluation instruments; e.g., examinations, written assignments, projects, and portfolios. These evaluations for the E-course can then be analyzed in exactly the same way as they are in traditional, on-campus courses, such as providing average student scores and grade percentages for individual assignments to grade point averages for the course. Student mastery with the technology can be tested directly, such as by giving them technology-related tasks to perform, or inferred by their success with the assignments in general. If grades are not an issue, mastery learning techniques will provide instructors with the number of modules or instruments completed at a given proficiency level (which should ideally be at or near 100%).

Level 3: Transfer of Learning

Identify Goals of Transfer Learning

The goals of Level 3 evaluation are twofold. First of all, learning in an academic setting is often considered to be sequential and progressive. That is, basic knowledge and understanding must be acquired before students may "advance" to higher order thinking and problem solving. This is the philosophy behind offering some courses in sequence, and requiring that the preceding course be successfully completed before moving on to the next level. Secondly, the goal of much higher education is that student learning will be transferred to real-life situations/problems (such as internships, student teaching, service learning projects, professional tasks, etc.). Whether E-learning focuses on the professional development needs of those already in the field, or are a part of university programs in professional education, successful transfer of learning is usually the ultimate goal of the educational process. Thus, they often encompass the goals of both pre-service professional training and the further development of professionals in the field. Transfer of learning, though, is often difficult to evaluate, since it must be evaluated after the learning process takes place, and in a setting other than the real or virtual classroom. Universities are not accustomed to tracking student learning post instruction, except for programs with comprehensive or qualifying exams or summative portfolios. However, since transfer of learning is so important, any rigorous assessment program must include this aspect in its design.

Identify objectives

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The objectives of transfer learning are diverse and depend heavily on the field of study, but in general the objectives will address students' ability to access specific skills and relevant knowledge post instruction, and their knowledge about when and how to use these skills and relevant knowledge for real-world problems and tasks.

Develop Performance Criteria

Specific performance criteria for transfer learning will depend heavily upon the field of study and/or the professional field involved, and the level at which the students work in that field. Professional fields often determine the criteria that their members must meet through granting licenses and certification. Academic fields typically measure performance through instruction, research and publication. Subprofessional performance criteria in both of these fields often approximate professional tasks, but at a lower level of mastery.

Specify Methods to Evaluate Transfer Learning

In both academic and professional settings, the transferability of learning can be assessed using simulated, authentic scenarios or case studies in which the students' problem-solving skills are put to test. In order to approach real-life situations, cases must be complex, ill-defined (Savery & Duffy, 1996) and require the use of higher-order thinking skills on the part of the students. To further authenticate the process, when the task would, in the real-world, be a collaborative effort, students can be required to work in teams so that the skills of communication, negotiation, and compromise are also implicated in the solution. In these scenarios or cases, roles can either be initially defined for the students or can evolve naturally from the process. Another option for assessing transfer learning, if the students are employed or interning in a real-world professional/academic environment, is that the students may be observed in real-life situations by supervisors, by colleagues, and by clients (students). Another option would involve the students submitting a video or audiotape of a job-related performance for evaluation.

Level 4: Return on Investment or Business/Academic Impact

Identify Goals

Whereas in a corporate training program the return on investment (ROI) of any online training effort is measured in terms of whether or not the cost of the training is more or less than the additional profit gained through performance improvement based on the training, academic programs define success in different ways. While the financial aspect still exists for the academic world, because most students hope to be in a better financial position after a course of study than before, there may be other indicators of success for students that they count into their calculations of ROI, such as increased job satisfaction, lower stress, etc. In any case, deciding whether a course "was worth it," is often a very personal kind of ROI calculation, and difficult to quantify. Looking at ROI from an institutional perspective, colleges and universities often look to intermediary indices, only some of which indirectly refer to the financial health of the organization. Specifically, academic institutions and programs often use academic reputation, program rankings, and accreditation status as indicators of success. Although the reputation is somewhat ephemeral, high program ranking established by a reputable organization and accreditation through appropriate organizations are attributes that institutions of higher education that offer E-learning are not willing to sacrifice. Other indicators of program success are the success of graduates of online programs as well as increasing popularity with the E-learning program for students.

Identify Objectives

Calculating objectives related to ROI from an individual student perspective can be, as stated above, a very personal process, involving an estimation of how much the learning from a given course or program improves the life of the learner in terms of fulfilling monetary, career and personal goals. From the institutional perspective, objectives relating to academic or program reputation may also be difficult to decide upon, since much of reputation is established through word-of-mouth and on other informal bases. School and/or program rankings, however, generally occur at predictable intervals through identifiable evaluative agencies. Therefore, objectives can be set which relate to these specific evaluative events. In addition, objectives can be set related to a positive change in the type and level of positions attained by graduates of the program or institution, and/or positive changes in institution/program enrollment rates.

Develop Criteria for Positive Changes

Again, students will determine their own individual criteria for assessing the ROI relative to a given course or program of study. The threshold for which the student decides that the course or program was "worth it" may be difficult to quantify, but most students will have an implicit sense of it. From the institutional perspective, given the imprecise nature of measuring a concept such as institutional reputation, criteria for assessing an institution's or program's reputation may merely focus on the documentation of a stakeholder's opinions regarding positive changes. Positions attained by graduates of a program can be evaluated along the lines of perceived status, entry salaries, and/or numbers hired within a certain period of time. Rankings and enrollment rates, however, can reveal quantitative changes, in which positive changes can be tracked and documented. Care must be taken to ensure that perceived positive change is not the result of other, external factors such as changes in the nature of the field, changes in professional demands, changes in the availability of resources, or changes in other policies or regulations.

Develop Evaluation Methods

Evaluating student assessment of ROI may simply consist of asking them, in a survey or interview format, whether they regard the benefits of the course of study to have been greater than the associated costs. Since the objectives of each student and the criteria for measuring these objectives are likely to be so idiosyncratic, it would be difficult or perhaps impossible to get at a more objective assessment. From the institutional side, evaluation methods for determining the impact of an online program on an institution or program can be accomplished through: inspection of published ratings/rankings; the hiring rates of graduates; the level of positions obtained by the graduates; the accreditation and licensing status of graduates; the accreditation status of the program, and enrollment rates. These measures all provide data that can be used to indicate program success. Data may also be collected on the status of graduates through surveys, interviews, and focus groups with them.

Conclusion

The major advantage of the Kirkpatrick model of evaluation is that it fosters a thorough assessment of the instructional process by viewing the process systematically, through four different lenses. Most college and university efforts to evaluate E-learning are not done systematically and fall short of their goals, either by emphasizing student satisfaction for the process over the actual learning achievements or lack thereof, by concentrating on positive or negative aspects of the technology while overlooking the learning process altogether, and/or by ignoring whether or not the learning will transfer to the real world environments that the learner will face. The Kirkpatrick model can also be used to integrate evaluation on the local scale with a more systematic and administrative look at institutional and programmatic influences. This new evaluation method helps put into perspective data that can inform future university decisions about their technology infrastructure, the professional development of faculty involved in online learning, and the prospective role of E-learning in university programs.

References

American Society for Training and Development (1997). *National HRD executive survey*. Retrieved August 14, 2001 from American Society for Training and Development Web site: http://www.astd.org/virtual_community/research/nhrd_executive_survey_97me.htm

Anglin, G. J. & Morrison, G. R. (2000). An analysis of distance education research: Implications for the instructional technologist. *Quarterly Review of Distance Education, 1* (3), 189-94.

Ashworth, K. H. (1996, September 6). Virtual universities could produce only virtual learning. *The Chronicle of Higher Education*, p. A56.

Clark, R. E. (2000). Evaluating distance education: Strategies and cautions. *The Quarterly Review of Distance Education, 1* (1), 3-16.

Cordes, C. (1998, January 16). As educators rush to embrace technology, a coterie of skeptics seeks to be heard. *The Chronicle of Higher Education*, p. A25.

Cross, P., Angelo, T. A. & Cross, P.K. (1993). *Classroom assessment techniques* (2nd ed.). San Francisco: Jossey-Bass.

Essex, C. & Cagiltay, K. (2001). Evaluating distance education: Feedback from 'distressed' students. *Quarterly Review of Distance Education, 2* (3), 233-239.

Green, K. C. (1997). *1997 campus computing survey*. Claremont, CA: Campus Computing Project.

Kirkpatrick, D. (1975). *Evaluating training programs*. Madison, WI: American Society for Training and Development.

Savery, J. R. & Duffy, T. M. (1996). Problem based learning: An instructional model and its constructivist framework. In B. G. Wilson (Ed.), *Constructivist learning environments.* Hillsdale, NJ: Educational Technology Publications.

Hack, L. & Tarouco, L. (2001). *New tools for assessment in distance education.* Retrieved August 21, 2001 from the Universidade Federal do Rio Grande Do Sul Website: http://www.pgie.ufrgs.br/webfolioead/artigo1.html

Trout, P. (2000, July-August). Flunking the test: The dismal record of student evaluations. *Academe*, 58-61.

sTeam- Providing Primary Media Functions for Web-Based Computer-Supported Cooperative Learning

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Abstract:
The WWW has developed as the de facto standard for computer based learning. However, as a server-centered approach it confines readers and learners to passive non-sequential reading. Authoring and web-publishing systems aim at supporting the authors' design process. Consequently, learners' activities are confined to selecting and reading (downloading documents) with almost no possibilities to structure and arrange their learning spaces nor do that in a cooperative manner.

This paper presents a learner-centered – completely web-based – approach through virtual knowledge rooms. Based on this concept, the goal of the presented work is firstly to develop a theoretical framework to explain the design potentials of technology-supported learning processes (distinguishing individual and cooperative primary media functions). Secondly, a technical framework (cf. `www.open-steam.org`) should be developed allowing us to study different technical configurations within the traditional university setting. Considering the systems design the concept of virtual knowledge rooms is to combine event-based technology of virtual worlds with the classical document management functions in a client-server framework. Knowledge rooms and learning materials such as documents or multimedia elements are represented as a fully object oriented model of objects, attributes and access rights. We do not focus on interactive systems managing individual access rights to knowledge bases, but rather on cooperative management and structuring of distributed knowledge bases.

Introduction

Discussions about the role of technology in teaching and learning center on two basic paradigms. Firstly on hypermedia systems that aim to support individual learning processes, here special emphasis is being placed on new didactic qualities, attributed to the interactive combination of different media types such as text, graphics, audio, video, etc. The second paradigm embodies the notion of "delivering education" that is networking technology being used to distribute and access study materials as well as to establish communication channels between students and teachers. Although the idea of utilizing net services has strong collaborative connotations, the main argument in favor of networking is the temporal and spatial independence it offers and, consequently, the independence from close collaboration with others.

Now, students can learn individually at their own pace and at a location chosen by themselves.

However, many studies evaluating the role of technology in learning processes have yielded conflicting results, indicating that there is no general, clear-cut connection between the effort required to produce high-quality multimedia educational materials and improvements in the learning process. The problem is to attribute certain benefits to a single variable – say, the specific technology used. Mostly, the results are a combination of different variables such as didactic style, educational strategy, technology deployment, appropriate selection of content and the personal qualities of teachers and students. (see [Hesse 1997] and [Keil-Slawik et al. 1996]). Thus, the widely accepted idea that learning can be improved by the individualization of learning processes using hypermedia and networking technology is not generally borne by scientific research.

Instead of using technology to individualize learning processes, we have chosen the opposite approach – namely, using technology to support cooperative learning processes within the framework of traditional university education. Rather than trying to do away with the need for physical presence in the learning situation, we seek to support social processes in which students and teachers meet for a specific time at different places. Apart from practical considerations, theoretical research reveals that, ultimately, the social embedding of learning is a crucial factor for success.

Furthermore, our approach is based on the general assumption that technology can only solve technological problems, didactic problems requiring didactic solutions. Hence, teaching activities cannot be replaced by technological functions, and the embedding of technology into teaching and learning activities must be studied carefully.

Media Functions

Media are generally viewed in terms of communication, based in most cases on the classical transmitter/ receiver or producer/ consumer model. The integration of different media types such as text, image and sound (multimedia) in combination with the fusion of transmission channels and services (Internet), make it necessary to extend our concept of media. Media are no longer simply means of communication; they are – and have always been – both means of expression/ cognition and means of organization. Without media our cultural achievements are inconceivable. Complex social processes based on the division of labor are just as reliant on media as they are on science and education. Media, for their part, require technology to create an objective, mostly symbolic world. To determine the potential and possibilities offered by new media, we must first remind ourselves of what constitutes, in technical terms, the benefits they provide.

Keil-Slawik and Selke at first distinguish three classes of media functions, called primary, secondary and tertiary media functions. They closely examine the relevance of technology in human learning processes. Primary media functions describe fundamental functions to place artifacts in the perceptual space of a person (a group of persons). Secondary media functions extend them taking the learning process itself into account, thus they refer to applicable didactic models. Tertiary media functions consider methods of self-adapting and artificial intelligence, that means, now the medium itself is subject matter (see [Keil-Slawik & Selke 1998] and [Hampel 2001]).

The next important step is to differentiate between primary *individual* media functions and primary *cooperative* media functions. Concerning the primary cooperative media functions the primary individual media functions such as Creating, Deleting, Arranging and Linking are seen in the context of the cooperative learning process. Consequently, the primary cooperative media functions are realized through the options of Transmitting, Accessing and Synchronizing. To sum up, we distinguish four primary individual media functions and three primary cooperative media functions as follows:

Primary individual media functions:

- *Creating, Deleting* - Media serve to create or delete a perceptual space. Concerning the first allowing conception and reality to be correlated by action and the relevant conclusions to be drawn. Scientific instruments, experimental apparatus, models and simulation programs are just as much instances of artifacts that perform this function as are symbolic descriptions, diagrams, images, formalisms and visualizations of large data sets.
- *Arranging* - To attain new insights it is necessary to correlate different documents. Problem solving and learning invariably involve identifying differences and concurrence, combining different types of descriptions

and representations or weighing statements from different sources against one another. To support these processes, the artifacts to be correlated must be brought into the field of perception, simultaneously if possible. Here, logical connections should be represented, if possible, by spatial connections as well, to enable them to be swiftly identified and processed.

- *Linking* - Arrangements embodying an important connection should be preserved after the act of arranging. In this way, they do not need to be regenerated at a later point in order to continue working with them. Suitable links, for example, enable users – ideally in a single step – to refer to all documents that are of relevance for the respective meaning context.

Primary cooperative media functions

- *Transfer* - The transfer of media between learners. Cultural learning achievements are social processes. Reducing learning to the individual processing of a document, e.g., means failing to realize that the same document has already been used, assessed and passed on in a specific social teaching/learning situation. The primary cooperative media function "Transfer" is meant to describe the exchange of media between two persons or between one person and an object, which arranges an exchange to a person.
- *Accessing* - Giving access rights to shared material, cooperative use of individual primary media functions: With the media function "Transfer" we explicitly address one person, whereas the media function of Accessing describes the access as a process which is not influenced by others, such as the creator. An illustrative example provides the filing of a document in a virtual room. Depending on the access rights to the concerning document it is possible to access it by "reading" and "writing". Another example is the use of a Shared Whiteboard, which offers the possibility to access materials of another person or to access materials from different learning places.
- *Synchronizing* - Conveying shared views on shared objects, coupling, awareness: We can identify the media function of Synchronizing in physical acts of updating presentations. On the one hand these acts are about creating shared views on documents and the report about changes in these documents and on the other hand the awareness of cooperation partners. Primary individual media functions in a cooperative structure require shared views of the partners on their materials.

The rationalization potential of new media lies in the implementation and integration of these primary media functions, concerning the more effective handling of the physical artifacts in terms of the mentioned basic areas of functionality. Here, the new media offer a wealth of new forms for the effective generating, transferring, giving access to, arranging and linking semiotic artifacts, ranging from the integration of different types of media to net-based services and search facilities.

To this extent, learning-supportive infrastructures, like the sTeam-system make use of all materials at any location where learning takes place.

Architecture

The developed basic architecture combines two different approaches. On the one hand the development of document based CSCW/ CSCL-Systems (mostly office motivated) and on the other hand the event-based architecture of MUDs and MOOs. As a result we have a flexible structure of cooperative virtual knowledge spaces which is strongly related to the WWW, but furthermore develops new methods of managing documents and other materials.

Interactions among users and between users and documents are realized as interactions between cooperating shared objects. Shared objects are persistent and are oriented towards a room structure (room metaphor). Access rights control the instance of new objects and the interaction between objects. These interactions may take place between objects in client and server.

The complex design of the basic architecture originates in the need for a scalable and easy to maintain architecture which can easily be suited to exiting and future standards. Design patterns describe recurring patterns in an object-orientated software engineering.

The designed basic architecture is subdivided in a sTeam-server, an external Web Server, a relational database and several clients.

The sTeam-server coordinates the administration of users and groups, provides for the room-structure with its containing objects, organizes the communication between users and realizes the synchronization of the presented contents between the different clients. The Roxen Web Server is used as a gateway to access different Web browsers of sTeam. The relational database guarantees the persistence of the various objects (see [Hampel & Keil-Slawik 2001]).

Core server

The sTeam-core server provides for the necessary mechanisms which guarantee the reciprocal perception and the cooperative use of knowledge structures. As runtime environment, the open source LPC interpreter Pike is employed. Aside from a good performance Pike is equipped with a wide code base and a great number of existing libraries. The native Pike libraries are supplemented by a connection to different open source libraries which are implemented in the programming language C for performance reasons.

The concept of cooperative knowledge spaces demands a special administration of objects, users and different events. Thus the chosen architecture follows an entirely object-oriented design. Objects own different attributes and sometimes in the case of document types a content. Interactions between objects are guaranteed by remote method calls or events. The runtime environment is composed of further modules for the implementation of various protocols. NNTP, POP3, IRC, LDAP and COAL are directly supported. By applying NNTP the annotations of documents are presented as news. POP3 is employed to integrate news that are transmitted within the sTeam platform into the usual working environment. The chat channels connected to rooms are released by the IRC protocol. Finally LDAP permits the access to the user administration within the learning environment of the institution where the system is employed. This way within a certain university students could get access to the cooperative learning environment by using their general identification and password. The communication between server and clients is guaranteed by the implementation of a specific communication layer, the Client Object Access Layer CAOL. Currently COAL-API is implemented for the programming languages Java, C++ and Pike. The COAL-/Java-API allows the login/logout of a client and the subscription and the reception of events from the server, furthermore method calls and the transfer (up-, down-load) of objects. The object structure of the server is reproduced in an analogue way on the client side. For each server object type a corresponding class exists in the COAL/Java-API. Instances of these classes correspond to real objects on the server but they do not contain data and contents of the object. A replication of objects does only reveal a part of the viewed or needed objects. Thus through the generated proxy-objects server objects may be accessed by direct method calls (e.g. in the case of attribute changes).

For different reasons the Web server is separated from the core architecture. We employ the open source Roxen Web server (cf.www.roxen.com). In this way protocols which are implemented within Roxen (e.g. the HTTP-protocol coded by the Secure Socket Layer (SSL) can be immediately used. Beside of the very robust implementation of the HTTP and the FTP protocols the gain in security seems to be an important aspect for the acceptance of the system. The database responds to the generic SQL interface of the programming language Pike. At the present time the free database MySQL is accessed. Through an abstraction layer, referring to papers from Ambler about the mapping of object structures on relational databases, (see [Ambler 2000]), the entire object administration is separated from the database logic. Thus the independence from the really employed database technology is guaranteed.

Evaluation

Designing technology only based on hypothesis calls for empirical confirmation in order to have evidence of the usability of the own results. Therefore we carried out the lecture "Grundlagen der Informatik für Lehrämter" ("Basics of computer science for prospective teachers"). Our evaluation concentrates on the use of virtual knowledge spaces as a structuring and learning platform for cooperative knowledge management. As such it provides the students with diverse possibilities to work in cooperation with others as well as to work for themselves. Technically, we speak of a collection of documents directly assigned to a synchronous communication channel. It is possible for the students to attach comments to all of the documents. The used configuration allows the students to insert documents, to annotate, to copy and to create new links. Furthermore they could create new rooms and link already existing rooms with new exits. The setting for the mentioned lecture is characterized by three groups of virtual rooms. These are private areas of the students, assigned areas for the different learning groups and one central area containing all of the course materials.

The main goal of this setting was to prompt the students to search for additional material, which could be presented to the other students. Comments and annotations, which are connected to the documents should help the students discuss the content of the course with each other and with the lecturer throughout the semester. Thus, the contents of the lecture can be structured in an according way and new insights may be drawn from the different personal styles of structuring information.

Based on observations during the first weeks the students rather annotated any material, thus a new area called "Speakers Corner" was created. The goal was to focus on the possibilities for discussions in only one special area. Furthermore two students were asked weekly to select five slides of a presentation which in their opinion represented main aspects of the lecture. To discuss these slides, the students should as well annotate why they had especially selected the chosen ones. Now all the other students were asked to comment on the selection, to present further arguments or to show other possibilities.

Solutions to the weekly exercises were given as annotations to the respective documents if possible. If the answers were more extensive, another way was to create new documents or even new rooms. It was very interesting to see that the students agreed on publishing their results. Thus it was easier to discuss the results and refer to other solutions. As a first surprising outcome of this experiment, it was observed that the possibilities to structure the learning environment newly were not used as much as we thought it would. Such a lack in the use of provided technical possibilities can be traced back to several aspects, which in the following have to be examined more closely.

One possible hypothesis is that the method of creating new exits, etc. is too complicated (thesis I). Another explanation might be that the students realize only slowly, which new competencies they have while working with the system (thesis II). We have to examine how far this problem is a principal one, that means, how far hierarchical structures are internalized so that the students do not deviate from them (thesis III). One point to confirm the correctness of thesis I is the observation, that students only used annotations where they were forced to do so.

To sum up, the six month practical use may be assessed positively. The concept of cooperative virtual knowledge spaces has mastered its first practical application period.

Conclusions

Virtual knowledge spaces are a new approach towards the extension of traditional hypertext systems in their way of structuring documents with event-based cooperative approaches. At the same time, cooperative knowledge spaces create new design conflicts which have to be handled in a systematical and well-founded way to gain from their inherent creative potential. The main goal of our research is to acquire the necessary knowledge and to develop a theoretical foundation. Therefore we need a basic architecture, which allows us to realize a variety of virtual knowledge spaces with a small amount of time and energy. During the last years we have succeeded in developing such architecture. Another important prerequisite are theoretical concepts which allow us to distinguish between technical and non-technical aspects and furthermore to examine the correlation between them.

To experience the potentials of virtual knowledge spaces the system has been practically tested in a traditional learning situation.

References

[Ambler 2000] Ambler, S.W.: The Design of a Robust Persistence Layer For Relational Databases. AmbySoft Inc. White Paper, November 28, 2000. see: http://www.ambysoft.com/onlineWritings.html

[Hampel 2001] Hampel, T.: *Virtuelle Wissensräume, ein Ansatz für die kooperative Wissensorganisation*, PHD-thesis, department of Computer Science, University of Paderborn, Germany, December 2001.

[Hampel & Keil-Slawik 2001] Hampel, T., Keil-Slawik, R.: sTeam – Designing an Integrative Infrastructure for Web-Based Computer Supported Cooperative Learning. In: *Proceedings of the 10th International World Wide Web Conference*, May 1-5, 2001, Hong Kong, 76–85.

[Hesse 1997] Hesse, F.W. Konzeption und Realisierung virtueller Wissensvermittlung. In: Hamm, I. and Müller-Böling, D. (eds), *Hochschulentwicklung durch neue Medien*, Gütersloh, 1997.

[Keil-Slawik et al. 1996] Keil-Slawik, R., Klemme M. and Selke H. *Information and Communication Technologies in Education and Training (Part A)*. STOA Programme, European Parliament, Directorate General for Research, PE: 165.710., Luxembourg, 1996.

[Keil-Slawik & Selke 1998] Keil-Slawik, R., Selke, H.: Forschungsstand und Forschungsperspektiven zum virtuellen Lernen von Erwachsenen. In: Arbeitsgemeinschaft Qualifikations-Entwicklungs-Management Berlin (Hrsg.): *Kompetenzentwicklung '98 – Forschungsstand und Forschungsperspektiven*. Münster: Waxmann 1998, 165–208.

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Using Scripting to Increase the Impact of Highly Interactive Learning Objects

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Abstract: This brief contribution describes how to employ a scripting interface for proper embedding of highly interactive learning objects (Java Applets) into Web-based courseware. We start with a short overview of our current toolkit of reusable software components that allow the development of a greater pool of virtual experiments. We illustrate how we overcome their isolation by scripting from other learning objects, e.g. from course text, illustrations, or exercises. Further we discuss how to build up a community that may create and modify scripts online by using online wizards. As proof-of-concept we demonstrate applications in the field of Scientific Visualization[1].

Introduction

Process-oriented learning environments enforce active self-learning and therefore include constructive concepts that are embodied as interactive learning objects. Today, Java applets allow for intuitive, bi-directional interaction together with high-level visualization that may be seamlessly embedded into a Web-based courseware. In 1998 we demonstrated how to reduce the immense costs that affords the development of a large pool of virtual experiments by creating a toolkit of reusable software components (Klein & Hanisch 1998). Since then, many other projects focused on developing component repositories for learning objects (Laleuf & Spalter 2001).

Unfortunately, actual profit of resulting courseware is reduced by poorly implemented interlinking of learning objects. In particular, interactive learning objects appear isolated: they neither can be modified sufficiently (e.g. by choosing parameters or enhancing functionality) nor be interlinked properly with their context (e.g. by synchronizing with a guided tour). We therefore supplied our virtual experiments with a scripting interface. Scripting enables authors and learners to steer interactive learning objects by textual commands defined within other learning objects (Christian 2000).

To enable community members to take part in the development of our courseware, we set up online wizards. Single learning objects may be modified, annotated, or rated. We deal with non-interactive *and* interactive elements, e.g. we implemented prototypes that enable authors to modify an experiment's set of scripts.

Software Components

Our component-based architecture consists of geometry objects, renderers, constraints, scene graph components, and GUI elements. Renderers encapsulate an object's visual appearance. The may hold arbitrary properties to describe their visual appearance (e.g. colors, line strength, strokes). Similar, constraints separate an object's construction (e.g. orthogonal lines) and update dependencies automatically. A plug-in architecture assures extensibility. The object itself (point, mesh, etc.) contains only primitive functionality together with a transformation cache. Adapters synchronize objects with GUI elements (e.g. a scalar with a slider) automatically. Using a hierarchical scene graph we result in default interaction behavior and visualization for all our experiments. Scene graph nodes contain a geometry object together with a matching renderer and an interaction sub-tree that provides the desired interaction behavior for our geometry object. The set of scene graph actions (rendering, picking, dragging, etc.) is extensible.

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[1] http://www.gris.uni-tuebingen.de/projects/vis

Scripting Interface

The experiments' base component is equipped with a scripting interface. Scripts may import user-defined classes, instantiate objects, and call their methods. They also might be bound to GUI elements. Scripts are defined and documented by programmers, or, using online wizards, by community members. A well-defined state machine manages all data input steps and provides facilities for authorization, default values, undo, and preview (Figure 1). After verification of an editorial board, the given input is integrated into the script database. This entails other challenges. How to ensure bug-free and generally applicable scripts? Or, by what degree should we tolerate scripting if participants work collaboratively? Our answer is: simply do the same as for non-interactive content. Require authors to test their scripts at preview step. Evaluate and enhance scripts like any other learning object - gather access statistics, utilize a rating system, and equip scripts with forum, help, and annotation facilities.

Applications

Figure 1 illustrates how scripting may help us to overcome an interactive learning object's isolation. The current course text describes the definition and basic properties of a vector field. We embed scripts to match the experiment's vector field to the illustrations (which show a symmetric, radial, and potential field). The scripts will insert particles into our scene graph, or adapt the GUI and add text fields for a function parser. The learner may continue to work with his experiment. Other chapters contain scripts to exchange renderers for popular visualization techniques (arrow plot, colorization, streamlines, LIC).

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References

Klein, R., & Hanisch, F. (1998). *Using a modular construction kit for the realization of an interactive Computer Graphics course*, in Proceedings of ED-MEDIA & ED-TELECOM, AACE, USA.

Laleuf, J. R., Spalter, A. M. (2001). *Create@BROWN, A Component Repository for Learning Objects: A Progress Report*, in Proceedings of ACM JCDL2001, Roanoke, VA.

Christian, W., & Belloni, M. (2000). *Physlets*, Prentice Hall, NJ.

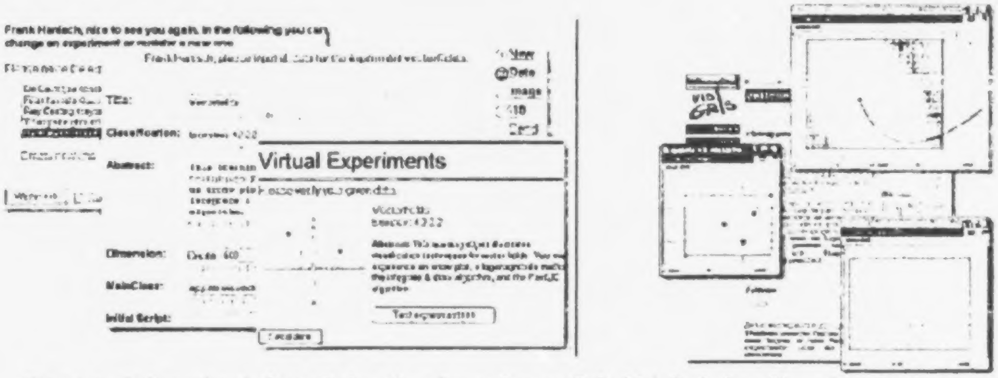

Figure 1: Online wizards for scripting virtual experiments (left side). Scripting allows for adapting an experiment's state to the current course text or illustration (right side).

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Planning, Implementing, and Evaluating a Blended Delivery Model Using Synchronous and Asynchronous Online Instruction

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Abstract: This paper is a report on the findings obtained from evaluating the planning and implementation of an online symposium addressing the issues of continuing professional development. The participants included educators, researchers, and training specialists in Canada. The symposium was part of an Office of Learning Technologies (OLT) funded project. The symposium was delivered through a blended learning model delivered via asynchronous and synchronous technologies. The symposium's goal was to gather and disseminate knowledge regarding the process of implementing learning technology initiatives in the workplace. It also evaluated the use of a blended learning model for professional development. Overall, the symposium achieved its goals using a blended learning model, however, the synchronous virtual classroom environment worked more effectively in group collaboration and discussion compared to the asynchronous learning environment. Recommendations are summarized for planning and implementing an online blended learning model.

Introduction

While researchers claim that the majority of adult learners are satisfied with learning in computer-mediated contexts, there are still students that do not appreciate this type of learning or find it extremely challenging because of the lack of human elements like visual/verbal cues in Internet based forums (Holt, Kleiber, Swenson, Rees, and Milton, 1998). Therefore, there is a constant need for distance educators to evaluate the experience of adult learners in the context of interactive computer mediated communication (Sorg and McEihinney, 2000). One of the functions of this project is to examine the effectiveness of using a blended learning solution, including both synchronous and asynchronous delivery tools for collaboration, interactivity, and dissemination of information.

Several researchers and practitioners have noted the benefits and disadvantages of using synchronous online conferencing for instructional purposes. Perceived disadvantages of text-based synchronous online communication include a lack of focus and reflection in students' comments (Honeycutt, 2000). Other limitations noted in the literature are that students are constantly challenged because visual and verbal cues are not present during the text-based discussion (Sorg and McEihinney, 2000).

However these disadvantages seem to be outweighed by the several benefits associated with text-based synchronous online communication. Such benefits include increased student participation, liberation of minorities, and facilitation of small group discussions (Bump, 1990). Sorg and McEihinney (2000) concluded that by using text-based synchronous environments students gain a sense of empowerment, a feeling of belonging to a group, and construct their own knowledge.

While useful, the previous studies are limited to synchronous online conferencing that is text-based. Recent studies have started examining the effects of synchronous online learning environments or virtual classrooms that use video and audio (Voice-over-Internet Protocol) for communication. In a study that used synchronous online instruction with one-way video and two-way audio, Hofmann (2000) observed that the technologies became transparent in the learning process, and the focus became the content rather than the medium. This is an indicator of a successful technology based program. According to Appelt and Mambrey (1999) synchronous virtual learning environments seemed to increase the quantity and quality of interaction among students, and between students and teachers, subsequently establishing a network of communication and collaboration among students and teachers. The importance of collaboration in learning is evident, as it is tied to knowledge construction (Jonassen, 1996).

These virtual learning environments may be even more effective if a combination of synchronous and asynchronous learning is utilized, which is referred to as blended learning. Blended learning "focuses on optimizing achievement of learning objectives by applying an appropriate combination of learning technologies for the learners, context, and skills taught (Singh and Reed, 2001). Charr-Chellman and Duchastel (2001) claim that the ideal online course may include web-based textual materials such as study guides, discussion forums, both synchronous (real-time) and asynchronous (delayed), e-mail, and voice/audio communication, which could be audio/video conferencing over the Internet or traditional telephony. These elements would be used depending on the context and content of instruction. An advantage of using asynchronous interchange is that students can participate in a flexible manner at their own time (Charr-Chellman and Duchastel, 2001) for thoughtful analysis and critical reflection (Bhattacharya, 1999). On the other hand, the benefits of using synchronous interchanges include "a more direct sense of collegial interaction, immediate resolution to questions posed, and possibly a strong contribution to team building" (Charr-Chellman and Duchastel, 2001, p.7). Blended learning would take advantage of the benefits of both synchronous and asynchronous instruction.

The Rensselaer 80/20 Model (Lister, Danchak, Scalzo, Jennings, and Wilson, 1999) proposes the use of blended learning. Based on this model Renneselaer Polytechnic Institute created undergraduate courses that were 80% asynchronous, including streamed on-demand video and audio or other resources accessed on the Web, and 20% synchronous. A technology used for the synchronous component was an interactive distance system called LearnLinc, which emulates "the proven techniques of interactive teaching that are so effective in the face-to-face classroom" (Lister et. al, 1999, p.2). Lister et. al (1999) conclude that while the asynchronous component is invaluable as long as it is instructionally sound, the synchronous interaction is an integral component of the distance learning course, which helps keep students on track with course deadlines, allows students to receive immediate feedback, builds a team and community spirit among students, and improves retention rates.

Blended learning seems to improve learning effectiveness and extends learning to a wider audience in different geographical locations and time zones, while optimizing development cost, time, and business results (Singh and Reed, 2001). Research completed by the University of Tennessee demonstrated that blended learning programs can be completed in approximately one half the time and at less than half the cost of using traditional classroom instruction (Dean, Stahl, Sylwester, Peat, 2001).

The Study

Beyond Learning Technologies: An Online Symposium was part of an Office of Learning Technologies (OLT)-funded research project entitled Evaluating Learning Technologies Initiatives (ELTI) in Continuing Professional Development. The Beyond Learning Technologies online symposium was organized and hosted by the TELUS Centre for Professional Development and the Institute of Professional Development at the

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University of Alberta, in collaboration with the ELTI research team. Participants in this symposium included educators and researchers from various universities across Canada and training specialists from the federal government and private industry.

The main purpose of the online symposium was to disseminate the findings of the ELTI project associated with implementing learning technologies initiatives and generate comments and feedback from the participants on these findings. Since innovative learning technologies initiatives were used for the symposium, including both synchronous and asynchronous delivery tools, the planning and implementation of these technologies was evaluated and recommendations are provided for professionals in the field.

The symposium took place completely online and consisted of an asynchronous (delayed) and synchronous (live, real-time) component.

The delivery tool used for the synchronous component was CentraOne. This is a Web-enabled virtual classroom environment using Voice-Over-Internet Protocol technology. Each of the synchronous sessions was 1.5 hours in duration. The content for the sessions was provided by the ELTI research team and was modified by TELUS Centre eLearning team to ensure that instructional design principles were followed and that the content was appropriate for synchronous online delivery.

For the asynchronous part of the symposium, an online course was created in Web Course Tools (WebCT), which contained case studies, executive summaries, links to resources, a draft of the final report, and an asynchronous discussion board.

The primary methods used in evaluating the Beyond Learning Technologies online symposium involved evaluation surveys, the recordings from the synchronous online sessions, and the archived asynchronous discussions.

As a secondary method the tracking system from within WebCT was also used to collect information on which participants logged on to the WebCT course and how many pages were accessed within the course.

Findings

Overall the symposium seemed to be successful as it achieved its primary goals, which were to disseminate knowledge about the Evaluating Learning Technologies Initiatives in the Workplace project and to gather feedback from participants on the questions examined in the project. It also achieved its second goal, which was to implement and evaluate the use of a blended delivery model, which is an innovative learning technology in itself, where by both synchronous and asynchronous online delivery modes were implemented for this symposium.

Specifically, the participants seemed very enthusiastic about the synchronous online sessions. Several participants noted that they enjoyed the interactivity and the opportunity to have a discussion with colleagues in different geographical locations, using the Internet, without having to travel. Additional positive comments were made related to the facilitation of the event, ease of use, effectiveness of the tool, and the collaborative human interaction amongst the participants. Negative comments centered on microphone volume levels, which were not consistent across users.

The asynchronous part of the symposium, a course built in WebCT did not seem be as successful. While participants used it to access the resources associated with the symposium (case studies, executive summaries, links etc.), the use of the asynchronous discussion forums were underutilized.

Recommendations

The success of a blended learning model using Web-enabled communication technologies depends on planning and implementing key procedures during the lifecycle of the project.

General Instructional Design Recommendations

- Identify the audience (participant)
- Identify the learning objectives and outcomes
- Identify discussion topics and evaluation methodology
- Choose the appropriate amount of time needed for synchronous and asynchronous instruction
- Choose the appropriate tools within each learning environment to best convey the learning concepts
- Develop electronic curriculum which is instructionally sound and suited for online delivery
- Develop discussion and survey questions to encourage participants to interact and collaborate

Recommendations for a Blended Learning Model (including synchronous and asynchronous online instruction):

- Ensure that participants meet minimum computer hardware requirements, which is critical for remote participant connectivity and for reducing participant frustration.
- E-mail logon credentials to the remote participants as well as timelines and dates.
- Provide an orientation of each learning environment to participants.
- Provide access to technical support for the participants to help those who experience difficulty in getting properly connected to both learning environments, during the events.
- Encourage participants to log in one half-hour prior to the commencement of the event. This facilitates establishing a comfort level for the participants. Microphone and speaker volumes can be adjusted appropriately.
- Complete a dry-run session prior to the actual synchronous live event to ensure the presenters are well prepared and comfortable with the Graphic User Interface.
- Integrate the use of synchronous and asynchronous components of the course so they are interdependent rather than independent. For example, answering questions in the asynchronous component successfully will require that you have attended the synchronous component of the course.
- Evaluate the participants' learning experience.

References

Appelt, W., & Mambrey, P. (1999). Experiences with the BSCW shared workspace system as the backbone of a virtual learning environment for students. (Report No. 020 357). Seattle: Washington: ED-MEDIA 99 World Conference on Educational Telecommunication. (Eric Document Reproduction Service No. ED 446 729)

Battacharya, M. (1999). A study of asynchronous and synchronous maps in a distributed learning environment. Proceedings of the WebNet 99 World Conference, Honolulu, Hawaii.

Charr-Chellman, A., & Duchastel, P. (2001). The ideal online course. Library Trends,50(1),145-159.

Dean, P., Stahl, M., Sylwester, D., & Peat, J. (2001). Effectiveness of combined delivery modalities for distance learning and resident learning. Quarterly Review Education, July/August 2001.

Hofmann, J. (2000). Getting in synch. Learning Circuits February 2000. Available: http://www.learningcircuits.org/feb2000/feb2000_synch.html

Holt, M. E., Kleiber, P.B., Swenson, J.D., Rees, E. F., & Milton, J. (1998). Facilitating group learning on the Internet. In Sorg, J., & McEihinney, J.H., (2000). A case study describing student experiences of learning in a context of synchronous computer-mediated communication in a distance education environment. (ERIC Document Reproduction Service No. ED 447 794).

Jonassen, D. H. (1996). Computers in the Classroom: Mindtools for critical thinking. Englewoods Cliffs, NJ: Printice-Hall Inc.

Lister, B. C., Danchak, M.M., Scalzo, K.A., Jennings, W.C., and Wilson, J.M. (1999). The Rensselaer 80/20 model for interactive distance learning. Proceeding of the EDUCAUSE 99: Celebrating New Beginnings, Long Beach, CA. (Eric Document Reproduction Service No. ED 450 714)

Rogers, E.M (1995). Diffusion of Innovations (4th ed.). New York: The Free Press.

Singh. H., & Reed, A., (2001). Achieving success with blended learning. Unpublished manuscript.

Tagging the didactic functionality of learning objects

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Introduction: We recently undertook to implement and package a number of short presentations on a CD-ROM, as a supplement to other material for a course in numerical analysis. The items vary in terms of size, natural viewing media and intended use; and the purpose of our work, other than the didactical one, is to monitor the resource requirements for the production and wrapping of such material.

This seemingly straightforward task brought us into direct confrontation with issues concerned with the concept of *learning objects* (http://works.opencontent.org/writings2.pl) and their future usability.

Background: The CD-ROM in question will eventually contain fixed texts (surveys, exercises etc.), modifiable texts (a report layout, the framework for a do-it-yourself manual, etc.), code examples, animations with optional voice-overs, and video-recorded miniature lectures. To make the whole effort useful and at least to some extent re-usable, we ventured into marking up ("tagging") each item as a learning object. The difficulties encountered in this process hinge on the fact that the standards (consult http://www.imsproject.org/specifications.html) for learning object content packaging, whether finalized or drafted, are biased towards bibliographical usages and pay insufficient attention to the needs of the author, the teacher and the learner. In particular, we wanted to address, as equally important:

Subject: Within the subject of numerical analysis (our present example), there are sub-subjects such as one-dimensional interpolation, with sub-sub-subjects such as the proof of the structure of the error term in polynomial interpolation, and the "sub- vs. sub-sub"-relations are difficult to state in the tags

Didactic function: An interactive self-assessment is in quite another category than a video-recorded proof of a theorem, yet the current standards do not allow for this kind of distinction

Granularity: A whole alternative exam for a course is too large to be one learning object, a single graph too small, an exercise in programming a graph-drawing function suitable

Note, that adequately monitoring granularity is the responsibility of the author, not of the tagging tools; but it will be of importance for what follows.

Recommendations: There is a need for extending the *type declaration* to have it describe the *didactic function* of the object. A crude approximation to what is meant may look as follows:

Simple *fact(s)* may be such things as definitions, measurements, precise names
Relations may be rules, formulas, laws, observable causal connections
Operations may be experiments, algorithms, typical design manipulations, exercises and self-tests
Insights may be explanations, proofs, rationales of (best) practices
Stimuli of *innovation* are such open-ended items as project (exercise) proposals

(The five italicised categories used are part of a general paradigm currently under development by the first author and should only be considered a starting point in the present context).

The type declaration idea might in fact allow for composite types, as in procedural programming. The simplest version, a fixed-depth, fixed-span type declaration of depth D corresponds to the addition of D tags, each with a pre-defined table, table of tables etc., of allowed values, after the above manner.

The *structure* into which a user (teacher) will fit the individual component cannot and should not be standardized: the whole of such a structure will form a course or the equivalent, and — to name an example— the position of a learning object in the time-line of the course and in the logical flow in a final exercise may be very different, *top-down* vs. *bottom-up* composition being but one such disparity.

Yet, engineering disciplines abound with components-in-connection, as exemplified by circuits and networks, process plants, in fact the general idea of dynamical analogies and system design. — One may safely argue that the very notion of a "component" requires a network for the component to sit in. Also, one must avoid the situations of a learning object author blindly composing what he believes someone else may need, or the user receiving the result without knowing whether or not it is of any use in an overall arrangement unknown to the original author. We therefore most strongly recommend that learning objects and some mechanism for their assembly be considered dual and of equal importance in standardization initiatives. An idea of what we have in mind is illustrated in the following diagrams:

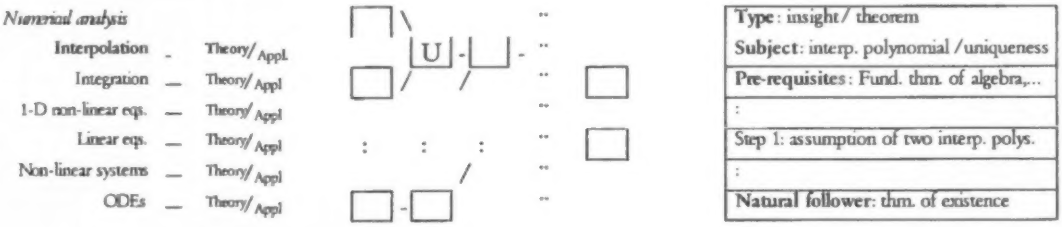
Numerical analysis
Interpolation - Theory/Appl.
Integration — Theory/Appl
1-D non-linear eqs. — Theory/Appl
Linear eqs. — Theory/Appl
Non-linear systems — Theory/Appl
ODEs — Theory/Appl
U
Type: insight / theorem
Subject: interp. polynomial / uniqueness
Pre-requisites: Fund. thm. of algebra,...
:
Step 1: assumption of two interp. polys.
:
Natural follower: thm. of existence

Figure text: The left listing, easily re cast for a graphical user interface, gives a choice of subjects for a course in elementary numerical analysis, one topic highlighted; the middle diagram indicates the learning objects as components-in-a-network, one selected; and the right table the inner structure of this specific learning object, with a few tag declarations (in bold).

To allow for composition with, and use of, such networks, meta-tags might assist by providing information concerning e.g. the pre-requisites of the learning object at hand. Such information requires standardization pertaining to the teaching and use of the subject items and may thus eventually be unacceptable outside the realm of the curriculum of a given university. Also, the tagging process, already time-consuming, will become truly demanding of intellectual effort whenever a new subject area is entered.

Still, learning objects are to be "launched" by authors, but searched for and employed by teachers and consumed by students. We expect to see authoring, searching and viewing tools merge in the near future and wish to point out that the choices of identical or symmetric display and operations lie with the tool designers, not with the designers of the mark-up standards. But as we envisage a future in which learning objects are aplenty and computer networking full-grown, we must require of the learning objects themselves, and hence of their tag structures, that they support a specialized search. Otherwise, the well-known "app. 1,001,300 hits"-message will soon preclude the use and hence the benefits of learning objects. This is why questions of object size interweave with the technical issues: you can only find what you are looking for if it is suitably tagged; and you can only carry the burden of "tagging", if each item is of an appropriate size. Otherwise, you either have too many to look after, or quite few, but each too complex to describe in the simple manner required by the mark-up procedure.

Brief conclusion: While the ideas and concepts behind learning objects are sound and natural, especially to engineering educators, aspects of their design and use are still un- or underdeveloped. From a components-in-a-network point of view, the most important issues are: a didactically based *typing* of the learning objects themselves; the entire *design superstructure* into which the learning objects must be fitted; and the *symmetry of the interfaces*, as seen by each pair of the triad: author, teacher, learner.

Exploring Student Performance on a Multimedia Exam Program (Vexam): the relationship between item formats and item difficulty levels

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Abstract: This research study aims to explore the influence of multimedia and text formats on student performance in the multimedia exams. The focus group is the 390 students who took an online, self-paced undergraduate course in Department of Anthropology at the University of Texas at Austin in fall 2001. Vexam was the assessment tool for the class. The test items, created by Vexam, were multiple-choice items and consisted of text, movie clips, and/ or pictures; they were categorized in the two groups, multimedia and text only. The research question is whether there is a significant relationship between the use of multimedia and text only formats and item difficulty levels in the exams. An exploratory research study and result will be presented.

Introduction

With information technology designs becoming more user friendly, and the cost of multimedia decreasing, multimedia technology provides the education field with additional degrees of freedom, enabling the exploration of alternatives to traditional education (Vogel & Klassen, 2001). In order to relieve pressure on teaching staff caused by increasing enrollments, more institutions are investigating computerized testing as a tool for formal assessment. (Stephens, Bull, & Wade, 1998; Zakrzewski & Bull, 1998).

The computer screen offers numerous options for overcoming the disadvantages of uninteresting and unvaried format (Byrnes, Forehand, Rice, Garrison, Griffin, McFadden, & Stepp-Bolling, 1991). By incorporating multimedia, some assessment tasks can be made more relevant. Item stimuli can be made dynamic by having video, audio, and animation (Bennett, 1999). Multimedia testing environments can be more authentic, because they can be contextualized with multiple media elements, and the text can be combined to present the tests with items resembling real-life tasks.

However, simply adding an illustration next to a word does not make the situation better (Gyselinck, 1996). Especially in testing, whether the type of presentation can influence student performance, it is not yet known and needs further research. More investigation is needed to establish whether people can be confused or distracted by multimedia when the items are easier. The purpose of this study is to gain deeper insight into the effects of use of multimedia and text only on student performance in the multimedia exam.

The Study

The study focuses on whether using multimedia can help people answer questions correctly. The item difficulty level is used to interpret the students' performance. The item difficulty level is defined as the number selecting correct answer divided by the total number taking the test (Kubiszyn & Borich, 1999). By analyzing the difficulty level of test items, the study investigated whether there was significant relationship between item formats and item difficulty levels (the students' performance). The research questions were raised for this study as follows.

- Is there a relationship between the use of multimedia and text-only and the item difficulty level (the students' performance)? If the answer is yes, what relationship is it?

The 390 students took the online, self-paced course and took the multimedia exams weekly. Vexam, a multimedia exam program and not a computer-adaptive testing program, was the assessment tool for the class. The 585 test items were retrieved from the 10 exams students took during the semester. The item formats consisted of text, movie clips, and/ or pictures. For those items whose item discrimination index is less than 0 were taken away. Only the items with positive discrimination index are worth analyzing. Thereafter, all the rest of the test items with positive discrimination index in 10 exams were categorized by their item difficulty levels (from 1 to 9) and by their item formats (multimedia and text only). By comparing different types of item formats with different item difficulty levels in the exams, the study tested whether there was significant relationship between item formats and item difficulty levels.

Findings

According to the result of the study, item formats have a significant relationship with item difficulty levels. Namely, different item formats have a significant relationship with the proportion of people who got the item correct. On the other hand, there is no significant difference between the multimedia format and the text format in each item difficulty level.

Conclusion

The results of the study showed that the use of different item formats had a significant relationship with the students' performance. Also, in each item difficulty level the text format and the multimedia format do not have significant differences. This is a work-in-progress. Further research will investigate the reliability of the research results and students' behavior and perspectives on taking the multimedia exams. Educators should be careful when using multimedia elements in testing, since item formats have a significant influence on students' performance. There still lacks a standard methodology for developing computerized testing (Drasgow and Olson-Buchanan, 1999). More innovative research is needed to explore when and how multimedia can cause the effects, which can influence student performance.

References

Bennett, R. E. (1999). Using new technology to improve assessment. Educational Measurement: Issues and Practice, Fall, 5-12.

Byrnes, M. E., Forehand, G. A., Rice, M. W., Garrison, D. R., Griffin, E., McFadden, M., & Stepp-Bolling, E. R. (1991). Putting assessment to work: Computer-based assessment for developmental education. Journal of Developmental Education, 14(3). 2-8.

Drasgow, F., & Olson-Buchanan, J. B. (1999). Innovations in computerized assessment. Lawrence Erlbaum Associates, Inc., New York.

Gyselinck, V. (1996). Illustrations et modeles mentaux dans la comprehension de textes. Annee Psychologique, 96, 495-516.

Kubiszyn, T., & Borich, G. (2000). Educational Testing and Measurement. John Wiley & Sons, Inc., New York.

Stephens, D., Bull, J., & Wade, W. (1998). Computer-assisted assessment: suggested guidelines for an institutional strategy. Assessment & Evaluation in Higher Education, 23(3), 283-294.

Vogel, D., & Klassen, J. (2001). Technology-supported learning: status, issues and trends. Journal of Computer Assisted Learning, 17, 104-114.

Zakrzewski, S., & Bull, J. (1988). Mass implementation and evaluation of computer based assessment, Assessment and Evaluation in Higher Education, 23, 2, 141-152.

Designing Simulations for complex skill development

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Abstract: Theoretical approaches to instructional design for skill development in complex domains lags behind the changing nature of education and training reflected in the application of contemporary views of learning. In particular, employing novel pedagogical approaches for advanced skill development has not been extensively investigated. The development of an application of guided simulation incorporating reflection tools to train naval officers in pilotage has been undertaken to illustrate this process. The skills and knowledge which are part of the conceptual framework that learners need to acquire to be pilots have been analyzed and the design incorporates a variety of instructional strategies that are well suited to supporting outcomes driven learning.

Introduction

The possibilities afforded by new multimedia technology, combined with contemporary ideas about learning, have opened up new design opportunities for educational simulations. In particular, the use of sophisticated multimedia environments has made the design of experiential simulations, in which the learner plays an authentic role carrying out complex tasks, a much more tractable design task.

However, theoretical approaches to instructional design for skill development in complex domains has lagged behind the changing nature of education and training reflected in the application of contemporary views of learning. As theories of learning have developed and educationists have gained more experience in the use of computer based technology, there has been a shift of emphasis from the behaviourist paradigm, and through what Atkins (1993) has called the weak artificial intelligence approach, to a constructivist view. This shift of emphasis has not been extensively investigated for advanced skill development with some notable exceptions such as the ADAPTIT project (Pass, et al, 1999). This view of design has influenced the development of an application of guided simulation incorporating reflection tools to train naval officers in Pilotage. The skills and knowledge which are part of the conceptual framework that learners need to acquire to be pilots have been analysed and the design incorporates a variety of instructional strategies that are well suited to supporting complex cognitive skill development.

Contemporary Theories of Learning

Many writers have stressed the need for open-ended exploratory authentic learning environments in which learners can develop personally meaningful and transferable knowledge and understanding. The lead provided by these writers has resulted in the proposing of guidelines and criteria for the development of software based on a constructivist view of learning (eg. Savery and Duffy 1995; Duffy and Cunningham 1996; Grabinger 1996; Squires 1996; Hannafin and Land 1997; Grabinger, Dunlap and Duffield 1997). Harper, Squires and McDougall (2000) have proposed a recurrent theme of these guidelines is that learning should be *authentic*. They have noted that a review of the literature points to three seminal concepts, which originate from the notion of authenticity: credibility, complexity and ownership.

For learners to feel that an environment offers credible opportunities for learning, especially when skill development is paramount, they need to be able to explore the behaviour of the systems, which are the focus of their learning. One way to do this is through working with simulations of the systems to be mastered. The environment should provide the learner with intrinsic feedback, which represents the effects of the learner's action on the system and mechanisms to experiment with ideas, try out different solutions to problems and reflect on those solutions.

Grabinger and Dunlap (1995) emphasise that learners should be presented with complex environments that represent interesting and motivating tasks, rather than contrived sterile problems. Only in complex,

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rich environments will learners have the opportunity to construct and reconstruct concepts in idiosyncratic and personally meaningful ways. However, learners may need help in coping with the skills to be developed in complex domains. Strategies, which have proved useful in helping learners, include scaffolding (Krajcik *et al.* 1998), anchoring (Cognition and Technology Group at Vanderbilt 1990), and problem-based environments (Tobin and Dawson 1992; Grabinger, Dunlap and Duffield 1997). Additionally, metacognition, in which learners reflect on their own cognition to improve their learning, has been advocated by a number of writers, eg. Scardamalia *et al.* (1989) and Papert (1980). It is claimed that by a conscious personal appraisal of cognitive processes, an individual can improve his or her capacity to learn (Hoban, 2000).

The Simulation Paradigm

Simulations as learning environments have had a long history of use in education and training and have been based on a variety of theoretical views of learning. Initial claims for the educational benefits of using simulations tended to emphasise pragmatic solutions to classroom problems. Processes, which take a long, time, eg. population growth or genetic change, or which happen very quickly, eg. changes in impulsive force during a collision, are possibilities for simulation. Difficult, dangerous or expensive processes are also candidates for simulation, eg. experiments with radioactive materials

The key feature of an educational or training simulation is that it makes use of a model to represent a process, event or phenomenon, which has some learning significance. The learner is able to interact with this representation and the simulation provides intrinsic feedback that the learner can interpret as the basis for further interaction. The underlying model may be mathematical leading to the generation of numerical results, rule-based with the intention of providing feedback on subjective input, or even context-based in that the learner is placed in a context that simulates a real situation.

A broader view of simulation can be taken if an 'in context' environment is considered as a simulation. In this form, the simulation is designed to place the user in a professionally-relevant context where they can investigate an issue and solve a problem, without necessarily receiving the intrinsic feedback characteristic of the more mathematically or rule-based simulations. While working with such models, the user often comes to see the simulation as a 'real world' in its own right (Crookall *et al*, 1987). Gredler has described such simulations as experiential and proposes they aim to establish a particular psychological reality and place learners in defined roles within the reality. He describes the essential components of an experiential simulation as '(1) a scenario of a complex task or problem that unfolds in part in response to learner actions, (2) a serious role taken by the learner in which he or she executes the responsibilities of the position, (3) multiple plausible paths through the experience, and (4) learner control of decision making' (1996, p. 523). Role playing simulations of environmental planning are classic examples of experiential simulations. Such models can be considered as representing real-world systems as either an "in-place-of" or a "bring-to-life" format.

Regardless of the type or format of the simulation, the overriding purpose for simulating systems remains to provide a learning environment that supports the learner to develop mental models about a process or the interrelationships of variables. Simulations can help learners achieve these objectives by providing a substitute experience for those processes and systems, which by reason of cost, scale, time or risk would not normally be accessible.

Complex Cognitive Skill Development

In many areas of training, where learners are to achieve a high level of efficiency in complex tasks, achievement of complex cognitive skills is a key goal. The term complex cognitive skills can be thought of as complex, in the sense that they comprise a set of constituent skills and at least some of these constituent skills involve conscious processing and cognitive, in that the majority of constituent skills are in the cognitive domain. Merrienboer, (1997) has developed an instructional design model, the 4C/ID model, which has influenced the design process which lead to development of the application described in this paper. The model is based on the view that in development of complex cognitive skills, learners should practice simple-to-complex versions of either the whole complex cognitive skill or meaningful clusters of constituent skills and that complex cognitive skills have both automated and cognitive components.

Pilotage Training

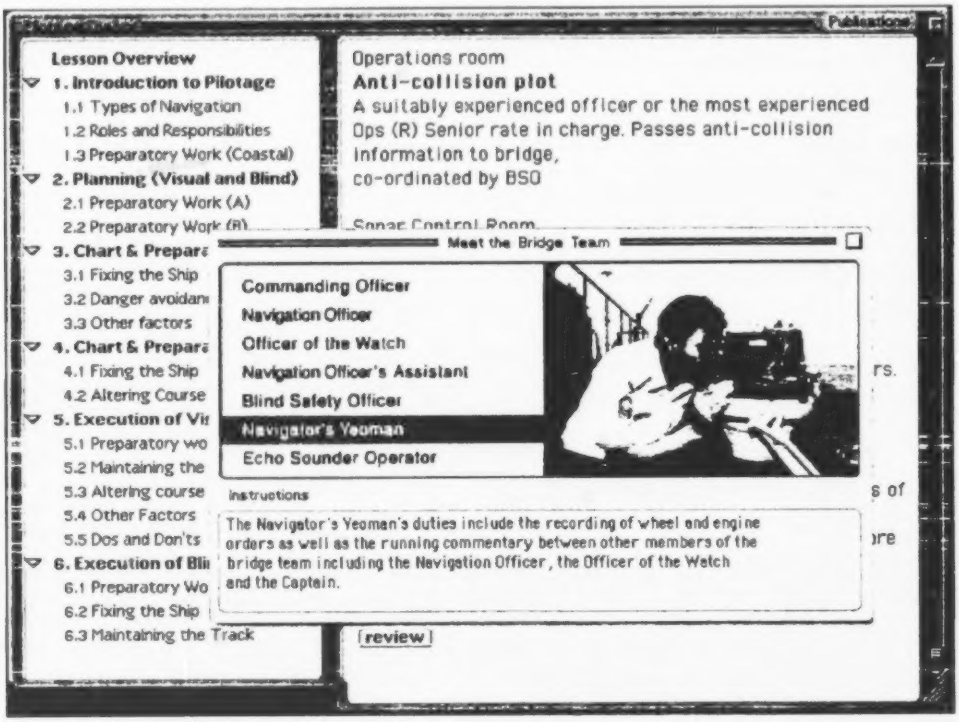
The skill of piloting a ship into an anchorage is a complex cognitive one, which involves not only a constant process of decision-making, based on data and crew input, but also management of multiple inputs in real time.

The training of navy personnel on the piloting of ships has had a history of making use of sophisticated simulators, but initial training has tended to be based on more traditional classroom experiences. With an aim of developing a more efficient training process, drawing from our experience and research with simulation, a PC based simulation has been developed, based on contemporary views of learning. Our instructional design strategies for this package are based on authentic experiences, a problem solving context and discovery (de Jong & van Joolingen, 1998) and reflection (Schon, 1983; Schon, 1987).

The development of an understanding of Pilotage is the key goal of this package. The skills and knowledge which are part of the conceptual framework that learners need to acquire to be pilots have been analysed and incorporated into instructional strategies that are well suited to supporting outcomes driven learning, and yet place learners in an environment which, in Gredler's terms, can be considered to be experiential.

The package makes use of learner-interaction in a visual context that is consistent with being a pilot on a combat ship. The strategies used to develop the high levels of skill necessary consist of:

- Lesson materials, containing support elements for concept development and review as well as a set of reference materials commonly used when planning and executing pilotage
- Guided simulation where the learner makes decisions within a simulated environment and can then consider the consequences of their decision, and
- Use of constituent skills which build to complex cognitive skill sets which are necessary to solve the task
- Reflection where the learner can review their experience and reflect on their success (Figure 1).


Publications
Lesson Overview
1. Introduction to Pilotage
1.1 Types of Navigation
1.2 Roles and Responsibilities
1.3 Preparatory Work (Coastal)
2. Planning (Visual and Blind)
2.1 Preparatory Work (A)
2.2 Preparatory Work (B)
3. Chart & Prepar
3.1 Fixing the Ship
3.2 Danger avoidan
3.3 Other factors
4. Chart & Prepar
4.1 Fixing the Ship
4.2 Altering Course
5. Execution of Vi
5.1 Preparatory wo
5.2 Maintaining the
5.3 Altering course
5.4 Other Factors
5.5 Dos and Don'ts
6. Execution of Bli
6.1 Preparatory Wo
6.2 Fixing the Ship
6.3 Maintaining the Track
Meet the Bridge Team
Commanding Officer
Navigation Officer
Officer of the Watch
Navigation Officer's Assistant
Blind Safety Officer
Navigator's Yeoman
Echo Sounder Operator
Instructions
[review]

Operations room
Anti-collision plot
A suitably experienced officer or the most experienced Ops (R) Senior rate in charge. Passes anti-collision information to bridge,
co-ordinated by BSO

Sonar Control Room

The Navigator's Yeoman's duties include the recording of wheel and engine orders as well as the running commentary between other members of the bridge team including the Navigation Officer, the Officer of the Watch and the Captain.

Figure 1 A view of the introductory tutorial window

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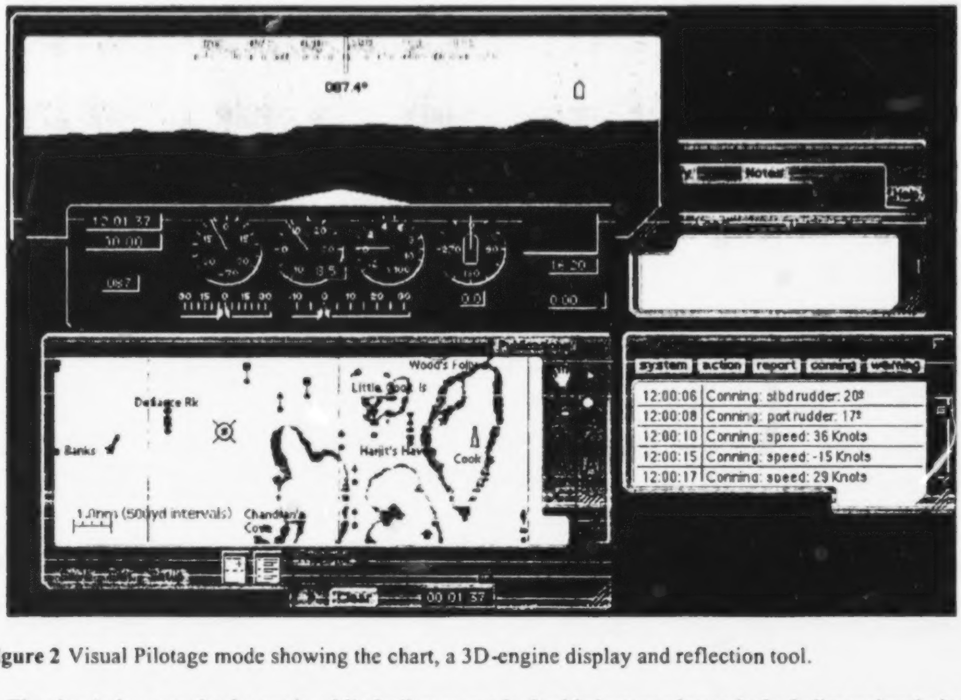
A set of *lesson-style tutorials* was developed to expose trainees to a logically sequenced set of pilotage theory concepts. Essential 'lessons' are available for trainees to use to increase their understanding within this area. Where the lesson concept is complex or difficult it is supported with animated sequences relationship models or diagrams. Each lesson also contains a review module where the key concepts of the lesson are presented for review using a question and answer approach Once an initial sub-set of the tutorial concepts has been worked through by the beginning trainees they can commence the simulation. The content remains easily accessible when a trainee needs to review or check a concept relevant to the complex skills demonstrated when working on the simulation environment.

The *Simulation* provides a pseudo-realistic environment modelled on the visual cues, pilotage processes and control tools found on a typical naval vessel. The experience of using the simulator gives the trainee the opportunity to plan, observe, and make decisions that directly impact upon the movement of the vessel with realistic outcomes such as being able to maintain a planned course to varying degrees from successfully reaching your destination through to running aground. The key interface elements of the simulation are: A chart that details a fictitious island group with the information needed for planning a pilotage track through the area, tools to 'mark-up' the chart for a planned pilotage run, data such as depth soundings and navigational aid such as beacons, landmarks and buoys. In visual pilotage mode, a 3-dimensional view from the bridge of the ship is derived from the chart as well as incorporating extra data such as tidal streams and currents (Figure 2). The trainee is able to manoeuvre the ship using speed and course adjustment controls, monitor the ship's progress via tools such as the depth sounder, wind-direction and wind-strength display, stopwatch, ship's clock, propeller revolutions, heading and speed readouts. As well as interacting with these controls, the trainee is able to take bearings on objects within the 3D visual environment, which can be panned, to starboard or port. This enables the monitoring of the ship's progress relative to the planned pilotage route.



```
12:00:06 Conning: stbd rudder: 20°
12:00:08 Conning: port rudder: 17°
12:00:10 Conning: speed: 36 Knots
12:00:15 Conning: speed: -15 Knots
12:00:17 Conning: speed: 29 Knots
```

Figure 2 Visual Pilotage mode showing the chart, a 3D-engine display and reflection tool.

The simulation can also be run in a blind-pilotage mode. In this instance instead of a 3-dimensional view of the experience, the trainee is provided with a radar view typical of that used in situations of limited or no visibility. The manoeuvring controls remain constant between modes.

Reporting progress to the ship's commander is achieved through a set of interfaces that allows the trainee to focus on single or multiple facets of pilotage such as monitoring a headmark, determining gyro error, fixing the position of the ship etc. These actions are recorded in the ship's log, designed to support learner

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reflection. The simulation can be operated within a practice or assessment mode. Within the practice mode, prompts triggered by the actions and sequence of actions of the trainee are provided to supply intelligent feedback on their progress. In this mode the trainee is also able to 'record' and 'playback' their pilotage run from a user–determined point in time. In assessment mode the trainee enters an environment absent of these support and review mechanisms, with a complete record of the run recorded for assessment by an instructor, or self-assessment by the learner.

The *reflective process* is facilitated through the use of a number of key features. Whilst the trainee is working within the simulator, practising their pilotage skills, their current actions are recorded in such a manner that enables them to review their past actions in two forms. The first is a list version of the key events that have occurred displayed within a floating log device window. The second is a visual 're-run' that reproduces their actions just as they occurred and displays them within the 3D visual environment. The provision of a 'snail-trail' that is visible within the chart module when the ship's movement is paused or stopped in practise mode gives a visual trail that shows the history of the ship's movements in the current simulation run. There is also the provision to 'save' pilotage chart and run sequences. These are small enough to be easily emailed to instructors for use in review procedures. A notes device which allows trainees to collect text, images or animations as well as store pilotage run files, provides a mechanism to assist them in making sense of the training environment through establishing and storing links to material of interest and annotating their experiences with their own language. The combination of these tools of reflection provides a substantial means of capturing, reviewing and assessing the performance of the trainee.

Conclusions and Research Agenda

The package offers a wealth of research opportunities, particularly in investigation of the use of simulation and reflection tools to develop complex cognitive skills. Initially the package will be used with the Singapore and Australian Navy with an evaluation process informing researchers about the effectiveness of the approach. An initial investigation of the usefulness of the package will be undertaken through user testing and expert review. The package will then be introduced to defence personnel in both countries, with a comparison of the traditional classroom outcomes against outcomes when using the package. Outcomes measures will be based on authentic assessment on board vessels modelled in the package. This will be a starting point for more detailed research on the specific tools built into the package.

Acknowledgements

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References

Atkins, M. J. (1993). Theories of learning and multimedia applications: an overview. Research Papers in Education, 8(2), 251-271.

Cognition and Technology Group at Vanderbilt. (1990). Anchored Instruction and its relationship to situated cognition. Educational Researcher, 19 (6), 2-10.

De Jong, T.,& van Joolingen,W. (1998). Scientific discovery learning with computer simulations of conceptual domains. Review of Educational Research, 68(2), 179-201

Crookall, D., Oxford, R., Saunders, D. (1987). Towards a Reconceptualization of Simulation: from Representation to Reality. Simulation/Games for Learning. 17 (4), 143-149

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), Handbook of Research for Educational Communications and Technology. New York: Macmillan Library Reference USA.

Grabinger, R. S. (1996). Rich environments for active learning. In D. H. Jonassen (Ed.), Handbook of Research for Educational Communications and Technology. New York: Macmillan Library Reference USA.

Grabinger, R. S. & Dunlap, J. C., (1995). Rich environments for active learning: a definition'. Association for Learning Technology Journal 2 (3) 5-34.

Grabinger, R. S., Dunlap, J. C., & Duffield, J. A. (1997). Rich environments for active learning in action: problem-based learning. Association for Learning Technology Journal 5(2), 5-17.

Hannafin, M. J., & Land, S. M. (1997). The foundations and assumptions of technology-enhanced student centres learning environments. Instructional Science 25, 167-202.

Harper, B., Squires, D. and McDougall, A., (2000) Constructivist Simulations in the Multimedia Age, Journal of Educational Multimedia and Hypermedia, Association for the Advancement of Computing in Education, 9(2), pp 115-130.

Hoban, G. F. (2000). Using Web-based templates to support reflection on learning in university classes. Proceedings of ED-MEDIA 2000 World Conference on Educational Multimedia, Hypermedia and Telecommunications, Montreal.(pp. 425-430)

Krajcik, J., Soloway, E., Bulmenfeld, P. & Marx, R. (1998) Scaffolding Technology Tools to Promote Teaching and Learning in Science. In C. Dede (Ed.) Association for Supervision and Curriculum Development Yearbook 1998: Learning with Technology. Alexandria, Virginia: Association for Supervision and Curriculum development, pp. 31-45.

Merrienboer, J.(1997) Training Complex Cognitive Skills; A Four Component Instructional Design Model for Technical Training. Edglewood Cliffs, NJ; Educational Technology Publications.

Papert, S. (1980). Mindstorms: Children, Computers and Powerful Ideas. New York: Basic Books.

Pass,F., van Merriënboer,J., de Croock, M, Advanced Design Approach for Personalised Training - Interactive Tools, (http://www.ouh.nl/info-alg-english-r_d/OTEC-research/projects/adaptit.htm), Accessed March, 2001

Savery, J. R., & Duffy, T. M. (1995). Problem based learning: an instructional model and its constructivist framework. Educational Technology, 35(5), 31-38.

Scardamalia, M., Bereiter, C., McLean, R., Swallow, J., & Woodruff, E. (1989). Computer supported intentional learning environments. Journal of Educational Computing Research, 5(1), 51-68.

Squires, D. (1996). Can multimedia support constructivist learning? Teaching Review, 4(2), 10-17.

Tobin, K., & Dawson, G. (1992). Constraints to curriculum reform: Teachers and the myths of schooling. Educational Technology Research and Development, 40(1), 81-92.

Schon, D.(1983) The Reflective Practitioner, San Francisco: Jossey Bass.

Schon, D. (1987). Educating the reflective practitioner, San Francisco: Jossy-Bass.

A framework for the instructional design of multi-structured educational applications

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Abstract:

An instructional application consists of a set of resources and activities that implement interacting, interrelated and structured experiences oriented towards achieving specific educational objectives. Computer-based instructional applications have to be faced as any other development activity following a well defined process. With this purpose some design methods for computer-based instructional applications have been proposed. However most of them are focused on "on-line" courseware structures which are quite rigid as far as they have serious shortcomings to deal with courses structured in multiple ways. Moreover, these methods usually lack a specific mechanism to model instructional concepts and strategies. This work proposes a design framework to develop multi-structured instructional applications combining a didactic model with a software engineering approach to deal with educational and technical requirements. The underlying model extends knowledge structures, such as those involved in the Merrill's Transaction Instruction Theory, adding them didactic information. It also considers the functional aspects of these structures. An XML-based notation is proposed to represent such structures and their management.

1. Introduction

An instructional application can be defined as a set of resources and activities which implement interacting, interrelated, structured experiences that are designed to achieve specific educational objectives. Instructional applications are usually structured by means of static patterns which are based on a sequence of book-like electronic pages. They are designed using courseware methodologies that focus on presentation and navigation issues but lack a didactic basis. The resultant products are mostly "pretty-printing" on-line courses but didactic aspects are hardly considered. The current work proposes a design framework which is independent from computer-based delivery technologies and it allows the representation of multiple didactic structures from an instructional point of view. Such a framework requires a model to deal, on one hand, with instructional design topics and, on the other hand, with the design of computer-based applications.

Instructional design can be defined as the discipline that connects descriptive theories with instructional practice. Among the different instructional theories proposed in the literature, we will assume the Instructional Transaction Theory (Merrill 1996) since it makes possible to figure out the relationships between educational and technical components. Merrill's mental models consist of two major components: knowledge structures (schema) and processes for using this knowledge (mental operations). The Merrill's hypothesis states that adequate instruction would require multiple types of knowledge structures to be identified and made explicit to the learner. Thus, the Instructional Transaction theory provides a powerful tool to structure the knowledge about a given topic and to define the procedures for accessing it. In the framework proposed in this paper, Merril's model is extended to add didactic information to knowledge objects and structures. A Didactic model is built using the previous entities as the basis and assigning them attributes whose values suggest how they can be used or even adapted in a specific learning or teaching scenario.

On the other hand, the proposed framework deals with the design of educational computer-based applications. Most of the existing methodologies are addressed to author courseware using formats such as HTML documents. They seem adequate for presenting and accessing information in a open environment like the Web but lack a data structuring capability. Another option is using proprietary multimedia authoring tools like Authorware™ or

Tooolbook™ that provide a more powerful data model but they bound the reuse and exchange of content module (Wiest, 2001). In this sense, an important effort has been made to organize and to manage educational data using metadata (Duval 2001). However, standard metadata proposals mainly aim at the reuse and exchange of learning material and they are not directly involved in the context of instructional application design. In the current work, notational systems based on metadata are used to represent instructional and didactic entities. The proposal consists of defining an XML-based notation which specifies the Merrill's Instructional Transaction Theory entities and their extension introduced in our Didactic model. Such notation will allow an instructor to define his own didactic structures which can be built from a common repository of instructional objects.

The remainder of the paper is organized as follows. Second section revises some related works. Third section introduces the design framework proposed in the current work. Such framework is based on a didactic model whose structural components are presented in fourth section. Fifth section complements this model with its functional view. An application example is described in section 6. Finally, section 7 presents some remarking conclusions.

2. Related work

There are several technology-based educational initiatives that propose a separation between didactic aspects and content related issues. In this context, the Multibook project (Steinacker et al. 1999) considers two domain spaces: the Concept Space and the Media Brick Space. The first one contains a network of knowledge topics which are connected via semantic relations. The second one contains information units of various multimedia formats. Media Brick elements are linked to the Concept entities and instructional mechanisms such as "example", "deepen" or "explain" are setup between these elements. A similar approach is proposed in LMML (Süß et al 2000) which differentiates Pedagogical and Instructional properties from the Module and Content objects. However, only strategy attributes with possible constant values "beh" (behaviouristic) or "con" (constructivistic) can be specified. Other proposals such as the Targeteam project (Teege 2000) or the Palo language (Rodriguez et al 1999) are also constrained to relations or mechanisms such as motivation, illustration, exercise or explanation without an additional didactic value.

In metadata contexts, there are Educational Modeling Languages (EML) which allow the specification of many kinds of educational data. These data can be implemented using notations which take advantage of standard proposals on one hand, or particular and specific proposals on the other hand. The first option is used in the Multibook project to define the Media Brick elements from IEEE Learning Objects or the Chameleon project and its TeachML (Wehner 2001) notation that is based on IMS standards. These standard formats are useful for exchanging them in different learning contexts but their didactic attributes are very restrictive. In the second category, there are formats such as LMML that defines instructional ContentObjects which contain media units such as tables, lists, images or text. The problem is that these units are strongly coupled with instructional objects and it prevents to assign them with different media objects. Similar problems are found on other EML proposals such as Targeteam contents, EML learning objects (Koper 2001) or Palo elements.

3. Design of Instructional Applications

Figure 1 shows the global architecture in the proposed instructional application design framework. The upper level deals with Instructional Design Theory which manages entities such as "knowledge objects", "knowledge structures" and "transaction shells". According to Merrill, a knowledge object is defined as "a precise way to describe the content to be taught". Knowledge objects can be combined into knowledge structures. Knowledge structures are external representations of knowledge that are parallel with mental models that in turn are internal (cognitive) representations of models. Transaction shells consist of rules for selecting and sequencing knowledge objects. The entities defined in the Merrill's model are the basis for the next level (Instructional Design Modeling). This central level is characterized by a Didactic Model whose components extend the previous entities with didactic information. They are divided in two categories that represent the structural and functional model, respectively. Structural model is composed by instructional objects, derived from knowledge objects, and didactic structures which extend knowledge structures. Functional model is based on instructional tasks and learning scenarios. An EML notation is being designed to specify both structural and functional components. Next section will describe them in depth. The lower two levels deal with the computational implementation of instructional applications. The first one is based on a hypermedia model to represent the instructional entities and their relationships in an formal and abstract notation (Buendia et al 2001). The second level is related to the technology involved in the delivery of instructional applications using an e-learning environment.

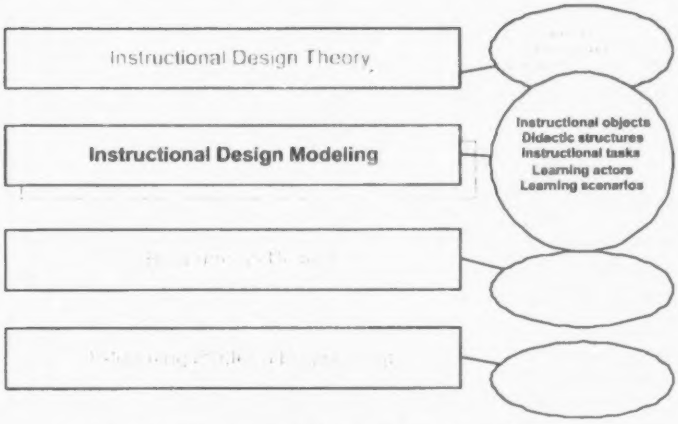

Figure 1. Instructional Application Design Architecture.

4. Structural model

This section focuses on the structural components of the Didactic Model proposed in this paper. The simplest element of the current model is the *Instructional Object* (IO) which is used to manage Merrill's knowledge objects from a learning point of view. Instructional Transaction Theory describes knowledge in terms of three types of knowledge objects: entities, activities and processes. When an entity, activity or process is addressed in a learning context, there are multiple aspects that differ depending on the learning conditions around the knowledge object. The main goal of IO elements is to represent such aspects. If the learning target is an entity, IOs such as definitions, statements or examples can be used to describe it. Activity knowledge items can be characterized using IOs such as exercises, questions, analogies, hints an so on, and finally, processes are also qualified with simulations, feedback elements, or animations.

IOs are not only isolated information units such as definitions or exercises but they are also concerned with the way these units are used in a learning context. For instance, an entity definition is assigned with a difficulty level, a statement declares a property value assigning it a relevance index and an example displays the entity with a specific portrayal (text, audio, image, and so on). Therefore, IOs must consider the multiple possibilities for a knowledge object to be learned in order to deal with different learning styles and needs.

The model presented in this paper provides a flexible framework to incorporate multiple kinds of didactic information which can be added to IOs. The instructor has to decide the different difficulty or abstraction levels assigned to each object, its relevance in a certain learning context or the portrayal that requires a given user profile. This design process is highly related to the features of a subject domain and it becomes a manual and laborious process. Tools as metadata notations have been used to support this process.

In this work, there is a simple XML notation proposal and the definition of IOs is adapted according to the subject domain. This means that they can be defined on top of other entities such as Merrill's knowledge objects or IEEE learning objects, extending them with didactic elements as those referred in Figure 2. In this example, a *Description* IO is used to teach the "magnetic disk structure" (knowledge object). The "ObjectDescription" shows that an image representation has been selected in the current teaching context. Didactic parameters as the portrayal configuration or the abstraction type indicate how this image is displayed and the level of abstraction it represents. EML notations usually also include information about the organization of the educational contents in different structures. In some cases like the Multibook project this information is mixed with the own instructional objects. In our model, there is a strong separation between both types of information.

Instructional objects are organized using *Didactic Structures* (DS) which can be managed as independent entities. These entities are addressed to capture the didactic relationships between those objects. There are two kinds of didactic relationships in the current model: explicit and implicit. Explicit relationships link IOs using a specific action, for instance, "an example *illustrates* a concept definition" or "a question *evaluates* an explanation". Implicit relationships are derived from the way knowledge items are organized.

```
<ComponentValue DidacticRef="Image reference">
        <ObjectRef>Magnetic Disk Structure reference (storage area).</ObjectRef>
        <InstructionalObject ObjectID=" IO-404" ObjectName="Description" ObjectDescription="Bi-dimensional image">
                <Portrayal Dimension="2" Background="false" Position="center"/>
                <Abstraction Type="structural" Depth="0"/>
        </InstructionalObject>
</ComponentValue>
```

Figure 2.- Instructional object example.

In this case, we are interested in knowledge structures coming from the Instructional Transaction Theory which are used in the current work to model DSs. Merrill mentions different types of knowledge structures such as lists, taxonomies, dependencies, algorithms and causal nets. A DS can be built on top of one or more knowledge structures. For instance, the description of a magnetic disk in a computer system can be based on identifying its components and assigning them a portrayal configuration. It can also include an algorithm representation to show the access to a specific component (e.g. a cylinder). The DS connections with other model entities are represented on Figure 3 It shows a simplified UML diagram which specifies that DSs are entities aggregated from instructional objects (IO) and knowledge structures (KS). Both IO and KS entities are based on knowledge objects (KO) which are composed by elements such as *Identif*, *Portrayal* and *Properties*. DS entities also extend the basic information coming from IO and KS, using didactic attributes such as the portrayal selection.

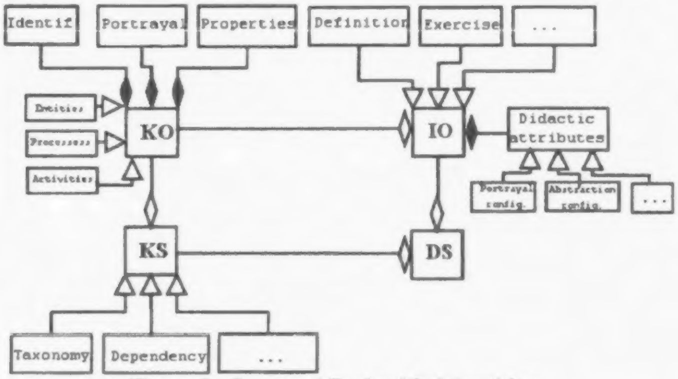

Figure 3.- Structural Design Model entities.

The current work is closer to the IMSDL proposal (Silberhorn & Gaede 1999) which defines instructional strategies, responsible for structuring the information units to be learned but independent from the subject domain. However, these structures are addressed mainly for courseware. Nevertheless, we do not know any proposal focused on generating structure templates which can be applied in specific didactic contexts in a reusable and modular way. We are developing XML Schemas to represent a wide range of didactic structures from basic knowledge structures.

5. Functional model

The functional model describes the entities that allow a user (student or instructor) to interact with DSs. DS entities are the nexus with the other structural elements. Figure 4 shows a simplified UML diagram that represents the main functional entities and their relationships with the remainder entities. These entities are learning scenarios and instructional tasks, respectively.

Learning scenarios (LS) are defined as the set of terms and conditions that characterize the user learning. Each individual user or group of them is assigned with one or more LSs. Instructors have to configure the LS entities, assigning features such as learning modes, timing schedules, instructional methods and learning goals. Each LS aggregates one or more *Instructional Tasks* (IT). They are defined as the operations a user has to perform to achieve a specific learning goal. IT entities model the functions associated to the didactic structure interface. They can access to one or more didactic structures and a certain DS can be attached to multiple ITs.

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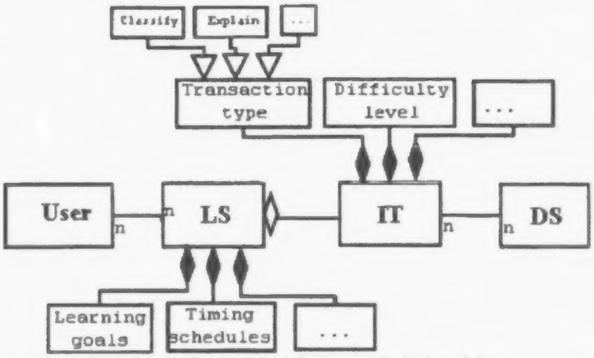

Figure 4.- Functional Design Model entities.

ITs are related to the Merrill's concept of "transaction shell" which consists of rules for selecting and sequencing knowledge objects. In the current model, IT entities do not access directly to IOs which are encapsulated into the didactic structures. This feature eases the design process because the instructor deals with IOs in a more abstract way. For instance, in a dependency DS, the IO components are all considered as chain elements without differentiating them. An IT like *Explain* specifies the navigational operations through the branches of the Dependency structure. A navigational operation can consist in the selection of a given branch and it could depend on learning modes such as "learning by examples", "by doing" or by "exploration and experimentation". In the first case, the *Explain* task is based on revising *Example* IOs while the other cases involve the working with *Activity* IOs. One of the main instructor responsibilities is to define the ITs attached to each DS. This definition is also a manual and laborious task and an EML notation is being developed to assist the instructor in this process.

6. Application example.

In this section, an example is used to show the application of the proposed Didactic model. The example consists of a Didactic Guide called "Learning XML basics" which is based on a Dependency structure. Figure 5 shows a diagram of top-down dependency. The root node represents the main learning goal described as "Learning XML". The descendent node has assigned a *Definition* IO which intends to answer the "What is XML" question. The didactic relationship between the *Goal* and *Definition* IOs is an *IsBasedOn* relationship type and it means that the knowledge about the XML notion (current node) is required to meet the goal defined in the previous node. From the current node, there are several branches which represent extensions (*IsExtendedBy* relationships) of the current definition node. These branches store requirements in order to understand the previous node and each one has assigned a specific competency (difficulty) level. According to this assignment, a different IT can be attached to each branch. These competency levels are based on the learning modes cited previously. Learning by examples can involve identifying instances of a concept, e.g. an XML document (left branch) or a DTD document (central branch). Moreover, each XML document example can be assigned with a certain difficulty level which is used as parameter by the IT. It causes that the structure branches can be navigated-accessed in different ways. A *Predict* IT can check a specific process, e.g. the validation of an input XML document using a DTD syntax. This validation process is based on an *Activity* IO which is related to a previous *Example* object by means of an *IsCheckedBy* didactic relationship. In a higher level learning mode, the *Predict* task could include additional activities such as the DTD configuration.

7. Conclusions

A design framework has been proposed for developing instructional applications beyond the rigid courseware structures that underlie the typical Web-based courses. The proposed framework is based on a didactic model which provides a gateway between instructional theories and concepts, and hypermedia and Web application engineering. This model considers two issues: a structural view based on instructional objects and didactic structures, and a functional view that manages the previous entities using instructional tasks and learning scenarios. The didactic model is supported by an XML-based notation which eases its translation to computing environments.

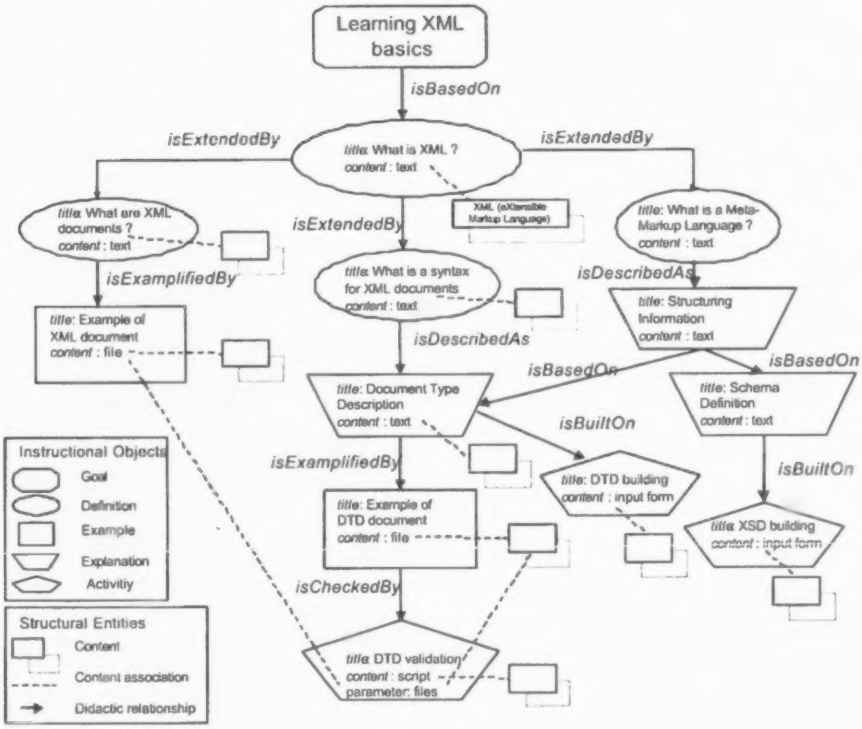
Learning XML basics
isBasedOn
isExtendodBy
isExtendedBy
title: What is XML ?
content : text
XML (eXtensible Markup Language)
title: What are XML documents ?
content : text
isExtendedBy
title: What is a Meta-Markup Language ?
content : text
isExamplifiedBy
title: What is a syntax for XML documents
content : text
isDescribedAs
title: Example of XML document
content : file
title: Structuring Information
content : text
isDescribedAs
isBasedOn
isBasedOn
title: Document Type Description
content : text
title: Schema Definition
content : text
isBuiltOn
Instructional Objects
Goal
Definition
Example
Explanation
Activitiy
isExamplifiedBy
title: DTD building
content : input form
isBuiltOn
title: Example of DTD document
content : file
title: XSD building
content : input form
isCheckedBy
Structural Entities
Content
Content association
Didactic relationship
title: DTD validation
content : script
parameter: files

Figure 5.- Didactic Structure example.

This notation has been applied to represent taxonomy-like didactic structures. It provides the possibility to organize available educational resources in a way closer to the instructor teaching requirements. We have also planned to extend the XML-based specification to other didactic structures based on dependencies and algorithms. Further works include their usage in specific learning contexts such as Electric and Information Engineering areas. We are also developing a tool to allow the access to these structures in a Web-based environment.

References

Merrill M. D., & ID2 Research Team (1996). *Instructional Transaction Theory: Instructional Design based on Knowledge Objects.* Educational Technology, 36(3), 30-37.

Wiest, S, Zell A. (2001) *Improving Web-Based Training Using an XML Content Base.* Proceedings of ED-MEDIA 2001, Tampere, Finland, pp-2045-2050.

Duval, E (2001). *Standardized Metadata for Education: a Status Report.* Proceedings of ED-MEDIA 2001, Tampere, Finland, pp-458-463.

Steinacker,A., Seeberg, C., Reichenberger, K., Fischer, S., Steinmetz, R. (1999) *Dynamically Generated Tables of Contents as Guided Tours inAdaptive Hypermedia Systems.* Proceedings of ED-MEDIA June 1999.

Süß,C., Kammerl, R., Freitag, B.A (2000). *Teachware Management Framework for Multiple Teaching Strategies.* Proceedings of ED-MEDIA 2000, World Conference on Educational Multimedia, Hypermedia & Telecommunications, Montreal, Quebec.

Teege, G. (2000) *Targeteam, TArgeted Reuse and GEneration of TEAching Materials.* http://www11.informatik.tu muenchen.de/forschung/projekte/targeteam/index.html.en

Rodríguez-Artacho, M., Verdejo, M.F., Mayorga, J.I., Calero M.Y. (1999) *Using a High-Level Language to Describe and Create Web-Based Learning Scenarios* Frontiers In Education Conference FIE '99 IEEE Computer Society San Juan, Puerto Rico.

Wehner, F., Lorz, (2001) A. *Developing Modular and Adaptable Courseware Using TeachML* Proceedings of ED-MEDIA 2001, Tampere, Finland, pp-2013-2018.

Koper, R. (2001) *Modeling Units of Study from a Pedagogical Perspective: the pedagogical meta-model behind EML* http://eml.ou.nl/introduction/docs/ped-metamodel.pdf

Buendía, F., Díaz, P., Sahuquillo, J., Benlloch, J., Gil, J.A., Agustí, M. (2001) *XEDU, a Framework for Developing XML-based Didactic Resources.* EuroMicro'01, pp427-434.

Silberhorn, H., & Gaede, B. (1999). *IMSDL: Instructional Material Structure Description Language*, 7 th BOBCATSSS Symposium on Learning Society, Learning Organisation, Lifelong Learning, Bratislava.

Videoconferencing: A Tool For Collaboration And Professional Development

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Introduction

With the expanding infrastructure for telecommunications in the world today, new applications for communications are emerging in society. To assure success in the workplace of tomorrow, it will be necessary for students to have collaboration and communication skills that utilize technology tools (Schlechty, 1997). As a communicative technology, videoconferencing offers the potential to provide students relevant skills, connect distant or remote learners, and induce change. Teachers and administrators must receive training in the design and application of appropriate uses of videoconferencing to support effective, efficient, and meaningful learning. Videoconferencing has been used in higher education and businesses for several years and now is spreading to K-12 environments. "Educators tend to use new technologies within the context of their perceptions of instructional strategies" (Hayden, 1999).

The instructionist teacher views the characteristic of videoconferencing that allows connection to a distant expert, as an opportunity for a remote lecture. On the other hand, the constructivist teacher views this same characteristic as an opportunity for students to ask questions and clarify meanings. Educational reform efforts suggest that constructivist teaching strategies and learning environments should be explored for student activities and assessments (Brooks & Brooks, 1993; Sandholtz, Ringstaff & Dwyer, 1997). In order to prepare teachers and schools for best practices using videoconferencing technology, constructivist instructional strategies need to be matched with new technologies (Hayden, 1999).

This paper will report the findings from a study (Hayden, 1999) that investigated the "best practices" for videoconferencing. The paper will describe the strategies that were applied from the research to an educational technology professional development program for teachers and administrators in California.

Research on Videoconferencing

Description of study

A study completed in 1999 (Hayden) used the Delphi process in order to facilitate a panel of experts in projecting their experiences with education, technology, and videoconferencing in order to identify important characteristics and critical support strategies necessary for videoconferencing in constructivist K-12 environments. The panel's recommendations provide a guide for technology trainers and professional development planners in implementing effective teacher training and support. As one participant in the Delphi study stated:

> I have been more conscious about what I've organized for teachers (VC project development) and in teacher trainings. I have stressed more active participation among the students. This has been very helpful for me; I have referred to the information/results from this survey several times in trainings. Teachers' ears seem to perk up when you have data to support your philosophies and different examples to give (Hayden, 1999).

Characteristics of Videoconferencing

Twenty characteristics of videoconferencing that support constructivist learning emerged in the study completed by Hayden (1999). These twenty characteristics are categorized into four themes in Table 1: (a) connections, (b) questioning, (c) learning, and (d) interaction. Within this list of twenty characteristics, ten characteristics of videoconferencing were rated higher than the other ten. By organizing the top ten characteristics by theme area, learning experiences using videoconferencing to support constructivist learning could be planned. Table 1 shows how a videoconferencing project can incorporate all ten of the top videoconferencing characteristics.

Theme	Characteristic	**Scenario:**
Connections	Synchronous connections between students and primary sources such as experts and remote locations; involving multiple sites in activities.	Students are assigned an authentic task that offers opportunities for planning connections outside the classroom with experts and primary sources such as museums. The students plan, develop and ask questions during a videoconference in order to collect information and gain an understanding of key concepts. The students use a suite of online tools as follow-up to the initial interaction and then present their findings "live" to remote partners concluding their research.
Questioning	Students develop and ask questions; they are in charge of their learning.	
Learning	Students present to remote partners using audio and video for communication.	
Interaction	Students work in groups on authentic activities with remote sites. This involves videoconferencing with remote sites and use of an online suite of tools to support videoconferencing activities.	

Table 1: Planning An Activity Using The Top Ten Characteristics Of Videoconferencing That Support Constructivist Learning Environments (Hayden, 1999)

Talking head. The theme of remote lecture, sometimes referred to as "talking head", has been a common format for videoconferencing sessions. New technologies are usually implemented first in the old paradigm. In the case of videoconferencing, the classroom lecture can be viewed by remote learners at different locations. The problem with the "talking head" model is that participants are often not engaged because they are not physically connected with the presenter by being in the same room. It is difficult for the presenter to see all of the remote participants and he/she may not be aware that viewers are losing interest in the session. The linking of videoconferencing and constructivist strategies tend to avoid the "talking head" model and participants become more engaged as they actively participate in the session.

Shared electronic documents. One way of engaging participants in a videoconference is to display shared documents and images to reinforce concepts and address multiple learning modalities. The characteristic of "students creating a shared electronic document using synchronous connections" was ranked 19th in the twenty-item list of videoconferencing characteristics. One suggestion made by an expert in the Dephi study was for "more accounting for the various media that are used in VC, i.e. elmo, video tape, computer, whiteboard, etc. All of these can enhance the potential for constructivist uses of VC."

Support Strategies

The three-round Delphi process identified critical strategies that support videoconferencing in constructivist environments. The top ten strategies for supporting videoconferencing are categorized into six themes: (a) people, (b) access, (c) hardware and software resources, (d) materials, (e) staff development, and (f) cost/budget (see Table 2).

From Desktop to Web: Standalone CBT to Web-based Instructional Application

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Abstract: The need to convert our stand-alone computer-based learning modules to a form that would be independent of any single location or brand of computer became clear to us several years ago. We were also interested in improving the availability of our software. The growth and standardization of the World Wide Web provided us with a format offering color, graphics, animation, and hypertext. Distribution problems would be eased, and the distance education possibilities were also an advantage of this approach. This presentation focuses on how the initial choice of an interactive, hypertext format was central to our repurposing effort.

Education as the first motive

Bonfils Blood Center's **Transfusion Medicine Education Program** was created to address the lack of familiarity of many medical practitioners with transfusion issues (Simon, 1985). We wanted to provide medical students with application-level experience of practical procedures or principles (clinical correlates) involving topics already identified as important in the field. Cases were chosen that involved many of those procedures or principles. These cases were grouped into thematically related modules, which were part of the regular course of medical studies. Given the extensive medical curriculum and the already busy schedule of the medical student, we felt a learner-centered, computer-based approach would be best. We have developed over twenty cases, grouped into four modules, in our first dozen years.

Active Learning

The instructional advisors to this program, from the University of Colorado at Denver's School of Education and University of Colorado School of Medicine, felt strongly that a learner-centered, active learning design would be most appropriate (Jonassen, Ambruso, Olesen, 1992). We had to provide experiences leading to competency in a complex, ill-structured domain. We hoped to avoid the usual over-simplified presentation that often leads to "inert knowledge" (Whitehead, 1929). We decided on an approach combining elements of cognitive flexibility theory, case-based learning, and instructional simulation (Heath, Ambruso 1996).

Hypertext

The obvious form for our educational experiences was hypertext (linked, interactive, random-access information). However, by the time we started working on our fourth set of instructional cases, it was obvious that the Internet itself had far outpaced the neglected HyperCard product as an implementation of the hypertext concept. We decided to try to replicate our first module as a series of HTML documents (Internet "pages"). The result proved very popular with students and faculty. Internet-based versions of two other modules were produced, and a third conversion is underway using DHTML and other advanced web technologies.

Opportunities for Updating, Refining

When a case or module is rewritten as World Wide Web pages, it can also be revised. The new version can reflect the latest advances in both the field of transfusion medicine and ("below the hood") in the newly available capabilities of the Internet.

Adding Color

The use of color in the standalone CBT versions was limited. No need was seen for color when these programs were originally written. Furthermore, the colorization schemes that became available for HyperCard were awkward and prone to technical difficulties. In the Internet environment, color has always been an inherent part of all visual elements, at least in the Netscape and Explorer programs . We hope that the presence of color and other appropriate graphic design elements may serve to enhance the learner's experience.

Client-side Data

One challenge of any Internet-based instructional system is the lack of an obvious way to store information for later use. Security issues require browser makers to prevent any Internet page from gaining direct access to the computer's permanent storage. The 'cookie' method allows limited creation of small amounts of data on a computer, but many people turn this feature off.

Global Variables

Instead of using local files for learner data that our programs may need, we store information in variables associated with the opening page, which remains open but hidden once the current page is opened in front of it. Alternatively, we use a 'frame' portion of the visible window to store information used by subsequent 'frame' portions of the same window.

For example, the students enter their names, which appear at various points in the program and on the completion report that is sent to us automatically when the student completes the program. Another example is the laboratory test orders placed at one point in the program, which must be acknowledged, and the results given, at a later point in the program. Both the student name and their orders must be stored in such a way as to be available to the routines that send us their report or that show them their earlier decisions or test results.

Data Management

Combining JavaScript variables, DOM element addressing, and Cascading Style Sheet controls, we have created a client-side database management system that would not have been possible with the technology available when this program began.

Conversion Process

We considered the following factors when we decided to convert our CBT to web-based instruction:

Does my CBT need to be converted to web-based instruction?

- Hypertext is suited to Internet
- Cross-platform operability (need to use any computer)
- Availability of graphic elements (color, animation)
- Ease of distribution, maintenance

What challenges face such a conversion?

- Different results on different platforms, browsers, versions…
- New capabilities not evenly implemented across browsers
- An Internet application does not have full disk access

What are some possibilities

- Client-side data management
- Animation
- Wide distribution

References

Heath, S. & Ambruso, D. (1996). An instructional simulation approach to teaching transfusion medicine. Computers in Education Conference: The Virtual Medical School (1996, Philadelphia). Poster abstract available at http://jeffline.tju.edu/CWIS/OAC/hslc/sym96/abstracts/heath.html

Jonassen, D.H., Ambruso, D.R., & Olesen, J. (1992). Designing a hypertext on transfusion medicine using cognitive flexibility theory. *Journal of Educational Hypermedia and Multimedia*, 3(3), 309-332.

Simon, T.L. (1985). Building a transfusion medicine curriculum. in C.H. Wallas and T.L. Simon (Eds.) *Education Programs in Transfusion Medicine*. (pp 14-25). Arlington, VA: American Association of Blood Banks.

Whitehead, A. N. (1929). *The aims of education and other essays.* New York, NY: The Macmillan Company

Designing high quality learning environments: Reflections on some successes and failures

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Over the past decade, there have been many changes in the tools we use to design, the ways information can be represented and the underpinning theories which drive educational experiences. This presentation will focus on several examples of software design that have been pedagogically successful and have demonstrated what is possible in software design and online learning. Contrasts will be made with some examples of the current push into e-learning and how best to structure learning environments to ensure student participation and high quality learning outcomes especially when students come from differing backgrounds and cultural traditions.

"A poor tradesman blames his tools"

Over the past decade there have been several major developments which have helped the growth of interactive multimedia and more recently the concept of e-learning. The task for designers has been challenging and this paper reviews several projects, many of which broke new ground and won international awards. Along the way the reality of creating innovative products which represent good practice and seek to model modern educational principles has been driven by several factors not the least being the tools which have been used and the visual representations of the knowledge domain of each product. This paper will describe several projects and critique their design ideas and their execution.

Significant efforts have been made to develop and implement alternative frameworks for learning often based on a class of theories collectively referred to as constructivism. Fundamentally, constructivism asserts that we learn through a continual process of constructing, interpreting, and modifying our own representations of reality based on our own experiences. Indeed many books enumerate a long list of ideas about how these principles might be applied to the design of learning environments, but how to place the ideas strategically into the learning experience is often omitted (see for example, Khan, 2001; and Mills, Lawless and Merrill, 2001). Often the advice is very broad and covers all aspects of pedagogical design from methods to integrate new technologies to potential assessment strategies. The integration of technologies, which may allow the representation of ideas in many different media forms, provide opportunities for the designer or instructor to customise instruction and place learners in open-ended, student–centred, rich tasks.

This paper explores what has been effective and what, while superficially might be seen as an effective product or set of ideas, might not have been as successful as first expected. It will generalise some of the lessons that might be drawn from the decade of effort to ensure that the learning environments:

1. fostered judgement and learner responsibility.
2. supported critical inquiry and creative approaches to problem-solving
3. created engagement through the effective combination of learning task, visual representation and authentic assessment of the product goals.

Principles assumptions and quality

Like past revolutions in education, e-learning will go the way of previous technologies unless there are changes to the design framework used as the starting point. Savery & Duffy (1995) described four principles that should be applied to modern technology-based learning environments based on constructivist views. These were:

1. Learning is **an active and engaged process**. "Learners are actively engaged in working at tasks and activities that are authentic to the environment in which they would be used." (Savery & Duffy, 1995, p.37).

2. Learning is **a process of constructing knowledge**. Learners need structures and challenges from which to develop their understanding of ideas and of the world.
3. Learners **function at a metacognitive level**. Learning is focused on thinking skills rather than working on the "right answer the teacher wants". Students generate their own strategies for defining the problem and working out a solution. Student can gain wisdom through reflection.
4. Learning involves "**social negotiation**". Students are able to challenge their thoughts, beliefs, perceptions and existing knowledge by collaborating with other students thus assisting their cognitive development process.

In a recent paper, David Boud and Mike Prosser (2002) have also attempted to specify the characteristics of high quality learning outcomes. They suggest that the four major areas of concentration in a high-quality learning environment should be:

1. How do learning activities support **learner engagement**? (This reasons for the learner wishing to become involved with the learning tasks and the way the tasks require them to reflect or employ their previous interests and understandings)
2. How does this learning activity **acknowledge the learning context**? (In the case of e-learning there are unique characteristics such as the unique position of the learner in a real context and how the assessment matches the real world skills that are seen as easily transferred from the learning context to professional practice)
3. How does the learning activity seek to **challenge learners**? (Novices need supportive structures, experts require information to fill in the missing blanks in an existing knowledge structure, too much ambiguity can turn a student away, too little and they become bored. Students might need support to extend the information provided as part of a problem-solving scenario)
4. How does the learning activity **provide practice**? (As with most effective learning contexts the matches between assessment, learning tasks, and the transfer tasks might align and model performance. To ensure that it occurs, the feedback must support the ongoing development of the learning)

In addition, in the e-learning context the choices of technology infrastructure and its deployment are crucial to support the effective learning outcomes. So the above lists describe the goals for constructivist design and high quality outcomes, but the choice of tools and the range of pedagogical options that the tools themselves either constrain or facilitate will also contribute to the learning outcomes. David Jonassen (2000) has provided recent guidance about the importance of the design of learning tasks by suggesting a range of problem types that vary in the degree of structure and the linkage they have to authentic real world tasks. Providing structure and support for the more ill-structured task is the real challenge for the designer working in a constructivist framework.

Design intentions for digital media

With an understanding of the shortcomings of much of the commercially generated available learning packages, a combination of ideas taken from constructivist learning environments, situated learning and problem-based learning in rich information landscapes can be used to form the basis for effective design. Hedberg et al (1994) proposed that learning outcomes in digital environments depend on starting points such as; the learning environment; the learner's view of the purpose of the task; and the motivation of the learner.

The process of learning involves the construction of meanings by the learner from what is said, demonstrated or experienced. Thus the role of the teacher is one of facilitating the development of understanding by selecting appropriate experiences and then allowing students to reflect on these experiences. Often constructivist learning situations *suddenly* throw students on their own management resources and many fend poorly in the high cognitive complexity of the learning environment. Cognitive support tools and the explicit acknowledgment of the double agenda of metacognitive self-management and learning can help. The scaffolding and coaching of the cognitive apprenticeship model offers another solution, a strategy which many design teams have explored with a great deal of success.

Several multimedia design models have been developed which illustrate the combination of complex learning environments and which also give students their own real control over their learning environment. If one of the primary goals of e-learning is to stimulate active involvement, then educators and instructional designers need to better understand the symbiosis between the visual interface and the design of the learning tasks in promoting and sustaining learner engagement. Engaged learners are intrinsically motivated to perform. They direct their efforts to understanding the tasks and challenges in a learning context; and they strive to construct knowledge and derive meaning from their prior experience and available resources. Well designed visual interfaces can help stimulate learner engagement or, conversely, disengage learners if they are poorly designed. Poor design can place high cognitive demands upon the learner that can reduce interest and divert attention away from the primary learning tasks. While not described in detail here, the combination of visual clarity of knowledge representation and manipulation and the sensitivity to outcomes of the learning task is which create challenge and engagement is a measure of the design success (Metros and Hedberg, 2002).

Instructional designers continue to wrestle with the challenge of affording a new generation of visually savvy learners with engaging online experiences. In her seminal book *Computers as Theatre,* Laurel (1993) suggested ways to use the notion of theatre, not simply as a metaphor, but as a way to conceptualize human-computer interactions. Laurel defines this type of engagement as, "what happens when we are able to give ourselves over to a representational action, comfortably and ambiguously. We gain a plethora of new possibilities for action and a kind of emotional guarantee" (p115). What Laurel is referring to is *Flow State*. Csikszentmihalyi (1996) coined the term to describe the state of total engagement. Users attain *Flow State* when they have no conscious awareness of the passage of time. *Flow State* occurs when users enjoy a sense of playfulness, a feeling of being in control, a period of concentration when attention is highly focused, an interlude of enjoyment of an activity for its own sake, a distorted sense of time, and a rewarding match between the challenge at hand and one's personal skills. The emphasis on motivating tasks situated within well-designed and engaging interactions provides the instructional designer greater surety that the final experience will be effective.

Creating a framework for review

Step 1: Information Design and Project Space Definition

At the beginning of any project it is necessary to compile information on learners' needs and describe the parameters of the project space. The purpose of this initial stage is to begin a holistic structuring of the information and to model it so that it will eventually form the basis of an organizing visual metaphor. Isolating the key attributes within a learning experience is not trivial. Three questions need to be answered by the client and designers.

1. *What is the topic (content) of this project*?
2. *Who are the intended users of this knowledge domain*? The content might be the same for different groups, but learners may want to "view, use or manipulate" the content in different ways.
3. *Why is this project(course) being undertaken or developed*? The client's original stated objective almost always needs revisions to better identify and describe the underlying purpose.

Step 2: Interaction Design

Effective interaction design that matches users' cognitive expectations ensures they are motivated and engaged. Simply the use of interactive technologies does not necessarily ensure that meaningful interactions will occur, rather The challenge is to create interactions that are easily manipulated at the users' technology skill level. Norman (1988) provides guidelines for constructing interactions.

1. *Visibility*: The user can tell the state of the device and the alternatives for action through observation.
2. *An effective conceptual model*: There should be consistency in how program functions "work" leading to a coherent conceptual user model.
3. *Effective mapping*: There are clear relationships between actions and results, controls and their effects, and between system state and what is visible.
4. *Feedback* : There must be continuous feedback about the results of actions. Novice designers often fail to realize that almost every action creates some perturbation. For feedback to be effective, designers should employ a variety of feedback that link to specific learning outcomes.

In addition to Norman's guidelines, there are alternative techniques for reducing the cognitive load on a learner's working memory to enhance interaction design.

1. *Use visual conventions borrowed from the real world*.
2. *Apply consistent visual metaphors*.
3. *Recognize the role of the learner as actor*. The user is participating in a dialogue that is unfolding, often in real-time (Laurel, 1993; Hedberg & Sims, 2001).

In several products, we provide access to the data in the same way as individuals would access, manipulate and explore resources in the real world. While there still must be supportive scaffolds and structures, the choices the learners make under this model are similar to those they make as "experts" in a knowledge domain. The only difference is that the tasks have supportive elements that describe decisions in context (Lave & Wenger, 1991). Visual metaphors and information structures must provide information-rich presentations, especially when the structures are extensible and can be unfolded, as the learners need more or less support and scaffolding to complete their chosen learning tasks.

Step 3: Presentation and Interface Design

The third step transforms the design concepts derived in the first two steps into a visual presentation structure, which represents concepts, conveying order, classifying information, clarifying meaning, directing focus, stimulating interest, facilitating interactions, confirming choices, supporting recall, directing navigation, creating ambience and otherwise engaging the learner. In many products, we chose visual metaphors of commonly-used places to serve as the context in which decisions about the learning tasks take place. Thus we used a field research centre for the ecological set of problems, a classroom with small groups placed around it to model groupwork for teaching K-2 mathematics.

Issues that have influenced the journey

While the above design intentions and process has been following to a greater or lesser extent, the following key aspects that have influenced the "judged effectiveness" of each project and have formed the basis of comparison:

- *Technological advances* — major advances in the past ten years have made a difference. Especially the advent of QuickTime in late 1991, the widespread availability of World Wide Web, and the use of browsers to drive cross platform products from 1994.
- *Visual Design* — mirroring the technology developments, several graphical design tools have improved and developed in the decade. Photoshop enables visual design overlays with their "layers"
- *Design of Learning Tasks* — the visual representation and the tools for constructing environments have been instrumental in achieving the growth in complex learning tasks and how they have been implemented in software.
- *Authentic assessment options* — as digital media became easier to integrate within products, the possibilities of presenting authentic environments where the assessment tasks were realistic and authentic became greater.
- *Clarity of team goals and ease of operation* — there are several options about how a team functions, as projects grew bigger the size of the team also increased but the relationships between client and designers, and the others contributing to the final product can have a critical bearing on the clarity of the representation of the knowledge space and the symbiotic relationship between the learning task and the visual representation of the task through the interface.
- *Degree of control of design team versus client demands* for particular outcomes. The client can support options to ensure new and creative implementation of their ideas. If this occurs then the project can push the boundaries, create new representations and more challenging tasks.
- *Implementation support in the field* — a project may have the best of intentions but it may not have support which makes it viable to generate high use by the intended audience. Also the increasing combination of CD-ROMs and web sites designed to maximise the feedback and interactivity can ensure that the products have the equivalent of "after sales service".

Examples of effective Symbiosis

The complete list of examples is provided at http://www.emlab.uow.edu.au/. However simple illustrations of the review can be drawn from the CD entitled "*123 Count with me*," which illustrates the application of the model (Figure 1). The CD introduces basic mathematical concepts to K-2 teachers and shows them how they might use an innovative instructional strategy to group students and introduce basic mathematical concepts. If a comparison is made between the two different approaches to a similar task (Figures 1 and 2), it can be seen that the poor representation of Figure 2 (and the fact that it varies with cursor movement) can be very difficult for an audience which does not hold sophisticated interface conventions. The comparison can be made over a range of factors which are outlined in the next section. (Other examples will be demonstrated in the presentation. These will be based on several products, including: *Stagestruck*, *Exploring the Nardoo*, *aspire*, *Pilotage* and *Count me in too*.)

Figure 1. Modelling the information and the message in "123 Count with me" through a spatial metaphor familiar to the intended audience

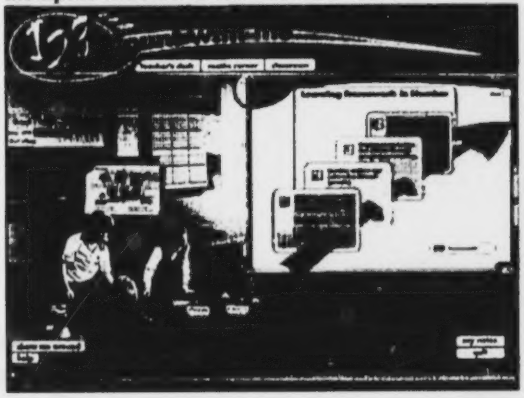
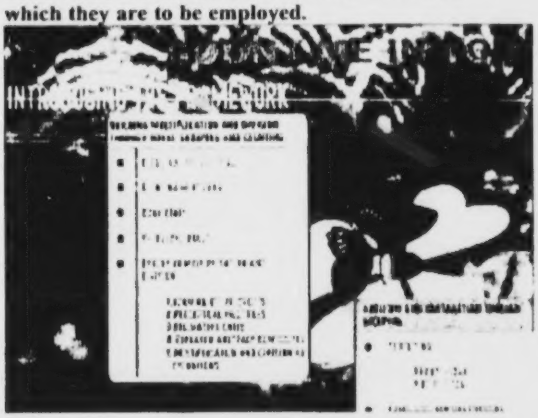


Figure 2. An alternative implementation of similar ideas without solid links to the environment in which they are to be employed.



Ensuring successful outcomes

There are many factors that might be judged as creating successes and when they are lacking producing less successful products. However in this paper, I will concentrate on a few:

Implementing the design concept. An idea at the concept stage may not necessarily translate into a good visual representation as the project develops. For instance, in developing materials to teach teachers how to implement a math program then the visual representation of those ideas has to correspond with the original concepts and intentions. Comparing the two figures (1 and 2) above which illustrate two forms of the same idea. Figure 1 was judged more comprehensible by the client. While in Figure 1, the major focus was to introduce mathematical understandings to an audience of remotely located teachers, for Figure 2, the emphasis was on explaining the nature of the mathematical framework and the visual elements became more focussed on decoration rather than functionality.

Representing information so that it can be accessed and manipulated. In the same example, in providing a list of options the use of the directory metaphor has been employed. In the early stage of design of *123 count with me*, we identified three organizing areas in which the related elements of information could be clustered and which provide meaningful structures for a teacher using a classroom metaphor.

Implementing constructive and problem-based activities. In many learning environments, learners can manipulate the elements which form the basis of their construction. Again in the above example, several capabilities have been provided which simplify some of the teacher/user tasks. There is a subtlety and a strategy to the design of activities which will lead to active use and engagement. The choice of problem (Jonassen, 2000) and the subtle development of activities that move from social to task focus suggest the direction of challenge for the designer. Jonassen (2000) has demonstrated how his initial theory of problem design can be translated into challenging tasks. Often this will mean that initially task a designed as series of discreet assignments, a rethink can create a series of linked tasks and challenges, and when these are woven into an ongoing scenario in which the student builds their skills as the go through the activities sequence then powerful learning outcomes can be produced.

Conclusion

Effective e-learning environments build upon solid foundations of learner needs and outcomes, metaphorically crafted cognitive processes, and instructional strategies communicated through effective visual interfaces that intrigue, challenge and engage the learner. Crafting of such projects requires an approach in which the instructional designer, technologist, graphic designer, educator and student collaborate to ensure that the end result is usable, functional and visually communicative and attractive. This can be accomplished by employing

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reasonable yet innovative conventions; such as organizing visual metaphors that scaffold access to the underpinning knowledge; choosing tasks that support the desired level of challenge and engagement. As interactive technologies become the staple communication vehicle for virtual worlds, effective interactive instructional design based on constructivist principles will ensure that the learner's focus on the learning task rather than simply operating the software. The choice of authoring tools can also greatly affect the way information may be structured and manipulated. Popular authoring tools may actually reduce the interactivity and information representations that are possible (Hedberg & Sims, 2001). Achieving success means that there is coherence between task, its visual representation and the project functionality. So the choice of tool, the selection of task and the importance of an engaging learning experience need to be undertaken with insight. And for e-learning, while some tools might facilitate the physical process of putting educational materials online and creating learner access, they may also never address the educational outcomes for high quality learning.

References

123 Count With Me. (2002) Sydney: NSW Department of Education and Training, Executive Producers, Kerry Long and John Hedberg, Instructional Design Shirley Agostinho, John Hedberg, Kerry Long, Vicki Lowery and Rob Wright, Graphic Design, Karl Mutimer.

aspire. (1999) Carlton South, Vic: Curriculum Corporation. Developed for the Australian Olympic Committee by Curriculum Support Directorate, NSW Dept of Education and Training Interactive Multimedia Learning Laboratory, University of Wollongong, and Curriculum Corporation. (A CD-ROM based interactive multimedia package)

Boud, D. & Prosser, M. (2002). Appraising new technologies for learning: a framework for development. *Educational Media International*, 39(3), in press.

Csikszentmihalyi, M. (1996) Thoughts about education, In D. Dickinson (Ed.) *Creating The Future: Perspectives on Educational Change*, Seattle, WA: New Horizons for Learning. Retrieved November 20, 2001 from http://www.newhorizons.org/crfut_csikszent.html.

Exploring the Nardoo. (1996) Canberra: Interactive Multimedia, Project Manager Barry Harper, Instructional Design Barry Harper, John Hedberg, Rob Wright, Grant Farr and Christine Brown (A CD-ROM produced in collaboration with NSW Dept of Land and Water Conservation)

Hedberg, J. G., & Sims, R. (2001). Speculations on design team interactions. *Journal of Interactive Learning Research*, *12*(2/3), 189-214.

Hedberg, J. G., Harper, B. M., Brown, C, & Corderoy, R, (1994). Exploring user interfaces to improve learner outcomes. In K. Beatie, C McNaught, & S. Wills, (Eds.), *Interactive Multimedia in University Education: Designing for Change in Teaching and Learning*. Amsterdam: North Holland, Elsevier, pp 15-29.

Jonassen, D. H. (2000). Toward a design theory of problem solving. *Educational Technology Research & Development*, *48*(4), 63-85.

Khan, B. (Ed.) (2001). *Web-based Training*. Englewood Cliffs, NJ: Educational Technology Publications.

Laurel, B. (1993). *Computers as Theatre*. Reading, MA: Addison-Wesley.

Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral practice*. New York: Cambridge University Press.

Metros, S.E. & Hedberg, J.G. (2002). More than Just a Pretty (Inter) Face: The Role of the Graphical User Interface in Engaging Learners. *Quarterly Review of Distance Education, 3(3)*.

Mills, R. J., Lawless, K. A. & Merrill, M. D. (2001). Designing Instructional Templates for Web-Based Training. In B. Khan (Ed.) *Web-based Training*. (pp.99-105). Englewood Cliffs, NJ: Educational Technology Publications.

Norman, D. (1988). *The Psychology of Everyday Things*. New York, NY: Basic Books.

Savery, J. R., & Duffy, T. M. (1996). Problem Based Learning: An instructional model and its constructivist framework. In B. G. Wilson (Ed.), *Constructivist Learning Environments: Case Studies in Instructional Design*. (pp. 135-148). Englewood Cliffs, NJ: Educational Technology Publications.

StageStruck. (1998) Sydney: National Institute for Dramatic Art. Project Director, Amanda Morris, Multimedia Producer, John Hedberg; Instructional Design, John Hedberg and Rob Wright (CD-ROM produced as part of the Australia on CD program, funded through the Department of Communication, Information Technology and the Arts, Canberra.)

Summary of key projects and their focus

123 – Count me in Too Credentialing Package (in production) Client: NSW Department of Education and Training, Curriculum Support Directorate.

Following the success of the earlier package, this package is being designed to assess the performance of those teachers who are seeking accreditation as "experts" in the use and application of the 123 K-2 mathematics program. It consists of a CD-ROM and links with a central site that will mark each authentic assessment.

123 - Count with Me (2002) Client: NSW Department of Education and Training, Curriculum Directorate.

The primary focus of the '123 Count With Me' CD-ROM project is to provide professional development to primary school teachers in small, remote schools who do not have easy access to district consultancy support. The project is based on the content of the Curriculum program "Count Me in Too", which is a numeracy program aimed at K-2. This numeracy program increases teachers' understandings about how children can be assisted to progress through the early components of the Mathematics syllabus in relation to Number.

K-6 Creative Arts Syllabus Professional Development (2002). Client: NSW Department of Education and Training, Curriculum Directorate

The aim of this project is to provide a tool for teachers that helps them to implement the Creative Arts K-6 syllabus. The CD-ROM illustrates and explicates the syllabus and CSD resources, demonstrating the syllabus in practice. Practice and methodology is shown through a range of visual and text modes. The CD-ROM allows teachers to explore all aspects of the syllabus, in a way that suits them as adult learners. The structure and content contained within the resource will support investigation by individual teachers working alone or in groups working under the guidance of a curriculum officer.

Pilotage Courseware (2001). Client: IMPART Corporation, RAN and SAF

The Royal Singapore Navy and Royal Australian Navy requested the submission of a creative solution to increase the level of success that trainee Officers of the Watch currently enjoy and the level of access they have to a flexible, practical training environment. Trainee Officers are provided with the basic background theory of pilotage, and a means of practicing the application of this knowledge and developing associated skills. This occurs in a simulated 'real life' environment that is consistent with being a pilot on a combat ship. In effect this provides an effective training environment whilst avoiding the usual risks and costs associated with conducting such practice in the real world.

aspire –Olympic Resource Kit for Australian Schools (1999). Clients: SOCOG; AOC; Collaborators: Dept of Education and Training; Curriculum Corporation

aspire: an educational kit developed for the 2000 Olympic Games comprises, a CD-ROM, booklet, posters and video and was distributed to schools Australia wide in 1999. The aim of the kit is to foster enthusiastic engagement in the Olympic experience and a belief in the Olympic spirit. It sought to raise interest in the Sydney 2000 Olympic Games and promote the richness and cultural diversity of Australian life and national identity. The target audience was wide K-12.

StageStruck (1998). Collaborators: The National Institute of Dramatic Art, The Australian Ballet, Opera Australia and The Sydney Opera House

StageStruck - was developed with the assistance of the Federal Government's Australia on CD Program. StageStruck was designed for students to experience the world of the performing arts as well as showcasing the diversity of Australian Performers and Performing Arts Companies. StageStruck provides a highly interactive environment where students are able to explore each of the elements associated with designing and directing a performance whilst creating their own. Awards have been numerous and include: In 1998, EMMA Gold Award- best overall; BAFTA Interactive Treatment award in the United Kingdom. In 1999, New York Festivals International Interactive Multimedia competition - Gold Medal in the Education section; AIMIA Award - Best Arts/Cultural Title or Site and in 2000 it won the Milia d'Or Awards for the Education & Training Category

Exploring the Nardoo (1996). Client: Department of Land and Water Conservation, New South Wales

This is a program based on an inland water catchment, which can be investigated through four time zones and four locations in each time zone. Each time zone has a particular theme that transposes the four locations and each location will have an embedded investigation in the form of a scenario. Users can move readily from location to location in each time zone and from zone to zone. Students will be able to interrogate data and personalise results. The user investigation is supported by help facilities and guides as well as simulations and games designed to support solutions to problems. In 1? ? ? it won an EMMA Award (European Multi-Media Association) and one of best five new educational products for 1997 by the American Software Publishers Association.

Investigating Lake Iluka (1993). Collaborator: Apple Computer Australia

A simulated lake environment on CD ROM. Students can investigate various ecosystems of the lake, make physical, chemical and biological measurements, collect information about individual animal and plant species in and around the lake, and see and hear news reports, expert views and local opinions on a variety of issues relating to the lake and its ecology. Inquiry and problem-solving techniques have been embedded in the package through case studies of ecological scenarios presented to the user via media reports of problems posed directly to the user.

Developing Evaluation Frameworks for Assessing Quality ICT-based Learning in Higher Education

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Abstract

This paper describes the evaluation of high quality learning designs which are being selected for possible redevelopment in a National Project funded by the Australian University Teaching Committee (AUTC). The project focuses on "Information and Communication Technologies (ICTs) and Their Role in Flexible Learning" and is evaluating over 50 projects with a view to developing a range of software tools, templates and/or guidelines based on those that are deemed to be effective ICT-based learning projects. The approach is unique in that it tries to pinpoint the key attributes of ICT-based projects that make them suitable for application in other contexts and in other knowledge domains.

Introduction

There tends to be general consensus among experts that the forms of learning environments most effective for meaningful learning in higher education are those that are based on the contemporary theories of learning which support knowledge construction through learner-centred settings (e.g. Duffy & Cunningham, 1996; Bostock, 1998). These perspectives about learning are challenging conventional teaching approaches. For example, Cunningham et al. (1998) state:

> The growing acceptance of new educational philosophies and practices, such as constructivism and action learning during the 1980s, have challenged the valence of the didactic lecture/tutorial/textbook model common in higher education, promoted the notions of the academic role as 'a guide on the side' rather than 'the sage on stage', and conceived of the student role as one of independent self-directed learner. (p. 25)

The growing awareness of effective and meaningful teaching and learning plus the recent developments in ICT has led to synergies emerging between the use of ICT and the adoption of powerful learning strategies. The Web is one technology that shows particular promise for supporting meaningful learning through its remarkable functionality, support for flexible delivery modes and capacity to link and connect those involved in the learning process (e.g. Levin, 1999). The possibilities exist for rich learning based on this technology, but for the most part, pedagogically sound and exciting Web courseware tools have yet to be developed to take advantage of such opportunities.

One of the key issues is that the pace of change of emerging Web technologies is so rapid that pedagogical models may be needed to help create Web tools from a learner-centred perspective. Salomon (1998) has supported this concern and has noted that for the first time in history, technologies are outpacing pedagogical and psychological rationale. However, a body of literature is starting to report on innovative tools, with strong pedagogical underpinning. Bonk (1998) has reported on interactive tools for on-line portfolio feedback, profile commenting, and Web link rating. Oliver and McLoughlin (1999) are building tools for on-line debate, reflection, concept mapping and student surveying and discussion. Wills, Ip & Bunnett (2000) are building engines for online role plays. As a way of describing the range of options that might contribute to a learning design in such contexts Figure 1 shows the combination of elements that might be considered in such an endeavour.

In this project, the terms "learning designs", "high quality learning experiences", and "flexible learning" are defined as follows: *Learning designs*: refer to a variety of designs that support student learning experiences. Learning designs may be at the level of a whole subject, subject component or learning resource. *High quality* *learning experiences*: refer to experiences resulting from an environment, which encourages students to seek understanding rather than memorisation (only for the purposes of assessment), and which encourage the development of lifelong learning skills. *Flexible learning*: refers to an educational approach that meets the diverse needs of students. The project is to focus on how ICT can be used to design flexible opportunities for students.

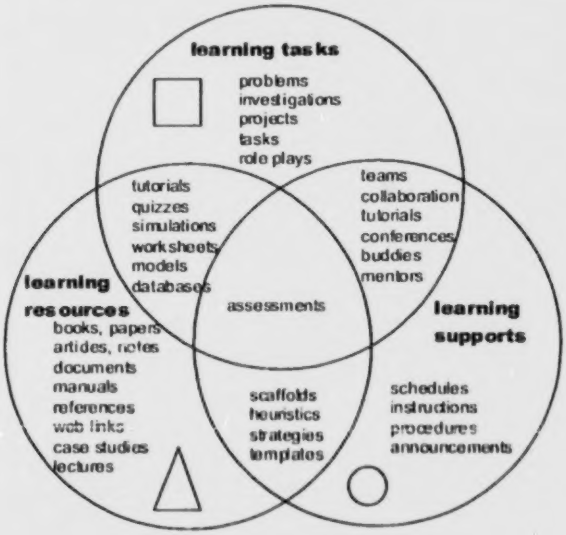
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Figure 1: Elements of learning designs for online learning

Current settings hold fewer impediments to ICT uptake than have been present in the past. Universities within Australia have moved swiftly in recent years to develop the necessary infrastructure to support ICT as a delivery medium and most universities now boast a solid ICT infrastructure aimed at supporting teaching and learning programs. The uptake of ICT as a delivery medium has been supported by professional development programs and activities aiming to develop the ICT literacy of staff plus clearinghouses and Web sites for dissemination of information about ICT in teaching. Funding has been applied by government sources to support the development of university teaching and learning and many organisations now exist that support and promote quality teaching as a scholarly pursuit. Among the major impediments that still stand are the lack of quality teaching and learning models and appropriate instructional material and software for teachers to apply.

This project aims to provide some relief to these impediments by identifying and creating quality resources for generic and mainstream application and by providing appropriate support and resources that will guide and encourage their use. Projects of this type should result in a coming decade that witnesses a growth in pedagogically based learning technologies.

Aims of this project

The aim of this project is to assist university instructors to create high quality flexible learning experiences for students by providing a range of generic resources/tools/templates/guidelines that draw upon successful flexible learning projects that utilise ICT and which may be generalised beyond the scope of the individual project. Successful ICT-based learning projects are those that facilitate high quality learning experiences for students. A study conducted by Alexander and McKenzie (1998) highlighted that one contributing factor towards a successful learning outcome for an ICT-based learning project was the learning design employed. Thus, this project has followed the process:

1. Identification of a range of learning designs that have been demonstrated to contribute to high quality learning experiences and which can be applied generically;

2. Design and subsequent development of a series of re-usable software, templates and/or guidelines for the learning designs previously identified; and
3. Dissemination of good practice for the use of or implementation of the software, templates and/or guidelines in new contexts.

Crucial to the success of this project was the development of an evaluation instrument referred to by the project as an *Evaluation and Redevelopment Framework* (ERF), with a twofold purpose:

1. To facilitate the identification of learning designs that foster high quality learning experiences; and
2. to provide a mechanism to determine whether such learning activity designs have the potential for re-development in a more generic form.

Project structure

The project began in November 2000 and is structured against four milestones:

1. *Milestone One (May 2001):* Development of the Evaluation and Redevelopment Framework
2. *Milestone Two (November 2001):* Identification and documentation of learning designs that foster high quality learning experiences and that have the potential for redevelopment in a more generic form.
3. *Milestone Three (June 2002)*: Development of a selected number of learning designs in a generic form to at least prototype stage.
4. *Milestone Four (December 2002):* Completion of the development of learning designs in a more generic form and finalisation of a web site that will store the project's developed resources.

Development of the Evaluation and Redevelopment Framework

Characterising High Quality Learning

A major project activity has been the critique of what constitutes "high quality learning". Professor Boud and Associate Professor Prosser were commissioned, as two leading thinkers about learning in higher education in Australia, to develop a paper on high quality learning. Their ideas together with feedback from the project team led to the development of a set of "Key Principles for High Quality Student Learning in Higher Education—from a Learning Perspective" (Boud & Prosser, 2001). The key principles describe four main characteristics that underpin high quality learning in the higher education context. The principles are elaborated through a series of questions that provide a lens through which learning environments can be explored. The four principles are holistic in that they incorporate both learning outcomes and learning processes and are based upon an experience-based learner-centred view of learning. The four principles are outlined below in the form of descriptions of high quality learning activities.

High quality learning activities:

1. **Engage learners through:**
   - Building on their learning intents generally and their particular expectations of the activity in question;
   - Acknowledging and taking account of their prior experience, both their knowledge and experience of situations which might impinge on the present ones;
   - Mobilising their will and desire and developing some kind of emotional engagement with the task in hand;
   - Providing them with a sense of agency with respect to the activity or significant parts of it; and
   - Recognising that learning is a social act and involves other learners for at least part of the activity.

2. **Acknowledge context through:**
   - Involvement with problems in context;
   - Recognising the context of the learner (who may see themselves as decontexualised);
   - Maintaining an awareness of the cultural assumptions and stereotyping which may be incorporated in the context;
   - Situating learning tasks within disciplinary or professional or practical knowledge as appropriate;
   - Taking account of the site of application of what is to be learned (this poses different challenges when the learner is currently engaged in the site of application and when they are not);
   - Appreciating the knowledge demands on students and equipping them to deal with them; and
   - Ensuring that there is a clear alignment between the activities in which students will be engaged and the ways in which they will be assessed.

3. **Challenge learners through:**
   - Prompting them to seek and discern variation in the knowledge and experiences in which they are involved;
   - Questioning the assumptions they bring to the activity and the assumptions they develop through it;
   - Encouraging them to see what is provided as a means to wider ends and go beyond what is provided; and
   - Creating situations in which they are required to take responsibility for their own learning and to shape the activity to their own ends.

4. **Involve practice through:**
   - Demonstrating what has been learned for themselves and for others;
   - Gaining feedback at strategic points in learning, but also recognising that finding ways of gaining feedback for one self other than that provided is also important;
   - Reflecting on and making sense of their experiences. Continuous exposure to new activities without integration and consolidation within the learner's framework is not conducive to good learning; and
   - Developing confidence in performance from practice.

Developing the evaluation instrumentation

Whilst the above principles formed the basis of the evaluation framework, the following issues were raised by the reviewers that they should be incorporated into the instrument:

- How technology is embedded in a learning design and how its use supports or hinders the learning experience.
- The issues of scalability, transferability, and technology affordances.
- To determine suitability of redevelopment of a learning design, the evaluation should provide a mechanism to glean the critical design features from a learning design and consider how these design features could be implemented in a more generic form.
- To place the review framework within a staged process which might inform the project through a series of critical decision points.

The first complete version of the evaluation instrument was devised by the Core Team and Research Team after the first workshop. This version was formatively evaluated in the second workshop (scheduled one month after the first). The Research Team also examined existing evaluative instruments to determine whether these could inform and/or be incorporated into the project's evaluation framework.

Since the second workshop (held at the end of April 2001) the evaluation framework has undergone further review and formative evaluation. Feedback from the Project Review Panel and International Reference Group has been considered and via discussions with the Core Team, Research Team and Steering Committee, a revised version of the evaluation framework has been developed. A challenge for the project has been how to elucidate the key and/or unique elements of the learning design that enable the facilitation of a high quality learning experience for students. The strategy thus adopted is to request a description of the learning design by the designer(s) in a contextualised form in terms of the following:

- The learning activities (and their sequence) that students are required to do.
- The resources that are required to support the activities.
- The support mechanisms that characterise the learning design, eg., role of the instructor, establishment of collaborative teams, etc.

In addition, all resources utilised by the students along with any evaluation data or findings have also been submitted. The evaluation review framework was implemented in two phases. The purpose, process and outcome for each phase are outlined in table 1.

Table 1: Evaluation Redevelopment Framework Implementation

Phase	Purpose	Process	Outcome
Phase 1	• Identify and describe the learning design. • Assess the data sources	Completion of two instruments: 1. Learning Design Submission Form —to be completed by the designer(s) of the learning design. 2. Learning Design Assessment Form—to be	• Detailed description of the learning design from the designer(s). • Decision whether to proceed to Phase 2. (If to proceed to

Table 1: Evaluation Redevelopment Framework Implementation

Phase	Purpose	Process	Outcome
	provided and determine whether to proceed to Phase 2.	completed by the Project Manager on receipt of the completed Learning Design Submission Form	Phase 2, details about Evaluation Team specified.)
Phase 2	Evaluation of the learning design in terms of: • Its potential to facilitate high quality learning experiences for students. • Its suitability for redevelopment in a more generic form.	Completion of one instrument: *Learning Design Evaluation Form*. The instrument comprises eight questions: • Questions 1 to 4 address the potential of the learning design to foster high quality learning. • Question 5 addresses how the technologies employed facilitate the learning design. • Questions 6 and 7 are designed to elucidate the key and/or unique elements of the learning design. • Question 8 requires a judgement to be made about whether the learning design is suitable for redevelopment in a more generic form. The instrument is to be completed individually by two evaluators. The evaluators are to reach consensus and submit one completed *Evaluation Form*.	• Judgement of the potential of the learning design to foster high quality learning. • Generic description of the learning design. • Judgement of the learning design's suitability for redevelopment in a more generic form.

The current stage of the project

The current stage of the project is applying the framework to a number of Learning Design exemplars. The outcome from this activity is intended to provide:

1. Documentation of Learning Designs identified as having potential for redevelopment in a more generic form; and
2. A formative evaluation of the framework and its operationalisation to a level of "robustness" deemed adequate by the project team.

In this stage we have:

- Identified over 50 potential ICT-based learning exemplars for examination. 28examples will undergo full evaluation. Some strategies employed to compile the list of exemplars included: nominations made from the project team, review of past CUTSD (Committee for University Teaching and Staff Development) projects; and a review of relevant literature sources.
- Established approximately 30 Evaluation Teams. Evaluation Teams comprise pairs of national and international experts in the use of information and communication technologies for teaching and learning in Higher Education. Nominations have been made by the Project Core Team and by participants who attended a national flexible learning conference in July 2001.

From the feedback received it appears that many of the learning designs the core team identified for evaluation are suitable for redevelopment but the expense may not warrant it. Preliminary analysis of the evaluations returned to date raises the following questions for the core team to consider:

- Do we have a large enough range of types of learning designs?
- Is the evaluation framework adequate to enable reviewers' analysis of the generic attributes of any learning design?
- Are reviewers capable of distinguishing between the task of software evaluation and this task of evaluating the underpinning learning design?
- Are reviewers evaluating a particular implementation of a learning design for redevelopment or are they taking into account other implementations of that particular learning design?
- Do we have an adequate definition of learning design and has it been communicated to the evaluators?
- Is the evaluation process able to cover levels of granularity in learning designs? Should the tasks, resources and supports in the learning design also be evaluated?
- Can learning designs really be context-free?

- Will the essence of a learning design always be translatable into a software product or would it instead be better to write guidelines for good design?

In order to ensure the range of learning designs reviewed is not limited in representation of a broad range of pedagogical approaches, the project team explored the development of a Learning Design classification framework. An analysis of the learning design exemplars collected to produce a grounded learning design categorisation plus a review of categorisations of learning designs in the literature will be presented at the conference. The project Web site aims to inform people of the progress and provide access to the resources and materials as they have been developed. (**http://www.learningdesigns.uow.edu.au**)

References

Alexander, S. & McKenzie, J. (1998) *An Evaluation of Information Technology Projects for University Learning*, CAUT, AGPS, Canberra

Bonk, C. (1998). Bonk, C. J., & Cummings, J. A. (1998). A dozen recommendations for placing the student at the center of Web-based instruction. *Educational Media International, 35*(2), 82-89.

Bostock, S. (1998). Constructivism in mass education: A case study. *British Journal of Educational Technology, 29*(3), 225-240.

Boud, D., & Prosser, M. (2001, April). *Key principles for high quality student learning in Higher Education—form a learning perspective*. Paper presented at a workshop held on April 27, 2001 for the AUTC funded project: Information and Communication Technologies and Their Role in Flexible Learning, Sydney, Australia.

Cunningham, S., Tapsall, S., Ryan, Y., Stedman, L., Bagdon, K., & Flew, T. (1998). *New media and borderless education: A review of the convergence between global media networks and higher education provision*. Evaluations and Investigations Program 97/22. Canberra: Australian Government Publishing Service. Available: http://www.detya.gov.au/highered/eippubs1997.htm

Duffy, T., & Cunningham, D. (1996). Constructivism: Implications for the design and delivery of instruction, In D. Jonassen, (Ed.) *Handbook of research for educational telecommunications and technology*. (pp. 170-198). New York: MacMillan.

Green, K. (1998). *Colleges struggle with IT planning*. The Campus Computing Project. Available: http://www.campuscomputing.net/summaries/1998/index.html

Gold, B. (1999). Punctuated legitimacy: a theory of educational change. *Teachers College Record, 101*(2), 192-219.

Levin, J. (1999). Dimensions of network-based learning. *International Journal of Educational Technology*, 2(1).

Mioduser, D., Nachmias, R., Oren, A., & Lahav, O. (1999). Web-based learning environments: Current states and emerging trends. Paper presented at the Ed-Media 1999. (pp 753-758) *World Conference on Educational Multimedia, Hypermedia and Telecommunications*, Seattle, USA.

Oliver, R. and McLoughlin, C. (1999). Curriculum and learning-resource issues arising from the use of Web-based course support systems. *International Journal of Educational Telecommunication, 5*(4), 419-438.

AUTC Project Brief. (2000). *Information and Communication Technologies and Their Role in Flexible Learning*. Available URL: http://www.autc.gov.au/pr/flexbriefs.htm

Salomon, G. (1998). Novel constructivist learning environments and novel technologies: Some issues to be concerned with. *Research Dialogue, 1*(1), 3-12.

Tsichritzis, D. (1999). Reengineering the university. *Communications of the ACM, 42*(6), 93-100.

Wills, S., Ip, A. & Bunnett, A. (2000). Complementary pedagogical strategies for online design. In R. Sims, M. O'Reilly & S. Hawkins, (Eds.), *Learning to Choose – Choosing to Learn*, (pp. 405-414). Proceedings of the 17th Annual ASCILITE Conference. Lismore, NSW. Southern Cross University.

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Student Modeling in Computer-Assisted Language Learning

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Abstract: This paper provides an overview of Student Modeling techniques that have been employed in Intelligent Language Tutoring Systems (ILTSs) over the past decade. We further discuss the Student Model of our *ESL Tutor*, an ILTS for English as a Second Language. The Student Model is based on student subject matter performance and provides feedback and remedial exercises suited to learner expertise. We further report on a study in which we determined the extent to which our Student Model addresses the need for an individualized language learning environment.

1. Introduction

Individualized language instruction has long been recognized as a significant advantage of Computer-Assisted Language Learning (CALL) over more traditional workbook tasks. A "one size fits all" approach is not appropriate for a learning environment. Students learn at their own pace and often, work for their own purposes. Learners also vary with respect to prior language experience, aptitude, and/or learning styles and strategies. According to the Individual Differences Theory as described by Oxford (1995), if learners learn differently, then they likely benefit from individualized instruction.

Despite the need for an individualized learning environment, Student Modeling has not been a strong focus of CALL. One likely reason is that in order for a computer program to adapt itself to different learner needs, the system needs a dynamic model of the strengths and weaknesses of the learner (McCalla & Greer, 1992). Even when it comes to Intelligent Language Tutoring Systems (ILTSs), only a few have employed Student Models to individualize the learning environment. According to Holland & Kaplan (1995), this is likely due to the challenging task of representing the domain knowledge itself, the module which contains facts and information about the language being taught. If the grammar is not accurate and complete, even a precise Student Model cannot compensate. For instance, Holland (1994) states that a system which does not detect ambiguous errors accurately will obscure a Student Model.

There are a number of modeling techniques that can be implemented in a computer program. The system can model subject matter performance, students' learning strategies and/or cognitive styles. ILTSs primarily model subject matter performance, that is, students' surface errors. While such a Student Model might not be complete, it assists in individualizing the language learning process and "is sufficient to model the student to the level of detail necessary for the teaching decisions we are able to make" (Elsom-Cook, 1993: 238).

In this paper, we describe the Student Model of the *ESL Tutor*, our Web-based ILTS for English as a Second Language (ESL). The *ESL Tutor* analyzes sentences from the student and detects grammatical and other errors. The feedback modules of the system correlate the detailed output of the linguistic analysis with an error-specific feedback message. The Student Model is based on student subject matter performance. It provides feedback and remediation suited to learner expertise.

In the following section, we provide examples of CALL systems that employ Student Models and discuss their distinct emphasis. In section 3, we describe the architecture of the Student Model of the *ESL Tutor*. Section 4 reports on a study in which we determined the extent to which our Student Model addresses the need for an individualized language learning environment. Concluding comments can be found in section 5.

2. Student Modeling and Intelligent Language Tutoring Systems

In analyzing Student Models, McCalla (1992) makes a distinction between implicit and explicit Student Modeling which is particularly useful in classifying the Student Models in ILTSs.

An implicit Student Model is static, in the sense that the Student Model is reflected in the design decisions inherent to the system and derived from a designer's point of view. For instance, in an ILTS the native language of the learner can be encoded as a bug model that includes frequently made errors and ultimately diagnoses them.

In contrast, an explicit Student Model is dynamic. It is a representation of the learner which is used to drive instructional decisions. For ILTSs, for instance, the Student Model can assist in guiding the student through remedial exercises or it can adjust instructional feedback suited to the level of the learner. In either case, the decisions are based on the previous performance history of the learner. The following discussion will provide examples of ILTSs which have implemented implicit and explicit Student Models.

2.1 Implicit Student Models

Implicit Student Modeling has been applied to ILTSs to diagnose errors. For example, in Catt & Hirst's (1990) system *Scripsi* the native language of the student represents the learner model. It is used to model the learner's interlanguage. With regard to Student Modeling, the pitfall of such an implementation is that it is a static conception. The system's view of the learner cannot change across interactions with the system. It has no impact on instructional decisions and provides only a gross individualization of the learning process when ideally, a Student Model is dynamic (Holt et al., 1994).

In a more individualized example, Bull (1994) developed a system that teaches clitic pronoun placement in European Portuguese. The Student Model is based on the system's and the student's belief measures, language learning strategies, and language awareness.

The system's belief measure is comprised of the proportion of incorrect/correct uses of the rule; the students provide the data for the student's belief measure, being required to state their confidence in their answer when entering sentences. Learners also identify their preferred learning strategies when using the program. According to Bull (1994), language awareness is achieved by allowing the student access to all information held in the system. The information, however, is not used to drive the instructional process. A number of studies have also shown that students tend to not take advantage of the option to access additional information. For example, Cobb & Stevens (1996) found that in their reading program learners' use of self-accessible help was virtually non-existent, in spite of their previously having tried it in a practice session, and also having doubled their reading performance as compared to either a no help or dictionary help option in the practice session.

2.2. Explicit Student Models

In developing an explicit Student Model one typically starts by making some initial assumptions based on pretests or stereotypical postulations about the learner. For example, initially every student could be assessed as an intermediate. During the instructional process, the Student Model adjusts to student's behaviour moving to a novice or expert profile, as appropriate. This technique is used in explicit Student Models to make instructional decisions.

Explicit Student Modeling has been used in a number of ILTSs, primarily in the form of tracking. Tracking can be as simple as calculating percentages of correct answers or more sophisticatedly, identifying particular errors which occurred in the student's input. The information is then used to alter the instructional process, either in the form of further language tasks or feedback.

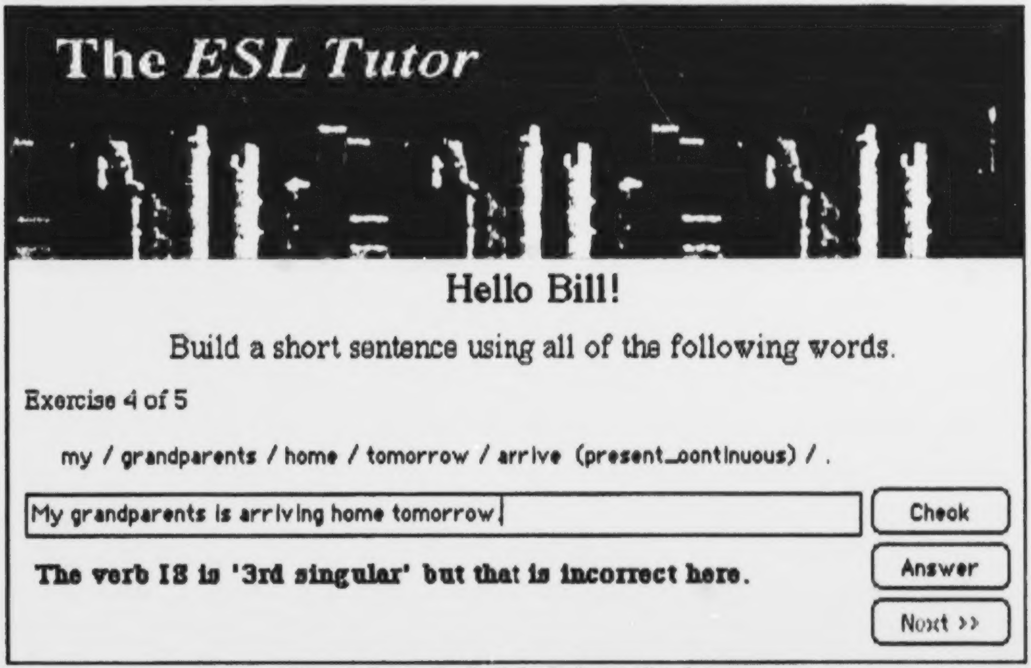
Explicit Student Modeling is found in the system *The Fawlty Article Tutor* (Kurup, Greer & McCalla, 1992) which teaches correct article use in English. The system presents the student with scenarios whereby the student must select the correct article form and the appropriate rule. The tutor keeps an error count and selects the scenarios on the basis of the performance of the student; thus the path through the program is individualized by altering the instructional process according to prior performance of the student.

Bailin (1988, 1990) in his system *Verbcon/Diagnosis* also employs the tracking method. *Diagnosis* provides practice in using English verb forms in written texts. All verbs are presented in their infinitival form challenging the student to provide the appropriate verb form. The system tracks the most frequent error occurrence and the context in which the error occurred. The information is used to provide informative feedback based on contrasting correct and ungrammatical uses of tenses. In addition, *Diagnosis* suggests exercises to help with the remediation process.

In the following section we describe the *ESL Tutor* and discuss the modeling technique used.

3. The *ESL Tutor*

The goal of the ILTS we have developed for ESL is to provide meaningful and interactive vocabulary and grammar practice for second language learners. The *ESL Tutor* analyzes sentences from the student and detects grammatical and other errors. The feedback modules of the system correlate the detailed output of the linguistic analysis with an error-specific feedback message.



Hello Bill!

Build a short sentence using all of the following words.

Exercise 4 of 5

my / grandparents / home / tomorrow / arrive (present_continuous) / .

My grandparents is arriving home tomorrow.

The verb IS is '3rd singular' but that is incorrect here.

Figure 1: System Feedback for the Intermediate Learner

In the *ESL Tutor*, feedback is individualized through an adaptive, explicit Student Model, which monitors a user's performance over time across different grammatical constructs. This record of strengths and weaknesses is used to tailor feedback messages to learner expertise within a framework of guided discovery learning: a beginner student will receive the most explicit feedback while the instructional messages for the expert will merely hint at the error. The feedback aimed at the beginner will also contain less technical terminology than that for the intermediate and expert. For example, Figure (1) shows a feedback message for an intermediate student, which indicates incorrect subject-verb agreement.

In contrast to Figure (1), the feedback message for the beginner learner will provide less linguistic terminology and state that *The verb IS is not correct here*. For the advanced learner, the feedback will provide less of a clue and simply display *There is an agreement error in this sentence*.
In the following section we discuss the technique employed in the Student Model of the *ESL Tutor*.

3.1. The Student Model of the *ESL Tutor*

The Student Model of the *ESL Tutor* dynamically evolves based on the student's performance. The information in the model is used for two main functions: modulation of instructional feedback and assessment and remediation.

The Student Model keeps track of an individual student's performance on a variety of grammar skills; from subject-verb agreement to passives to count/mass nouns. A student has a score for each grammar skill. This score ranges from 0 - n, where we have set n to 30. The score increases when the student provides evidence of a successful use of that grammar skill, and decreases when the student provides evidence of an unsuccessful use of that grammar skill. The amount by which a student's score increases or decreases can vary depending on the current value of the score. Initially, we set all scores to an intermediate level.

For the purposes of modulating instructional feedback, we identify 3 categories of scores. Scores from 0-10 are assigned to the novice category, 11-20 to the intermediate category, and 21-30 to the expert category.

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When a student makes an error on a particular grammar skill, the message they receive depends on their score for that skill. If they are ranked as novice, they will receive a more informative message than if they are ranked as an expert. Since the score for each grammar skill is independent of the score for the other grammar skills, a student may be expert at subject-verb agreement, but novice at forming the passive - and receive the appropriate message.

The score information is also used for a variety of remediation and assessment tasks. By comparing the Student Model at the beginning and end of a session, we can provide a summary of the mistakes that a student made during that session. In our current system, these are summarized into general categories such as "Verb Tenses", "Pronouns", etc. These groups are set by means of a parameter file. Similarly, we can also identify the grammar skills where the student was correct and provide a "positive" of what the student did right. At present we show a list of the errors at the end of each exercise set.

Further, one can also examine the Student Model overall and identify the current strengths and weaknesses of the student. We identify the strengths of a student as the five highest scoring grammar skills that have a score greater than 15 (half of the total scale). We identify the weaknesses of a student as the 5 lowest scoring grammar skills that have a score less than 15. Students can access this information.

Finally, the Student Model information can also be used to provide exercises to the student which focus on their areas of weaknesses. Instead of repeating the same exercise which the student made the mistake on, the *ESL Tutor* has the capacity to identify examples which require the same grammar skill. This avoids the problem of the student rote learning the solution to a particular example, without actually learning the general solution. We have not yet implemented this functionality in the *ESL Tutor*.

4. Evaluation

The Student Model of the *ESL Tutor* is based on our German system (Heift & Nicholson, 2001) which has been tested extensively. In one of the studies, we determined the extent to which the Student Model addresses the need for an individualized language learning environment. 33 students participated in the study and a total of 1352 sentences were considered for analysis.

When analyzing the data with respect to individualized instruction, we were interested in the types of errors that occurred during practice and their distribution with respect to the three learner levels: beginner, intermediate and advanced.

The error break-down in Table (1) shows that students were most often at the intermediate level, which is not surprising since each student is initially placed at the intermediate level. Nonetheless, approximately one third, or 30%, of the time, students either required more elaborate feedback suited to the beginner learner, or, in the case of the advanced learner, less detailed feedback was sufficient to correct the errors. Moreover, and although not illustrated in Table (1), ten students or 30.3% of all participants received remedial exercises for at least one of the six chapters.

	Beginner	Intermediate	Advanced	Total	%
Direct Objects (gender, number, case)	64	226	1	291	21.5%
Subject-Verb Agreement (person, number)	27	188	63	278	20.6%
Prepositional Phrases: Dative (gender, number, case)	48	185	1	234	17.3%
Indirect Objects (gender, number, case)	42	97	7	146	10.8%
Subjects (gender, number, case)	3	82	43	128	9.5%
Missing Words	17	37	12	66	4.9%
Prepositional Phrases: Two-way (gender, number, case)	21	47		68	5.0%
Prepositional Phrases: Accusative (gender, number, case)	15	39		54	4.0%
Extra Words	11	19	11	41	3.0%
Word Order	10	16	10	36	2.7%
Auxiliaries (*to have*vs. *to be*)	1	6		7	0.5%
Verb complements (infinitive vs. past participle)	1	2		3	0.2%
	260 (19.2%)	944 (69.8 %)	148 (11%)	1352	100%

Table 1: Break-down of Grammar Errors

The data further indicate that most errors occurred with direct objects (21.5%) and subject-verb agreement (20.6%). However, these were the most frequent constructions contained in the 120 exercises of this study. For instance, only chapters 5 and 6 (40 exercises in total) focus on the present perfect and modals. These constructions are not contained in any of the previous chapters, thus there is less opportunity for errors with these grammar topics than, for example, subject-verb agreement.

It is interesting, however, to consider the number of grammar errors made by each learner level. From a learning perspective, the data in Table (1) indicate three distinct groups:

1. those grammar topics where the error distribution for the beginner and advanced levels is fairly balanced (missing words, extra words, word order, auxiliaries, verb complements),
2. those grammar points where students are far more often at the beginner than the advanced level (direct and indirect objects, accusative, dative, two-way prepositions), and
3. those grammatical constructions where students are far more often at the advanced than the beginner level (subject-verb agreement, subjects).

The data of our Student Model also allow us to gain insight into students' performance on a particular grammar skill over time. For example, Figure (2) illustrates the performance on direct objects by four students who were randomly selected from our data set. The x-axis displays the five chapters that contain direct object constructions and the y-axis shows the scores which correspond to the three learner levels. The graphs indicate that one of the students stayed at the intermediate level throughout practice. In contrast, the remaining three students shifted from the intermediate to the advanced level. The data confirm that while there is variation across learners each student also changes performance levels as s/he progresses through the course.

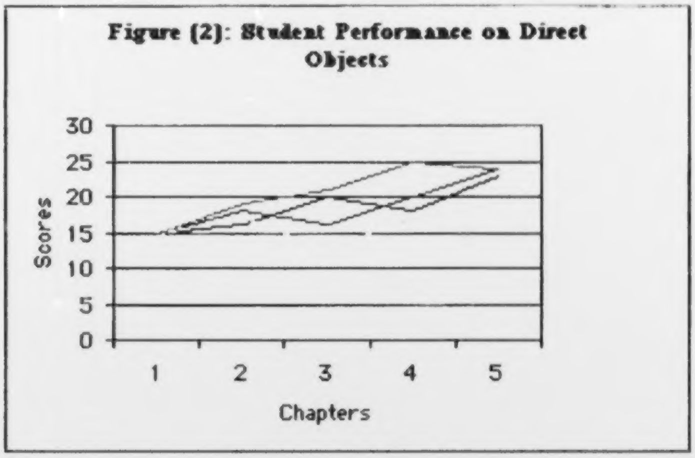
Figure (2): Student Performance on Direct Objects

The data support the need for an individualized system which makes subtle distinctions between learners and error types. Our Student Model has a number of advantages. It takes into account students' past performance, and by adjusting the score value to be incremented or decremented, it is adaptable to a particular grammatical constraint in an exercise or the pedagogy of a particular instructor. For example, a language instructor might rate some errors more salient than others in a given exercise. In such an instance, the increment/decrement of some grammar constraints can be tuned to change their sensitivity.

The main strength of our Student Model, however, is that a single erroneous message will not drastically change the overall assessment of the student. The Student Model indicates precisely which grammatical violations occurred, allowing for a fine-grained assessment of student competency. In consequence, a student can be at a different level for each given grammar constraint reflecting her performance of each particular grammatical skill. This subtlety of evaluation is desirable in a language teaching environment because as the student progresses through a language course a single measure is not sufficient to capture the knowledge attained and to distinguish among learners. The Student Model aids in directing each student toward error-specific and individualized remediation.

5. Conclusion

In this paper we provided examples of Student Models that have been employed in CALL over the past decade. We introduced our *ESL Tutor*, an ILTS that provides error-specific and individualized feedback. The Student Model of the *ESL Tutor* is based on learner performance history and makes system decisions accordingly.

A study in which we evaluated the extent to which our Student Model addresses the need for an individualized language learning environment emphasizes the importance of an adaptive language learning system that considers user diversity. Approximately one third, or 30%, of the time, students either required more elaborate feedback suited to the beginner learner, or, in the case of the advanced learner, less detailed feedback was sufficient to correct the errors. The data further confirm that while there is variation across learners individual students also change performance levels as they progress through a course.

Our study also provided some interesting insights into the error typology of different learner levels. Due to the constrained environment of the exercises of our system where students select from a given pool of vocabulary and grammatical structures, errors in omission, insertion and word order were less frequent than other grammar errors. Fewer errors occurred overall and thus the error distribution with respect to beginner and advanced levels was fairly balanced. We are currently establishing a similar error typology for our *ESL Tutor*.

References

Bailin, A. (1990). "Skills in Context and Student Modeling." CALICO Journal, 8: 7-22.

Bailin, A., and Thomson, P. (1988). "The Use of Natural Language Processing in Computer-Assisted Language Instruction." Computers and the Humanities, 22: 99-110.

Bull, S. (1994). "Student Modelling for Second Language Acquisition." Computers and Education, 23 (1-2): 13-20.

Catt, M., and Hirst, G. (1990). "An Intelligent CALI System for Grammatical Error Diagnosis." Computer Assisted Language Learning, 3: 3-27.

Cobb, T., and Stevens, V. (1996). "A Principled Consideration of Computers and Reading in a Second Language." The Power of CALL. Pennington, M. C. ed. Houston: Athelstan Publications: 115-137.

Elsom-Cook, M. (1993). "Student Modelling in Intelligent Tutoring Systems." The Artificial Intelligence Review, 7 (3-4): 227- 240.

Heift, T. & Nicholson, D. (2001). Web Delivery of Adaptive and Interactive Language Tutoring. *International Journal of Artificial Intelligence in Education*, to appear fall issue 2001.

Holland, M. V., Kaplan, J.D., and Sama, M.R., eds. (1995). Intelligent Language Tutors: Theory Shaping Technology. Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

Holland, M. V. (1994). "Lessons Learned in Designing Intelligent CALL: Managing Communication across Disciplines." Computer Assisted Language Learning, 7 (3): 227-256.

Holt, P., Dubs, S., Jones, M., Greer, J. (1994). "The State of Student Modelling." Student Modelling: The Key to Individualized Knowledge-Based Instruction. Greer, J. E., McCalla, G, eds. NATO ASI Series. Series F: Computer and Systems Sciences. Springer Verlag. Vol: 125: 39-35.

Kurup, M., Greer, J. E., and McCalla, G. (1992). "The Fawlty Article Tutor." Intelligent Tutoring Systems. Frasson, C., Gauthier, G., McCalla G.I, eds. Lecture Notes in Computer Science. Springer Verlag: 84-91.

McCalla, G. (1992). "The Centrality of Student Modelling to Intelligent Tutoring." New Directions for Intelligent Tutoring Systems Costa, E., ed. NATO ASI Series F: Computer and Systems Sciences. Springer Verlag. Vol: 91: 107-131.

McCalla, G., and Greer, J. (1992). "Special Issue on Student Modelling: Editors' Introduction." Journal of Artificial Intelligence in Education, 3 (4): 377-380.

Oxford, R. L. (1995). "Linking Theories of Learning with Intelligent Computer-Assisted Language Learning (CALL)." Intelligent Language Tutors: Theory Shaping Technology. Holland, M. V., Kaplan, J.D., Sama, M.R., eds. Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc. 359-369.

The Development Project for University-Level Teaching Methods, *New Learning Environments in the Work of the Teacher (NET)* – Development and the Assessment of Effectiveness

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Abstract. This article describes *the New Learning Environments in the Work of the Teacher (NET)* development project in the Province of Lapland for university-level teaching methods NET is organized by the Centre for Media Pedagogy and funded by the European Union's European Social Fund (ESF). Its objective is to improve and support the use of information and communications technology (ICT) in the work of university-level teachers and the teaching support staff. The article presents the content, some assessment principles, and the effectiveness of the *NET* study programme (15 cr.) developed during the project. The study programme will be realized twice in 2001 –2002. The research into effectiveness of the study programme will examine the methodological and ontological commitments of empowerment-evaluation. Self-direction will be examined later in relation to meaningful learning, methods of guidance and to the more extensive, regional effectiveness of training.

1. Introduction

New Learning Environments in the Work of the Teacher (NET) is a development project for university-level teaching methods in the Province of Lapland. It is organized by the Centre for Media Pedagogy at the University of Lapland and realized through funding by the European Union's European Social Fund (see Ruokamo, Syrjäkari & Karppinen.) The project is the result of cooperation between university-level educational institutions and the Provincial Government of Lapland and it is being realized in the years 2000–2002. The goal of the project is to:

1. support the professional development of teaching and the teaching support staff at the university-level using client-oriented multi-disciplinary courses by focussing on the use of information and communication technology,
2. develop the content and methods of training and development services in order to serve working life, and
3. stabilize the cooperation of the institutions of higher education in the development of the area.

The 15-credit (NET) study programme, which corresponds to the first objective of the project, supports the preparedness of university-level teachers and teaching support staff to benefit from information and communications technology in their work. Its purpose is also to increase awareness of open learning environments, their related perspectives on learning and pedagogical trends. The study programme is organized twice in the years 2001–2002 and the research of effectiveness is closely related to both courses. In this article, empowerment-evaluation is taken as a perspective of the research of effectiveness. Its functionality as a method of assessing effectiveness will be examined in relation to both the course students and the objective of the project. Empowerment-evaluation is related closely to the concept of self-direction. The aim is to consider the development of the participants' self-direction during the study programme and later to examine whether self-direction can have a wider regional effectiveness and how assessment by itself can be effective.

2. New Learning Environments and Self-Direction

Learning environments are comprehensive environments of operation that are formed from many different factors: environment, students, teachers, different perspectives of learning and forms of action, sources of learning, and the tools and objectives in using them [http://www.uta.fi/tyt/verkkotutor/oppymp.htm]. Thus, a learning environment is much more than a physical space. New learning environments are often connected to the use of developed technology in teaching. However, new technology can also be used in a traditional learning environment. Challenges and obligations, which in themselves are not bonded to new technology any more than they are to older technology, are often connected to a new learning environment. An attempt is made in new learning environments to create natural forms of working in which a student can direct events in the direction of his or her personal objectives and assessment. Often, a virtual learning environment, an open learning environment, and a network-based learning environment are used as a parallel or replaceable concept of the new learning environments (Manninen & Pesonen 1997). With the concept of an open learning environment, student centricity and flexibility form the basis of the learning experience. Openness can mean, for example, emphasizing the goal-orientation of the individual and individual self-direction. (Kivimäki 2000.)

Working in a network forces a student to be active and to make choices, in other words to be self-directed. A student also influences how he or she works in the environment, at what speed, and at what depth he or she wants to become familiar with certain contents on his or her computer (Kivimäki 2000). Self-direction and autonomy is not only a question of technical control; rather, it is also a question of the student's internal expansion of knowledge. Instead of self-direction, Garland (1994) uses the concept of personal control. The personal control of learning requires that a student aspires toward study in a critical manner and, for example, aims when studying to separate essential knowledge from the immaterial or believable theory from the unbelievable. Often, this type of activity does not happen automatically, nor do the skills of an adult student always give the readiness to act in a self-directed manner. The role of a tutor becomes emphasized in studies within new learning environments. Lehtinen and Jokinen (1999) describe the change in the roles between a guide and a student towards that of self-direction as presented in Figure 1.

Student	**Guide**	
dependent	authority	develops critically in order to assess one's life situation and to consider one's learning needs / beating opposition
interested	motivator	sets individual goals and selects the suitable means to conclude them as well as considers learning strategies
committed	aid	develops the skills of group work, the responsibility for learning in a group and as individuals, commonly agreed criteria and learning contracts
self-directed	delegator	provides space, the interaction of students and the surrounding world, e.g. follow-up study, mentor activities, expert and supporter

Figure 1. The roles of students and guides

3. Empowerment in Order to Strengthen Self-Direction and Effectiveness

The effectiveness of training can be studied from many perspectives. In addition, its focus and the role of the researcher influence the formation of the research process. These dimensions are outlined in Figure 2.

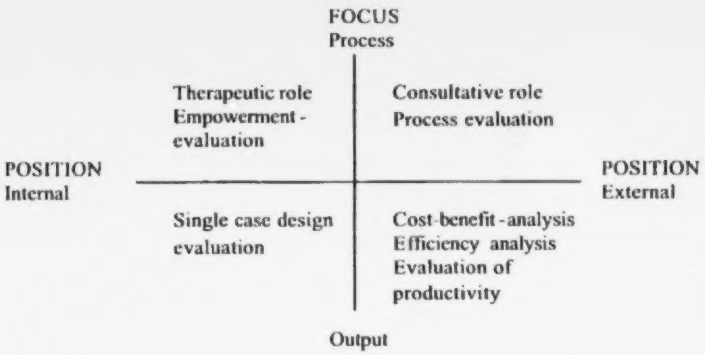

Figure 2. The focus of evaluation and the role of the researcher (Lindquist 1999, see also Albæk 1996)

The methodological and ontological commitments of assessment research are defined according to the focus of assessment, the role of the researcher, and the nature of the knowledge. The point of emphasis for assessment can be either in the result or in the process. The role of the researcher can change from the external observation of a process to that of an internally operating therapist. Moreover, the nature of knowledge can change from one objective reality to the relative relativism of subjective knowledge and to the pluralism of knowledge. In the development project *New Learning Environments in the Work of the Teacher* for university-level teaching methods, project planners work in the role of both tutor and researcher. Thus, the position of the researcher suits the role of empowerment/confirmer. An attempt is made through process-formed assessment to develop the training project and the study programme. The central task of process evaluation is how well the material collected during the process is used in guiding the project and in specifying its objectives (Seppänen–Järvelä 1999). The challenge is to be able clearly to bring forth the informative material obtained through experience, its basic observations and findings. It will help the work of development, learning, and reflectivity and thus improvement. The core of empowerment is participation and participating. Conquest includes the two related sides of empowerment: change in the individual's self-determination, in other words in the ego, and participation through changes taking place in the environment. It strengthens the functionality of the subject. (Antikainen 1996, 253–254.)

The meaning of the concept of empowerment in relation to professional adult education differs slightly from the above. A study programme should provide its participants with such tools, that in their work (and life) they are able to activate, motivate, and solve their problems by themselves. The afore-mentioned claim is based on the humanistic concept of a person, which believes, among other things, in the following strengths and opportunities for individual development.

1. The subject principle: a human is a conscious being that can affect his or her thinking and action; he or she is not a passive object in which information can be accumulated.
2. The development principle: a human is not naturally a subject; rather, he or she develops gradually as an increasingly knowledgeable actor and thinker.
3. The action principle: development takes place through human action.
4. The societal principle: development always takes place in some societal and cultural environment. (Toiskallio 1994, 20–22.)

Therefore, empowerment–evaluation offers the opportunity for the work of development; in addition, it notes the relationship between the individual and the environment through the activity of an individual's development of activation and self-direction (see Heikkilä 2001).

4. New Learning Environments in the Work of the Teacher – the Realization and Content of Training

The NET training provides the preparedness to benefit from new learning environments and to renew one's pedagogical practices and skills in information and communications technology (ICT). As part of their practice during the course, the participants develop network-based training modules, web-based learning materials, and the beneficial tools for building knowledge in the learning environment, the use of which is assessed during the course.

The NET study programme is intended for university-level teachers and teaching support staff in the Province of Lapland. It has 130 participants from the University of Lapland, the Rovaniemi and Kemi-Tornio Polytechnics, and class teacher students specializing in media education.

Training includes contact teaching in Rovaniemi, video-conferencing to distant localities, and collaborative working. It takes advantage of environments based on information networks. In addition, support training is organised to further the development and realization of network courses and web-based learning materials.

The training offered in the *New Learning Environments in the Work of the Teacher* (NET) project provides a 15-credit study programme organized twice during 2001 and 2002. The NET I course was and is being realized from January 2001 – February 2002 and NET II from November 2001 – December 2002. [http://www.urova.fi/home/mpk/Koulutus.htm] The training includes the following courses:

1. Orientation to Studies,
2. Learning Environments and Network Pedagogy (3 cr.),
3. The Planning and Realization of Network-Based Studies (4 cr.),
4. Copyright, Data Privacy, and Data Protection (1 cr.),
5. Information and Communication Technology (ICT) in Learning (1 cr.),
6. Interaction in a Network (3 cr.), and
7. Assessing the Learning Process and Learning Environments (3 cr.).

The study programmeis in accordance with the study requirements at the Faculty of Education at the University of Lapland.

The first NET course began in January 2001 with the participation of 74 university-level teachers and teaching support staff from the University of Lapland, the Rovaniemi Polytechnic, and the Kemi-Tornio Polytechnic. This first course group acted as the focus for the experiment and development of the study programme. Its contents were mainly considered satisfactory; however, some parts were seen as problematic. The lack of clear and objective-oriented tutoring was one of the more significant problems. Insufficient attention was paid to the relationship of interaction among the student group and to benefiting from group strength and shared expertise. These factors can in turn affect the preparation of the final work on time and the realization of the objectives of the course. The NET I course came to an end in February 2002.

The second NET course began in November 2001. The first experience gained in the course was that at the beginning, insufficient attention was paid to group strength (face-to-face presentation), to taking into possession and working in the learning environment, and to rules. Moreover, time was used separately for guiding personal curricula and the principles of goal-oriented learning. The *Sonera eXperience Training* environment was used as the network environment for NET I. *Discendum Optima* was chosen as the network-based environment for NET II. The *Discendum Optima* environment enables better non-hierarchic and interactive activity in a network than the *Sonera eXperience Training* environment does. [http://www.discendum.com/] Of the training contents, thematic discussion channels are built into the environment, where the aim is to promote learning, shared expertise and experience. The concept of shared expertise refers to a process during which several people share intelligent resources related to knowledge, plans, and objectives in order to achieve something that an individual person is unable to realize on his or her own (Brown et al. 1993; Oatley 1990). The students in NET II will graduate by the end of 2002, when information about the achievement of their goals will have been obtained.

5. Conclusions

This article has examined the *New Learning Environments in the Work of the Teacher (NET)* development project in the Province of Lapland for university-level teaching methods – its contents, objectives, and some assessment principles. The goal has been to present a model based on empowerment-evaluation, which is one means of performing effective and planned assessment. Post-assessment is insufficient; rather, pre-assessment and guided assessment are also needed. As a central concept, self-direction rises to the fore in empowerment-evaluation, which increases the meaningfulness of learning and the effectiveness of training. Self-direction is often related to network-based education, to new and open learning environments, in that it is in these that study demands some form of self-direction from a student. Its internalization is not, however, self-evident for the adult student; rather, its development requires the development of guiding processes. On the one hand, the learning occurring in new learning environments in itself can encourage self-direction; on the other hand, simply being along on a network course does not automatically bring about self-direction. This research will examine self-direction in relation to methods of guidance and in relation to achieving the objectives of the project by answering the following questions: 1) Does NET strengthen and confirm the self-direction of the participants in the study programme? 2) What were the significance and procedures of guidance in the process? 3) Can self-direction have a more extensive, regional influence?

Based on the assessment of the NET course, an advanced study programme will be developed that, instead of being based on teaching methods related to new learning environments, will provide more systematic information on teaching methods related to new learning environments and to the opportunities offered by digital media in open learning environments. In addition, the pedagogical models and principles occurring within network-based education are developed and assessed in the national *HelLa* project, which is a cooperative project of the Universities of Lapland and Helsinki (see Ruokamo, Tella, Vahtivuori, Tuovinen & Tissari). We are able to utilize the principles of assessment developed by the HelLa project in analysing results of this study programme, and will present results of effectiveness research when both NET study programmes have ended.

References

Albæk, E. (1996) "Evaluation Design and Utilization: Any Connection?" Lecture 5.10.1996 at the University of Helsinki, Finland.

Antikainen, A. (1996). Merkittävät oppimiskokemukset ja valtautuminen. In A. Antikainen & H. Huotelin (eds.) Oppiminen ja elämänhistoria. Aikuiskasvatuksen 37. vuosikirja. Gummerus: Jyväskylä, 251-296.

Brown, A.L., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A. & Campione, J. (1993). Distributed expertise in the classroom. In: G. Salomon (ed.), Distributed Cognitions: Psychological and educational considerations. Cambridge: University Press, 188–228.

Garland, M.G. (1994). The adult need for "personal control" provides a cogent guiding concept for distance education. Journal of Distance Education 9 (1), 45–59.

Heikkilä, I. (2001). Ennen sitä oli toisten ohjailtavissa – havaintoja ja pohdintoja MoniNainen lappilainen projektista. Lapin yliopiston täydennyskoulutuskeskuksen julkaisuja n:o 60. Rovaniemi.

Kivimäki, K. (2000). Johdatus verkkopedagogiikkaan. Keski-Pohjanmaan ammattikorkeakoulu A: Tutkimusraportteja. Kokkola.

Lehtinen, E. & Jokinen, T. (1999). Tutor – itsenäistyvän oppijan ohjaaja. WSOY: Juva.

Lindquist, T. (1999). Evaluaation uskottavuus. In R. Eräsaari & T. Lindquist, M. Mäntysaari & M. Rajavaara (eds.) Arviointi ja asiantuntijuus. Tammer-Paino Oy: Tampere, 106–118.

Manninen, J. & Pesonen, S. (1997). Uudet oppimisympäristöt. Aikuiskasvatus 17 (4), 267–274.

Oatley, K. (1990). Distributed cognition. In: H. Eysenck, A., Ellis, E., Hunt & P. Johnson-Laird (ed.) The Blackwell dictionary of cognitive psychology, Oxford: Blackwell, 102-107.

Ruokamo, H., Syrjäkari, M. & Karppinen, P. (to appear). The University of Lapland Faces the Challenges of the Virtual University. Paper to be presented and published in ED-MEDIA2002 Conference, June 24–29, 2002 Denver, Colorado USA.

Ruokamo, H., Tella, S., Vahtivuori, S., Tuovinen, H. & Tissari, V. (to appear). Pedagogical Models in the Design and Assessment of Network-Based Education. Paper to be presented and published in ED-MEDIA2002 Conference, June 24–29, 2002 Denver, Colorado USA.

Seppänen-Järvelä, R. (1999). Kehittämistyö ja arviointi. In R. Eräsaari, T. Lindquist, M. Mäntysaari & M. Rajavaara. (eds.) Arviointi ja asiantuntijuus. Tammer-Paino Oy: Tampere, 90–105.

Toiskallio, J., Roisko, H & Trapp, H. (1994). Tekemällä oppii – toiminta. Turun yliopiston täydennyskoulutuskeskuksen julkaisuja B; 6 / 1994. Turku.

A User Interface and Knowledge Delivery Solution for a Modern WBT System

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Abstract: In order to take a part in a particular Web-based training session learners need to work with a number of tools reflecting a particular training strategy. By operating these tools learners access different training objects contained in that training session. Such training objects contain relevant information for their current training task. Nowadays, modern WBT systems support dozens of different, sometimes rather complex tools and provide access to thousands of training objects. In this paper we analyze the problems of user interface that can become a rather complex one in training sessions conducted in such systems. In order to overcome such problems we provide a simple general user interface solution for these WBT systems. Further we provide an evaluation of the responses from users we gathered in applying that solution in a number of Web-based training sessions. This evaluation showed us that there is much more potential in our solution than we believed at the first resulting in the evolution of our user interface solution to a simple knowledge delivery tool. Such tool might be used to conduct training sessions that contain always the most up-to-date and the most relevant training objects residing in the system.

1. Introduction

Technically, WBT systems (Gaines et al., 1997) consist of a large repository of training objects and a number of tools to manipulate these training objects. Usually, these tools support operations such as creating, deleting, accessing, or updating of training objects (Dietinger et al., 1997).

According to the variety of types of training objects supported by a particular WBT system, or in other words according to the number of tools and functionality that such tools support we may distinguish between (Helic et al., 2000):

- Standard WBT systems
- Advanced WBT systems.

Standard WBT systems support only basic training objects, such as learning unit, learning course or discussion forum. Tools provided by such systems include authoring tools, publishing tools, navigation tools, simple search tools, etc. Usually, such tools are rather primitive with a simple basic functionality and a comprehensive user interface. On the other hand, advanced WBT systems support a wide range of different training objects. For instance, these training objects include learning goals, mentoring sessions, brainstorming sessions, knowledge cards, knowledge profiles, etc. Structurally these objects may be rather complex. For instance, a knowledge card is an instance of so-called semantic network, which is a rather complex structure. Obviously, tools provided by advanced WBT systems are by far, more numerous,

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provide a richer functionality and more complex than tools provided by standard WBT systems. Consequently, these tools have a rather complex user interface.

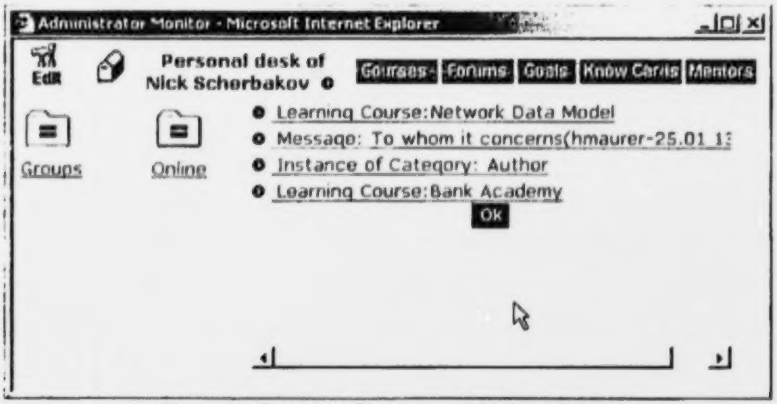
From the users' point of view WBT systems offer possibilities to take part in different training sessions. Usually, a training session is considered to consist of a so-called training strategy and a number of training objects (Helic et al., 2001a). Training strategy reflects a particular way of working through the subset of training objects to achieve a particular training goal (Helic et al., 2001b). Actually, a training strategy is a collection of tools combined in a certain way and reflecting a particular training methodology. For instance, consider the training strategy known as Web-based learning. This training strategy is a collection of tools that provide functionality needed to access and navigate through different learning units and learning courses (Andrews et al., 1995). Web-based learning might be considered as the basic training strategy supported by all WBT systems. Another example of a training strategy would be so called Web-based tutoring. This strategy is a rather advanced training strategy supported by an advanced WBT system called WBT-Master. Web-based tutoring prescribes working with a set of special WBT-Master tools. These tools allow users to navigate through a sequence of so-called learning actions and training objects associated to such learning actions in order to achieve a particular learning goal.

Obviously, advanced training strategies supported by means of advanced WBT systems might consist of a rather large number of tools (Helic et al., 2001a; Helic et al., 2001b). Considering that such tools have rather complex user interface themselves any collection of these tools would have a rather complex user interface as well. Thus, users of advanced WBT systems might be confronted with a serious problem of a complex, inscrutable user interface. Also taking into account that more advanced training strategies might include training objects of many different types, thus resulting in an increased number of different tools needed to implement such a training strategy, the user interface problem is becoming even larger. Evidently, if we want to be able to conduct training session by means of advanced training strategies we need to solve the increasing user interface problem on a larger scale. Hence, not only do we need to simplify the user interface of a particular tool but we need also a more general user interface solution that is able to reflect all peculiarities of any training strategy and provide a single access point to each of tools needed to implement a particular training strategy. Apparently, such solution needs to be highly configurable, customizable user interface solution.

WBT-Master provides such general user interface solution in the form of so called Personal Desktop.

2. Personal Desktop

Conceptually, a personal desktop is just a set of folders containing references to designated training objects and WBT-Master tools. Tools from a particular folder reflect a particular training strategy, whereas the training objects from that folder contain information relevant for achieving a certain training goal.



- Learning Course:Network Data Model
- Message: To whom it concerns(hmaurer-25.01 1:
- Instance of Category: Author
- Learning Course:Bank Academy

Figure 1: Content of a personal desktop folder

The main idea behind the concept of a personal desktop might be seen as the following. An advanced user, say an author or a tutor manages a particular training session with a group of learners.

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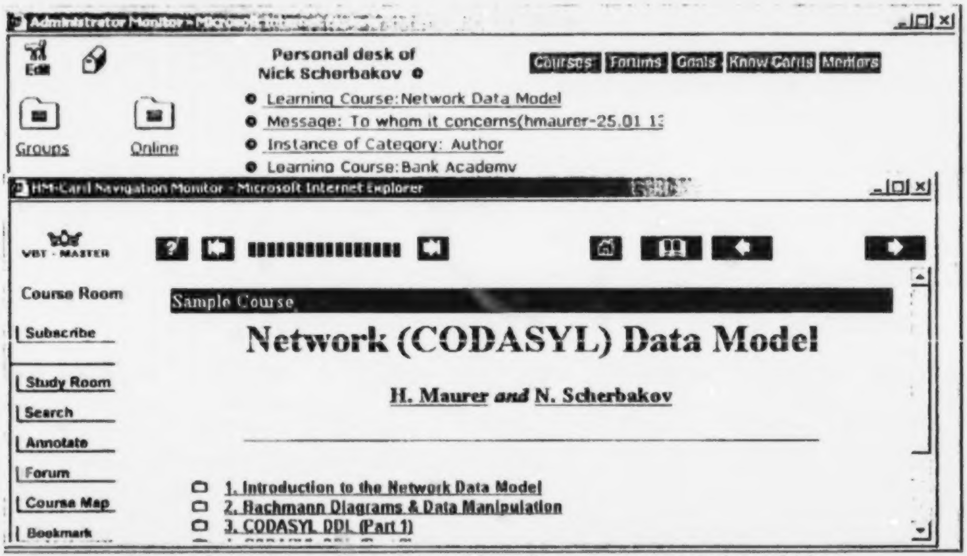
He/she creates a personal desktop folder containing different WBT-Master tools and a number of training objects residing on the server. Once when the personal desktop folder has been created he may share that folder with the learners' group, thus allowing them to participate in his/her training session. Obviously, by accessing the created personal desktop folder learners have access to designated training objects by means of the implemented strategy. However, learners are not any more confronted with arbitrary tools or training objects provided by the system. Rather they are supposed to access only few relevant training objects and that by means of tools reflecting the desired training strategy.


Administrator Monitor - Microsoft Internet Explorer
Edit
Personal desk of
Nick Scherbakov
Courses
Forums
Goals
Know Cards
Mentors
Groups
Online
HM-Card Navigation Monitor - Microsoft Internet Explorer
WBT - MASTER
Course Room
Subscribe
Study Room
Search
Annotate
Forum
Course Map
Bookmark
Sample Course

- Learning Course:Network Data Model
- Message: To whom it concerns(hmaurer-25.01 1
- Instance of Category: Author
- Learning Course:Bank Academy

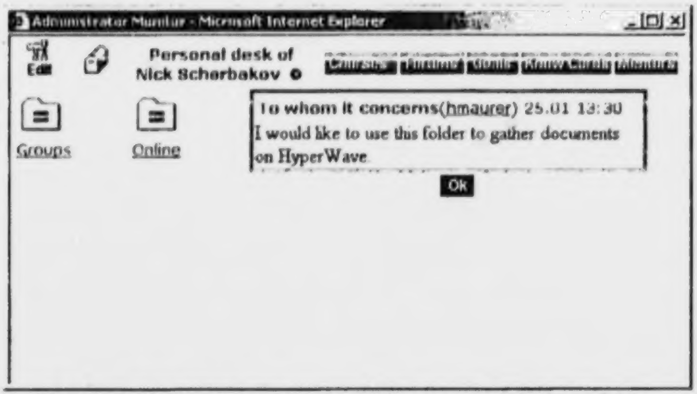
Network (CODASYL) Data Model

H. Maurer *and* N. Scherbakov

1. Introduction to the Network Data Model
2. Bachmann Diagrams & Data Manipulation
3. CODASYL DDL (Part 1)

Figure 2: working with training objects from a personal desktop folder

This concept greatly facilitates the fact that a typical user works with just a few tools and training objects offered by the system. In other words, this special customization mechanism is used to adjust the rich system functionality to personal needs of a particular learner or a group of learners. Hence, a tutor or an author may decide on preferable user interface for such group of learners and on training objects, which are needed to accomplish a particular training task. Another important aspect of the personal desktop concept is collaboration facilities, which are provided by so-called shared folders and internal messaging system. For example, a learner group may share a certain folder to put all contributions of the group members into it. In this way, the contributions may be easily accessed by group members and discussed by attaching messages to such contributions.


Administrator Monitor - Microsoft Internet Explorer
Edit
Personal desk of
Nick Scherbakov
Groups
Online
Ok

To whom it concerns(hmaurer) 25.01 13:30
I would like to use this folder to gather documents on HyperWave

Figure 3: Exchanging messages with a personal desktop folder

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3. Working with Personal Desktop

Generally, first experiments with personal desktop show a great acceptance of this concept by users.

Authors very much appreciated a possibility to define all requisites of a particular training session, i.e., all tools that are needed to implement a particular training strategy, as well as all relevant training objects as members of a folder. In this way they were not supposed to know all peculiarities of the system in order to combine the system tools into a coherent training strategy. For instance, they were not supposed to know how to attach a discussion forum to a learning course to provide learners with a board to discuss topics from that learning course, but rather they just put that learning course and a discussion forum into a personal desktop folder and the above-mentioned relationship between these objects was automatically established by the system.

On the other hand, tutors liked the messaging functionality of a personal desktop folder the most. This functionality allowed them to keep the communication between members of a particular learner group within the scope of a particular training session. Also, possibility to reuse (for instance, in the form of FAQ) the results of such communication was quite well accepted by tutors.

Finally, learners appreciated the simplicity of user interface as offered by such training sessions very much. Not any more did they need to find their way through dozens of system tools and large number of training objects. Rather they just worked with a few tools and relevant training objects combined into a simple navigable list.

However, there exist some disadvantages of this concept as well. The most important shortcoming of such an approach can be stated as follows. A particular training strategy, i.e., a particular collection of tools that implements that training strategy might be seen as a rather static entity. That means that a particular training strategy is likely not to change in the course of the time. For instance, consider the above-mentioned Web-based learning training strategy. This strategy consists always from say a number of learning courses and a discussion forum attached to these courses. What really changes in training sessions is training objects. Actually, training objects might be seen as a very dynamic entity. Not only that in different training sessions training objects are completely different but also in one and the same training session training objects are likely to change. For instance, some training objects might become obsolete, newly updated versions of training objects might be created, etc.

These results led us to the conclusion that we need to extend the concept of personal desktop and redesign it in a way that it becomes robust to such changes. Thus, we decided to incorporate a mechanism that would be able to automatically select training objects that are the most relevant and the most up-to-date training objects. Only such training objects should become members of a particular personal desktop folder. Obviously, such mechanism must be able to "reason" about training objects and decide whether a particular training object is relevant to a particular training session, i.e., does it match certain criteria posed by that training session.

4. Personal Desktop as knowledge delivery tool

WBT-Master supports semantic data structures, which can be used to create different semantic overviews of training objects residing in the system (Helic et al., 2001a). These structures include so-called knowledge cards and knowledge domains.

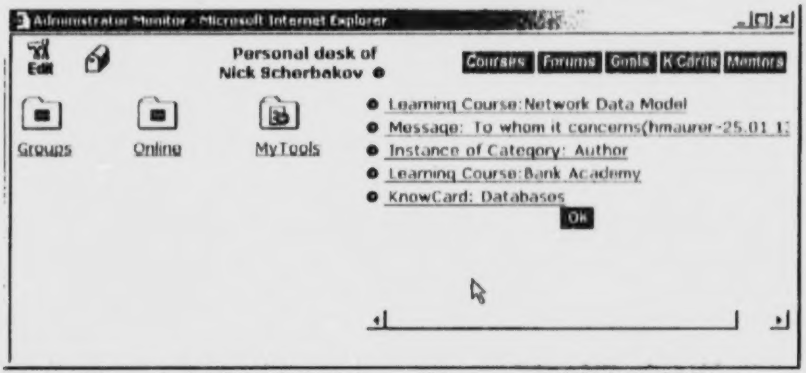
A knowledge card is a description of particular concept (i.e. semantic entity). For example, a semantic entity "Database technology" may be seen as a knowledge card. Practically speaking, each knowledge card may provide access to a number of associated training objects. For example, a course on "Relational Data Model" may be associated with the knowledge card "Relational Data Model", some other training objects may be associated with the same knowledge card. Knowledge cards may be interrelated into a semantic network using different types of relationships: "is a part of", "is a kind of", "synonym for", etc. For example, the knowledge card "Relational Data Model" may be related as "is a part of" to the knowledge card "Database Technology". The knowledge card "World Wide Web" may be related as "is a kind of" to the knowledge card "Hypermedia Systems". The knowledge card "Web Base Training" may be related as "is a synonym for" to the knowledge card "Computer Supported Collaborative Learning".

The infer mechanism essentially utilizes the other important property of the semantic network - a possibility to infer training objects using semantic relationships. Whenever users access a knowledge card, the system automatically infers all training objects, which are associated with this particular knowledge card and with knowledge cards related to this one. This mechanism greatly facilitates the initial access to the most relevant training objects.

On the other hand, a knowledge domain is a collection of training objects, which are structured using a predefined template called the knowledge domain schema. A knowledge domain schema may be seen as a definition of semantic categories and all possible semantic relationships between them. Thus, a knowledge domain contains training objects, which might be seen as instances of a particular semantic category interrelated by means of semantic relationships with training objects that are instances of related semantic categories. Basically, we may use this mechanism to express facts such as: the document "C" (an instance of say "Module" category) is related to the document "A" (an instance of say "Author" category) by means of the "Author Modules" semantic relationship. Similarly, the document "C" is related to the document "B" (an instance of say "Project") by the means of the "Project Modules" semantic relationship, etc.

Now, users may browse and search knowledge domains by means of the terms defined by the knowledge domain schema. For instance, users accessing an instance of the "Author" category automatically get a link to an index of all instances of related categories, i.e., a link o all "Author Modules" appears on the screen. Similarly, knowledge domain might be used to execute semantic queries, i.e., to search for all "Modules" that are related to a certain "Project" training object, etc.

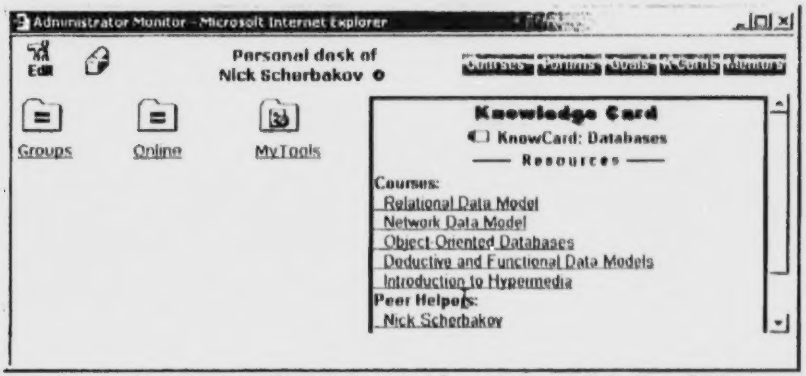
The extension of the personal desktop concept treats knowledge cards and knowledge domains as training objects that might be added to a personal desktop folder.


Administrator Monitor - Microsoft Internet Explorer
Edit
Personal desk of
Nick Scherbakov
Courses
Forums
Goals
K Cards
Mentors
Groups
Online
MyTools
OK

- Learning Course:Network Data Model
- Message: To whom it concerns(hmaurer-25.01 1:
- Instance of Category: Author
- Learning Course:Bank Academy
- KnowCard: Databases

Figure 4: Adding a knowledge card to a personal desktop folder

By adding a knowledge card as a training object in a personal desktop folder we achieve the following. Whenever users access a knowledge card from a personal desktop folder the system automatically infers all related and to that particular concept relevant training objects.


Administrator Monitor - Microsoft Internet Explorer
Edit
Personal desk of
Nick Scherbakov
Courses
Forums
Goals
K Cards
Mentors
Groups
Online
MyTools

Knowledge Card
KnowCard: Databases
Resources
Courses:
Relational Data Model
Network Data Model
Object Oriented Databases
Deductive and Functional Data Models
Introduction to Hypermedia
Peer Helpers:
Nick Scherbakov

Figure 5: Accessing a knowledge card from a personal desktop folder

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If a new training object is associated with this knowledge card, the system automatically captures that change by inferring the newly added training object the next time we access the personal desktop folder. Thus, this mechanism is a rather robust one to changes in the underlying repository of training objects. On the other hand, by adding a knowledge domain to a personal desktop folder users are provided with possibility of browsing semantic overviews of training objects residing in the system. Again, if a new training object is added to such an overview, the system automatically updates the overview the next time when we access it. Thus, changes in the system's repository of training objects are captured again. Hence, by incorporating these two simple knowledge-processing mechanisms into the concept of personal desktop we were able to enhance personal desktop from a general user interface solution to a simple knowledge delivery tool.

5. Conclusion

Generally, first experiments with the Personal Desktop system demonstrate a rather good functionality and acceptance by users. Learners like the situation where they are not confronted with too much system tools or irrelevant training objects but rather with just few important tools and training objects. On the other hand, tutors and authors very much appreciate the fact that they were able to completely control their training sessions and especially corresponding training strategy. They can be sure that their learners are confronted with only those tools that are the essential part of the implemented training strategy. Moreover, the extension of the concept of a simple user interface tool to a knowledge delivery tool leads to the conclusion that learners are not only confronted with the relevant system tools but also with the most relevant and up-to-date training objects that are needed for a successful training sessions.

References

Andrews K., Nedoumov A., and Scherbakov N.: *Embedding Courseware Into Internet: Problems and Solutions*, Proceedings of ED-MEDIA'95, pp.69-74., 1995

Dietinger T., Maurer H.: *GENTLE - (GEneral Networked Training and Learning Environment);* Proceedings of ED-MEDIA'98, AACE, Charlottesville, VA

Gaines, B.R. and Shaw, M.: *Institutional Transformations to a Learning Web*, in: Proceedings of ED-Media/ED-Telecom, the World Conference on Educational Multimedia/Hypermedia, T. Müldner and T.C. Reeves (Eds.), 1997.

Helic D., Maurer H., Scerbakov N.: *Web Based Training: What Do We Expect from the System.* Proceedings of ICCE 2000, Taiwan 2000, 1689-1694.

Helic D., Maurer H., Scerbakov N.: *Knowledge Domains: A Global Structuring Mechanism for Learning Resources in WBT Systems*, Proceedings WebNet 2001, AACE, Charlottesville, USA 2001, 509-514.

Helic D., Maurer H., Scerbakov N.: *Mentoring Sessions: Increasing the Influence of Tutors on the Learning Process in WBT Systems*, Proceedings WebNet 2001, AACE, Charlottesville, USA 2001, 515-519.

Teege G. and Koch M.. *Integrating Access and Collaboration for Multimedia Applications*. Proceedings of International Conference on Multimedia, Hypermedia and Virtual Reality, Moscow, Russia, pages 170--176, P. Brusilowsky, editor, September 1994.

Playing Video Games and Cognitive Effects: Teenagers' Thinking Skills and Strategies

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Abstract: The study examines a dominant aspect of youth culture: playing video computer games. The study is interested in the recreational video game as a means of informal cognitive education. Centered within an information processing theory and introspection methodological framework, the study investigates via stimulated recall methods the thinking skills and strategies used by two teenagers when playing an action-adventure video computer game. The players used a wide range of cognitive processes that are valued in schools such as: metacognition, prediction, justification, inductive and deductive reasoning, strategy planning, and parallel processing.

Surveys (eg., Australian Bureau Statistics, 2000; DigiPlay.org.uk, 2001; Hall, 2000) have replica findings revealing that, although video games are predominantly a male youth pastime (approx. 80% boys 9-14 years), female youth are increasingly playing (approx. 60% girls 11-14 years); both play daily for periods ranging from 30 minutes to five and a half hours. Recreational video games are one of the most dynamic influential forces shaping youth culture.

There is a remarkably limited research literature concerning the cognitive effects of video game playing (eg., the special edition, *Journal of Applied Developmental Psychology, 15*, 1994; Camioni, Ercolani, Perrucchini, & Greenfield, 1990; Pillay, Brownlee, & Wilss, 1999). This is perhaps because recreational video games are popularly seen as trivial without educational worth and something from which educators must rescue children and distance themselves. Yet cognitive processes are broader than those taught and tested in school. As part of our informal education, playing games has been identified as an important facilitator of cognitive development. This study is interested in the recreational video game as a means of informal cognitive education. The exploration of the cognitive processes utilised by teenagers while developing video game literacy will be of theoretical and practical interest to teachers, researchers, and the interactive multimedia industry. Overall, the project aimed to understand one key question: Do recreational video games, a dominant aspect of teenage culture, provide a context that encourage valued cognitive processes? To this end, the study investigated (identified, categorised, and analysed) the thinking skills, processes, and strategies utilised by young teenagers when playing recreational (as opposed to school-based educational) video games.

This was an empirical qualitative study based in an information processing theory, mediating processes paradigm, and introspection methodological framework. This paper reports data from two 13 year old volunteers, one male and one female (self-identified as Tony and Eyore, respectively), who had been playing for over two years. *Final Fantasy IX*, an adventure/action game, was chosen by the students and approved by their parents as it contains some low level violence but no "blood and gore". The data were collected through videotaped individual stimulated recall interviews at the beginning of the game and up to the same screen in the game. The stimulated recall technique is designed to probe the players' reasons behind their actions and interpretations of the results of the action as well as to reveal the range and types of thinking skills, strategies, and processes utilised within the context of their use. Hence, these interviews occurred when playing the game which, together, took approximately one hour. Participants were not allowed to read the instruction help booklet before commencing the game.

Thinking skills	**Eyore**	**Tony**	**Total**	**Strategies**	**Eyore**	**Tony**	**Total**
Predicting	20	30	50	Trial and error	9	7	16
Evaluating	14	24	38	Equipping	5	7	12
Justifying	14	8	22	Exploring	4	5	9
Affecting	5	14	19	Induction	4	4	8
Comparing	17	1	18	Deduction	3	5	8
Metacognising	7	10	17	Talking to characters	4	3	7

Confirming	4	10	14	Double checking	2	2	4
Generating	4	9	13	Putting values on hold	0	3	3
Reflecting	6	7	13	Attacking	1	1	2
Judging	1	12	13	Using potions	2	0	2
Translating	7	5	12	Watching movies	1	1	2
Linking	8	4	12	Naming characters	2 no	1 yes 1 no	1 yes 2 no
Anticipating	1	6	7				
Categorising	2	5	7	Reading instructions	usually	no	
Analysing	0	3	3				
Imaging	0	2	2				
Applying	0	1	1				
Recalling	0	1	1				
Total	**118**	**147**	**265**		**37**	**40**	**77**

Table 1: Thinking Skills and Strategies when Playing Video Games

Eighteen types of thinking skills were utilised during the students' first encounter with the game. Higher order thinking skills were utilised by both students, for example: predicting what may happen and hypothesising "if … then …" consequences of actions and events; evaluating the game, graphics, characters, and their own gameplay; justifying, rationalising, and explaining their actions and what was happening in the game; and metacognising their awareness of what they knew and did not understand and suggesting ways to troubleshoot their lack of comprehension. Some types of thinking skills were unevenly engaged in by the students: comparing this game with other games; confirming the accuracy of their strategies, predictions, and ideas; judging, particularly issues of morality in the game and expressing thoughts about their affective feelings such as frustration (more so Eyore) and empathy for what the characters were experiencing (more so Tony).

Inductive and deductive reasoning were utilised a pleasing number of times. However, trial and error, a legitimate problem solving approach though not the most efficient (Martinez, 1998), was the major strategy because they were "learning how this game worked" (Tony's Interview). Nor was it surprising that equipping their characters for fighting came a close second during the short session.

In terms of overall processes, the players had to work out how the symbols, icons, images, and control buttons acted individually and in unison. They had to attend simultaneously and selectively to a number of different pieces and types of information displayed on various parts of one screen and from one screen to the next; that is, they had to further develop their skills of parallel processing (Greenfield, et al., 1994). They had to figure out the rules of the game. Indeed, what the data shows is that they were engaged in a process of transforming and manipulating their mental models of previous games and gameplaying with this game and its quite different gameplay.

Even with such a short playing time as this research episode, the data reveal that playing *Final Fantasy IX* provided a valuable informal educative experience. They engaged in cognitive skills, strategies, and processes that are valued in schools. They demonstrated that playing this game involved complex cognitive processes.

Literature References

Australian Bureau of Statistics (2001) ABS Catalogue No.4901.0 Children's participation in cultural and leisure activities, 2000. Canberra: ABS [http://www.abs.gov.au]

Camioni, L., Ercolani, A., Perrucchini, P., & Greenfield, P. (1990). *Video games and cognitive ability: The transfer hypothesis. Italian Journal of Psychology, 17*(2), 331-348.

Centre for Research on Innovation and Competition and Department of Psychology (2002). *Digiplay Initiative.* Manchester: University of Manchester and University of Central Lancashire. [http://digiplay.org.uk]

Greenfield, P., Camaioni, L., Ercolani, P., Weiss, L., Lauber, B., & Perucchini, P. (1994). Cognitive socialization by computer games in two cultures: Inductive discovery or mastery of an iconic code*? Journal of Applied Developmental Psychology, 15*(1), 59-86.

Hall, W. (2000). Demographics: The kids are all right. Are today's Japanese children – the next Internet generation – going to hell in a hand-basket? Tokyo: Japan.Inc. [http://www.japaninc.net/mag/comp/2000/03/mar00_reports_js.html]

Journal of Applied Developmental Psychology, 15, Special Edition (1994).

Martinez, M. (1998). What is problem solving? *Phi Delta Kappan, 79*, 605-609.

Pillay, H., Brownlee, J., & Wilss, L. (1999). Cognition and recreational computer games: Implications for educational technology. *Journal of Research on Computing in Education, 32*(1), 203-216.

Researching teenagers' recreational video/computer gameplaying

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Abstract: The purpose of this brief paper is to invite additional project partners into our research. We believe that an international, rather than country specific, survey of the various issues involved in playing recreational video/computer games will help characterize this important aspect of youth culture on a global basis. It will also help inform parents, teachers, governments, the media, and video/computer game designers, including educational and edutainment instructional computer game designers.

Recreational video/computer games are a significant cultural artifact of youth culture and are a multi-billion dollar industry. "Video/computer games", is a generic term encompassing four types of games: (a) video games that use a CD or cassette console with attached control devices connected to a TV monitor; (b) computer games that are played on the computer using a CD-ROM or the Internet; (c) "gameboys" that are small hand-held rectangular devices that have the display screen in the top half and the control buttons in the lower half; and (d) arcade games that are played in public shops or arcades. The pervasiveness of these cultural play artifacts with their "scintillating pulsating surfaces that are dynamically seductive", invite exploratory play while shaping the users' lives (Turkle, 1997). This pervasiveness has led to a corresponding rise in the emotional debate regarding the consequences of video/computer game playing.

There have been a number of surveys establishing children's, teenagers', and young adults' gender usage patterns, game preferences, and/or opinions on issues of violence and addiction (e.g. Australian Bureau of Statistics, 2000; Centre for Research on Innovation and Competition, 2002; Downes, 2000; Drotner, 2001; Media Analysis Laboratory, 1998; Griffiths, 1997; & Walsh, 2001). However, these surveys and studies have limitations that our international multi-focussed survey would help overcome. For instance:

- previous surveys, except for Drotner's European survey based on 1998 data, have been country specific;
- they sometimes target different age groups, making international comparison incomplete;
- they do not target all types of recreational video games: computer CD-ROM games, Internet games, arcade games, and "gameboy" games;
- many of their questions are not the same, making international comparison incomplete;
- they usually do not target identity-status issues;
- they do not target the participants' perceptions of educational versus recreational video/computer games; and
- they do not target English literacy, video/computer game genre literacy, and identity issues with respect to the Web and print computer gaming magazines.

We have commenced research that involves a comparison of various issues concerning video/computer game playing by 13 and 14 year old youth in Australia, Israel, England, and, in a minor way, China. This age-group was chosen because it has been identified in some surveys to be the age when teenagers lose interest in video/computer game playing and this age group is consequently often ignored in the wider literature. (Yet our survey reveals that the 13/14 year olds all play one or more types of video/computer games.) The research comprises a 28 item questionnaire that was designed to help identify various aspects of computer/video gaming for this age group. The questionnaire obtains gender, age, and ethnicity profile data.. While some items contain multiple parts with fixed choices within those parts, others (including a drawing) are open-ended thereby allowing the students to delineate the issues relevant to them. (Surveys usually opt for closed categorical-mode entries for ease of coding and correlation.)

The broad issues targeted in our survey concerning video games, computer CD-ROM games, computer Internet games, arcade games, and "gameboy" games include:

- usage patterns (what types are played, and for how long, when, where and with whom with each game type); use of Internet game playing is particularly targeted;
- reasons for playing each type they play;
- reasons why they quit a particular game playing session;
- role of video/computer games in their recreational lives;
- game genres played and preferred, and reasons why;
- identity-status construction and positioning (of themselves, of and by their peers, by the games, and by the gaming print media); this area is also linked to gender and violent/non-violent issues;
- perceptions of effects of games on themselves and others;
- concerns associated with video/computer games;
- characteristics that make a good video/computer game;
- video/computer game literacy;
- comparison of educational vs recreational computer games. (Our data highlights the relevance of identity-status factors in this comparison.)

At present, we are processing some 584 completed questionnaires from the participating countries. Categories and correlations have been delineated and a database is being constructed. We expect this analysis to enable us to obtain a global characterization of this growing digital gaming culture, and to shed light on its role in the youths' lives internationally.

Literature References

Australian Bureau of Statistics (2000) *ABS Catalogue No.4901.0 Children's participation in cultural and leisure activities, 2000*. Canberra: ABS [Online: http://www.abs.gov.au/]

Centre for Research on Innovation and Competition and Department of Psychology (2002). *Digiplay Initiative*. Manchester: University of Manchester and University of Central Lancashire. [Online http://digiplay.org.uk]

Downes, T. (2000). An Australian study: The computer as a "playable tool." Paper presented at *American Education Research Association Conference: Creating knowledge in the 21st century: Insights from multiple perspectives*, New Orleans, 24-28 April.

Drotner, Kirsten (2001). Medier for Fremtiden. Copenhagen: Høst og Søn

Griffiths, M. (1997). Computer game playing in early adolescence. *Youth & Society; 29*(2), 223-37.

Hall, W. (2000). Demographics: The kids are all right. Are today's Japanese children – the next Internet generation – going to hell in a hand basket? Tokyo: Japan.Inc.
[Online http://www.japaninc.net/mag/comp/2000/03/mar00_reports_js.html]

http://game-research.com/statistics.html)

Media Analysis Laboratory. (1998). Video game culture: Leisure and play preferences of B.C. teens. Vancouver: Simon Fraser University [Online http://www.media-awareness.ca/eng/issues/violence/resource/reports/vgames.htm]

Turkle, S. (1997). Seeing Through Computers: Education in a Culture of Simulation. The American Prospect, 31(March-April), 76-82. [Also Online http://epn.org/prospect/31/31turkfs.html].

Walsh, D. (2001). Sixth annual video and computer game report card National Institute on the Media and the Family. [Online: http://www.mediafamily.org/research/vgrc/2001-1.shtml]

Students Composing Music in a Cognitive Apprenticeship Interdisciplinary Online Curriculum:
An Analysis of Systemic Issues in the MUSYC-IT Program

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Abstract: Music Uniting Schools, Youth, and Communities through Information Technologies (MUSYC-IT) is an innovative multidisciplinary program offered to Grade 5-8 students in Schools of Distance Education and small rural schools. Students conduct an oral history interview, reinterpret this as a lyric, compose a melody to that lyric using computer software in a cognitive apprenticeship model through mentoring by experts via the Internet. The paper analyses 764 emails to identify the issues involved. The findings reveal four major themes: information technologies; intersystemic development; implementation and delivery; and student learning and outcomes. Technological gliches, variability in mentors, commitment of participants, maintenance of the status quo were major issues. Most students completed their song and presented it publicly; principals, parents, and students request it be continued.

In Australia, there is unequal access to music studies for rural and remote students. Where offered, music is limited as it is theoretical or extra-curricular. Music Uniting Schools, Youth, and Communities through Information Technologies (MUSYC-IT) is significant in that it addresses rural youth identity, place, computer technologies, and music in a way not previously approached in Australian curriculum or, we believe, internationally. Compare the face to face PACERS Small Schools Cooperative which employs a professional musician (Anderson, 1999) and the Harvard's SongSmith classroom based program (Walters, Meyaard, & Scripp, 1990). The e-mentoring approach adopted by Canada's Composers in Electronic Residence (http://www.edu.yorku.ca/CIERmain.html) and the USA's Vermont MIDI Project (http://www.vtmidi.org) are both extension programs supplementing classroom teaching (also see: MacKenzie, 1998; Ruippo, 1999).

MUSYC-IT *is* the music program for our students, whether learning in their own homes through the Schools of Distance Education (SDE) or in a classroom at a small rural school. Students of various ages (10-13 years), grade levels (5-8), and abilities participated individually and collaboratively, contributing at their own level within a cognitive apprenticeship model (Brown, Collins, & Duguid, 1989). The students conducted oral history interviews with community people thereby validating local identity and community within an increasingly globalised world. Students then reinterpreted the content of the interview as a lyric, composed a melody using PrintMusic software, and were coached during the process through guided scaffolding by expert mentors, particularly the nationally acclaimed composer and lyricist mentors, via the Internet (cf. Schlager, Poirier, Beans, 1996). The students were learning something of what is involved in being a professional historian, lyricist, and composer.

The three year project is an agent for educational change. This study is part of a larger research project that attempts to identify social and educational issues concerning intersystemic development, delivery, implementation, and outcome factors involving a computer-mediated interdisciplinary curriculum in SDE and small rural classroom context. As the research literature reveals, information technology innovation in schools is difficult with variable implementation success (eg., Riley, 2000; Rogers, 1995). The first year or phase of this project was no exception. The specific aim of the paper is to identify the systemic issues concerning the implementation and delivery factors in the first year with respect to the online email communications between the participants of the program.

Methodology

The procedure employed in this analysis utilized an interpretive perspective (Erickson, 1986). This interpretative approach advocates the portrayal of the idiosyncratic and the particular as legitimate in themselves (Walker, 1986; Wignall, 1998). Pseudonyms or role descriptions are used throughout this report. Ethical dilemmas associated with the use of confidential information were addressed by providing drafts to participants who could be identified in the text. Modifications and suggestions were incorporated at their request. The setting of the study involved a number of different sites. James Cook University was the location of the two university project directors and researchers. Two types of school sites were involved: One was the four SDE whose students are on grazing properties isolated from regular schools or travelling (one of MUSYC-IT students was in England with her family). Each of the students enrolled through the SDE had their own site that was, in fact, their own home. The second school type was a rural multi-grade classroom, half of whose students undertook the program under the guidance of a classroom teacher. Finally, both the lyricist and composer mentored from their homes as occasionally did the project directors. The participants involved the following:

Research and development project directors (1 male; 1 female) conceptualized and coordinated the program, designed and developed course materials and the Website, mentored, wrote grant applications, and oversaw the data collection by two research assistants.

Students: One self-selected cohort involved 11 Grade 6-8, SDE students (3 male and 8 female) who had some rudimentary knowledge of music and worked under the guidance of a home tutor, usually their mother. The second cohort involved 13 (8 male and 5 female) Grade 5-7 students selected by the teaching-principal on the basis of their ability to work unsupervised.

Mentors: Four subject specific mentors (3 males; 1 female) provided expertise to the students; and one parent acted as the IT troubleshooting mentor.

Home Tutors & Teachers: 12 home tutors (one had 2 children enrolled) and 1 teaching principal for Term 3 and 1 classroom teacher for Term 4 with the rural multi-aged/grade cohort. Most home tutors and both teachers had no or little music knowledge; and

Administrators: Two SDE female coordinators (one left at the beginning of Term 3). Theirs was an administrative role that did not involve mentoring and was extra to any regular teaching duties; 2 principals.

Data Results and Analysis

Specifically, this paper reports an analysis of the email documentation connected with the overall project. There were 764 emails between the participants during 2001 (additional ones were inadvertently deleted or not sent to the project directors). The data were firstly categorized according to the source of the documentation. The constant comparative method provided a theoretical construct from which to operate (Dye, Schatz, Rosenberg, & Coleman, 2000; Glaser & Strauss, 1967). Each category was coded with a set of interpretive codes that emerged from the data and from discussions between the researchers. These coding categories were combined into main themes about the processes and issues involved in the implementation of the curriculum. This text is an interpretive representation of those themes and aims to describe and characterize the factors involved in the implementation of the online curriculum.

The intensive and exhaustive analysis of the data yielded many significant insights into the processes and issues involved in the development, delivery, and implementation of the online curriculum. Four major themes presented in Table 1 elaborate these insights in an attempt to qualitatively describe what the participants were talking about as the program was implemented. Evaluative conclusions about the implementation of the program are drawn and implications for future implementation are discussed.

Information Technologies	*Intersystemic Development*	*Implementation, Delivery & Research*	*Student Learning & Outcomes*
Internet Issues: ▪ *Email* ▪ Address changes ▪ Connection problems ▪ Size limitations ▪ *Web Site* ▪ Firewalls	**Planning**: ▪ Scope ▪ Cohort size ▪ Curriculum ▪ Core or elective ▪ Funding ▪ Publicity ▪ Enrolment procedure ▪ Communication	**Administrative Duties:** ▪ Enrolments ▪ Mentors' role ▪ Music camp ▪ Organisation ▪ Implementing ▪ Timetables ▪ General information ▪ Distribution materials ▪ Distribution fliers	**Student-Mentor Interaction** ▪ Organising & reorganising student groups ▪ Feedback ▪ from mentors to individuals & general; ▪ from students: erratic ▪ Difficulty meeting

▪ Security issues ▪ Development ▪ Delays ▪ Uploading ▪ Content	methods ▪ Roles stakeholders ▪ Letters of support ▪ Engaging mentors	▪ *Meetings*: ▪ Formal & informal ▪ Teleconference ▪ Face to face	deadlines ▪ Delays communicating between mentors & rural school students ▪ Mostly positive
Software: ▪ Selecting ▪ Ordering issues ▪ Distribution issues ▪ Testing platforms ▪ Installation issues ▪ Plug-in issues	**Grant Applications**: ▪ Internal - research ▪ External ▪ Philanthropic ▪ Industry ▪ Government ▪ Ascertain guidelines ▪ Writing ▪ Liaison JCU R&D ▪ Liaison SDE	**Information & Feedback** ▪ Reading ▪ Coordinating SDEs ▪ Fliers ▪ Calendar; assessment ▪ Teaching/learning online methods ▪ Working collaboratively ▪ Website	**Collaboration** ▪ Confusion interviewing in pairs/groups at a distance ▪ Cancelled & late SDE enrolments meant group reorganisation ▪ Difficult for SDE students as not common practice ▪ Rural school: changing grouping for activities increased load for mentors
Hardware: ▪ Platform compatibility ▪ Crashes ▪ Speakers malfunction ▪ iMovie ▪ Camera ▪ Storage	**Media:** ▪ Liaison JCU unit ▪ Writing drafts ▪ Interviews; photo shoots	**Resources:** ▪ Music tutorials & worksheets ▪ Oral history themes, questions & protocols ▪ Web site ▪ iMovies **Research:** ▪ Appointing RA's ▪ Developing instruments ▪ Data collection ▪ Transcription audiotapes ▪ Analysis & writing papers	**Learning Outcomes:** ▪ Oral history: completed ▪ Lyric: all but 3 students ▪ Melodies: 8 completed; others extended to 2002 ▪ Increased IT competencies ▪ Collaboration: variable ▪ *Archival:* ▪ Publication songs; student comments ▪ iMovie music camp ▪ Public presentation songs

Table 1:Major Themes from Email Analysis

Theme 1: Information Technologies

This theme deals with the issues and processes involved in getting a the IT operational for the students enrolled in the program, as summarised in Table 1: Internet issues, software, and hardware.

Handling of the Internet issues was lengthy. There were issues such as the schools' and university's firewalls, Web site, Internet access, and security that needed quick resolution. There was an underestimation of the amount of time required for these issues to be addressed by the different stakeholders with messages becoming increasingly more urgent. The failure of the Website to be up and running at this stage caused much frustration for both students and administrators alike. The delay meant that multiple mailings of files and attachments were necessary. Once the Website was working students were able to access the site at their own convenience.

The initial stages of the course involved correspondence that reflected further frustrations concerning uncertainty in the accuracy of email addresses because of changed email accounts, the rural school's firewall, and the families of distance education students having two email accounts to handle various sized email files. In one case, these email problems, exacerbated by low bandwidth technology, resulted in two students withdrawing within the first 3 weeks of MUSYC-IT.

A significant issue involved the selection, ordering, and distribution of the relevant music software required for the program. After much discussion about, and trialing of, the most appropriate software to be used, there was a problem with the supply of this particular product. Decisions for alternative software had to be quickly made and actioned. Unfortunately, once the software arrived, installation of the PrintMusic two CD pack – the original program on one CD with the upgrade on the other - was variable as some worked and some did not. Conveniently for MUSYC-IT, a parent from the rural school volunteered to be the troubleshooter for software, email, downloading plug-ins, and hardware problems. Utilisation of community resources cannot be overlooked as an invaluable factor when dealing wit h IT and school change.

Theme 2: Intersystemic Development

This theme involved the intersystemic issues of planning, grant applications, and media publicity, as summarised in Table 1. Crucial issues involved the scope and cohort size of the project.

To help avoid a top-down imposition of MUSYC-IT on teachers and students, negotiation and consultation with the SDE, parents, and students commenced in December 2000 for implementation from July through to mid-December 2001, with a student involvement of up to three hours per week. Initially, it was thought that 20-30 students from Grades 7-10 would enrol in MUSYC-IT as a core interdisciplinary subject. This did not eventuate. Some reasons had to do with the maintenance of stasis and custodianship of the status quo (Southcott, 2000), as, when it came to the crunch, there was opposition to changing the SDE segmented curriculum. Other reasons had to do with the initial SDE coordinator's workload aggravated by being new to distance education and the level of appointment, and being a self-acclaimed neophyte with technology. Another possible reason is that there were no obvious status or career rewards, incentives, or recognition for teachers to support innovate change through MUSYC-IT (Ely, 1999).

An alternative to a core subject was implemented. MUSYC-IT was offered as an elective with students exempted from some activities and assessment to ensure that the students' total workload was not increased. Lack of clear communication about the latter was late and inadequate, helping to cause small SDE enrolments. In fact, this negotiated and agreed upon strategy was not operationalised for two Grade 8 students in one SDE district, and it was the reason for their failure to complete, and hence postpone till 2002, the lyric and melody. As it eventuated, having 11 SDE students geographically dispersed throughout half of Queensland with different bandwidth Internet access and one in England and 13 in a rural classroom proved a worthwhile "pilot" cohort for ascertaining the viability of MUSYC-IT under both conditions.

The various issues and balance of power involved with this area of intersystemic innovation in schools intrigued the project leaders. The literature helped us understand that the principal was adopting the role approved by Fullan (1992) and supported by Glickman (1991), arguing that too much store is placed in the leader as solution compared to the leader as enabler of solutions.

Funding applications for both research and development, particularly the latter, commenced well before the setting up of the project, and still continue. Collaboration with one of the administrator participants, the principal of the coordinating SDE, was pivotal in acquiring funding for the composer-educator mentor, the purchase of the PrintMusic software, and the music camp. Without this grant, the project would have been postponed. The assistance of the lyricist-mentor helped obtain an Arts Queensland grant for his involvement in MUSYCIT. The project leaders underestimated the time taken in submitting numerous grant applications, five of which were successful.

In requesting assistance from industry partners, the research project was hoping to offset costs involved in purchasing the necessary equipment to run the course. Requests for hardware support were not successful because industry were hoping to reach wider audiences and receive more in return for their support than simply recognition. Telstra CountryWide's support for free Internet access for 30 accounts, a designated secure Website and a Website domain name for six months demonstrated a significant level of support. It was especially welcomed by the families involved in MUSYC-IT.

Besides developing their own curriculum resources, the project directors became clients for four final year B.Ed. students in a core IT course: the students created and acted in three iMovies that formed part of their course assessment and that will be utilised as resources for next year's MUSYC-IT intake. Three of the students also critiqued the music curriculum tutorials and worksheets and suggested extension material using PrintMusic software. This unforseen outcome of MUSYC-IT capitalised on widening the scope of IT diffusion to JCU graduating students.

Theme 3: Implementation, Delivery, & Research

This theme describes the processes and issues involved in operationalising the program and conducting research (see Table 1).

The project directors committed an enormous amount of time to the project in terms of receiving information, attending formal and informal implementation meetings both at the university and at the coordinating SDE (2 hour drive) and rural school (1 hour drive), devising enrolment applications both in hard copy and an email version, distributing these via the SDE coordinator, processing enrolments, inducting the mentors, organising and running the music camp, providing feedback, troubleshooting, and conducting research. Email correspondence between project leaders was heavy during periods when either one of the project leaders was away. Email correspondence was open, frequent, prompt, and with the intent of keeping the leaders up to date with current developments pertaining to the whole project. The time commitment during the early part of Term 3 of the coordinator of the SDE to help solve the technical and enrolment gliches that delayed the start of the program by a week was a positive factor in the implementation of the project.

The project leaders also attempted to organize a teleconference in the initial stages of the program. This required that a range of times for all participants be offered and then narrowed to a common time. Unfortunately, because of some unforeseen circumstances, the teleconference did not eventuate. The purpose was that students, home-tutors, teachers, SDE coordinators, the rural school principal, and mentors would hear each other's voices, troubleshoot any major problems, and feel a greater sense of collegiality in this new venture of teaching and learning music. From the email exchanges, this sense of collegiality between students did not eventuate for all participants. Perhaps a teleconference would have helped.

Theme 4: Student Learning and Outcomes

This theme is concerned with the learning outcomes experienced by the students themselves. It involves the quality of interactions between students and mentors, their responses to the various tasks of the program, and the degree of satisfaction with their final product. The types of issues and processes discussed include working in pairs/groups, how to conduct interviews, and providing feedback to mentors.

Once the IT problems were overcome and the students were able to work through their worksheets with the music-educator mentor's guidance, there was a much more positive note to the email correspondences: "Whilst I am writing I just want to say how much I am enjoying doing this course. Sometimes I find some of the words a little hard to understand and it has been a little bit complicated with the few problems we've had. Now, though, I think it's great to see the music on the computer and I look forward to doing activities in the future" (Email correspondence 27/08/2001 from A to music curriculum mentor).

Students appeared eager to conduct interviews and were able to identify elements about their interviewee's story. However there was some confusion about how the SDE students were to work online in pairs for this activity. Group work for SDE students appears to be a challenge and, although suggestions on how this activity could be carried out were provided, they were obviously inadequate for some students.

The lyricist-mentor undertook a very prominent mentoring role and his concern for student progress was obvious. Rather than sit back and wait for student outcomes, he often was proactive in ensuring that communications were working and that students were making adequate progress on their lyrics. Some of the email messages from the lyricist mentor, rather than contain attachments, contained the information for students in the body of the message. Sometimes the messages were up to five pages long. Depending on the preferences of the mail programs used to receive mail, these messages may have had untidy formatting. Whether these email postings were somewhat overwhelming for students is something that will be explored further in the participant interviews. Students were appreciative of his mentoring; for instance: "Please find attached The Value of Time2. All of your suggestions were wonderful– they made me look more deeper [sic] into what I was trying to accomplish. I'm a lot happier with the song now that you've helped and I agree – it's worth changing the things that don't quite fit, even if you really like them … You've been brilliant and I really am grateful for the easy ways you have explained things to me" (Email 29/09/2001 from S to lyricist mentor cc. to the project directors). As the students were nearing the completion of their lyrics, there was evidence that they had established clear and effective lines of communication with their lyricist-mentor.

Unfortunately just as the melody composition stage of the project was commencing, the composer-mentor withdrew from the program and a replacement mentor had to be found. The new composer-educator appeared to find mentoring via email more problematic than did the lyricist mentor. He was also not as prompt with replies as students would have liked. This figured in the non-completion of some of the students melodies. It also suggests that the project directors should have provided formal induction into online mentoring.

There were very few correspondences from rural school students. This comparative dearth of email correspondence from the students, who all had their own email accounts, reflects the fact that the teacher-led class spent time face-to-face jointly brainstorming the various mentors' emails, activity tasks, composing the lyric, and working with PrintMusic. There were fewer problems with hardware and software at this site because the IT mentor-troubleshooter was a parent. Overall, this seemed to result in fewer frustrations or need to email the mentors quite so frequently as did the students who were studying in an individualized setting.

The music camp and presentation of their songs was a success. Both principals, the mentors, and most parents and students asked that MUSYC-IT be offered at both first and second year levels in 2002. As one Grade 6 student summarised: "Gliches in the program are only to be expected as it is new and innovative. These will be overcome next year. MUSYC-IT helps you grow as a student. I really enjoyed it."

Implications

- It is not only technical resources that count in technological diffusion and school change but also the time and energy demanded of people to plan, share, observe, and take action (Boyd, 1992).
- More lead-up time is necessary to avoid technical gliches interfering with the mentoring and learning, and thereby lessening frustrations.
- Maintaining a designated IT troubleshooter is important; the project directors thought they had it covered inhouse at both JCU and the SDE. Not surprisingly, hindsight proved that such IT personnel prioritised their commitments to their organisation before assisting a project.
- Mentoring online needs induction workshops for some to be the expert efficiently and effectively.
- Developing effective guidance for collaboration online needs implementation.
- Obviously having a designated project coordinator would ensure a smoother running of MUSYC-IT.

Literature References

Anderson, L. (Ed.) (1999). *Guidebook: PACERS Small Schools Cooperative*. Bethlehem, PA: Sing Out!

Boyd, V. (1992). *School context: Bridge or barrier for change*. Austin, TX: Southwest Educational Development Laboratory. Also [On-line: http://www.sedl.org/ Accessed 2 November 2001].

Brown, J., Collins, A., & Duguid, S. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Dye, J., Schatz, I., Rosenberg, B., & Coleman, S. (2000). Constant Comparison Method: A Kaleidoscope of Data. *The Qualitative Report, 4*(1/2), [Online: http://www.nova.edu/ssss/QR/QR4-1/dye.html Accessed 27 December 2001].

Erickson, F. (1986). Qualitative methods in research on teaching. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd edn.) (pp. 119-161). New York: Macmillan,.

Glaser, B., & Strauss, B. (1967). *The discovery of grounded theory: Strategies for qualitative research*. New York: Aldine De Gruyter.

Rogers, E. (1995). *Diffusion of innovations*. (4th Edn.). New York: The Free Press.

Riley, K. (2000). Leadership, learning and systemic reform. *Journal of Educational Change, 1*(1), 29-35.

Ruippo, M. (1999). *Net Conferencing in Music Distance Education: Observations on a Pilot Project*. Helsinki. Finland: Sibelius Academy [Online: http://www.pedanet.jyu.fi/cato/calive/musdista.html Accessed 27 December 2001].

Schlager, M., Poirier, C., & Means, B. (1996). Mentors in the classroom: Bringing the world outside in. In, McLellan, H. (Ed.), *Situated learning perspectives* (pp. 243-262). Englewood Cliffs, NJ: Educational Technology Publications.

Southcott, J. (2000). Curriculum stasis: Gratton in South Australia. *Research Studies in Music Education, 14*, 50-60.

Van de Ven, A. (1993). Managing the process of organizational innovation. In G. Huber & W. Glick (Eds.), *Organizational change and redesign: Ideas and insights for improving performance*. New York: Oxford University Press.

Walker, R. (1986). The conduct of educational case studies. h M. Hammersley (Ed.), *Controversies in classroom research*. Milton Keynes: Open University Press.

Walters, J., Meyaard, J., & Scripp, L. (1990). *Songsmith. Project Zero*. Cambridge, Mass.: Harvard University.

Wignall, R. (1998). Challenges for interpretivist inquiry. *The Alberta Journal of Educational Research, 44*(3), 302-319.

A System to Help Detect and Remediate Novice Programmer's Misconceptions

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Abstract: This paper describes a hypertext system to support novice Java programmers to improve their understanding of software design issues. The system provides the usual hypertext support such as cross-referencing and formatted display of source code. In addition it implements a number of object-oriented metrics and it detects and remediates typical misconceptions of novice programmers.

Introduction

For many years we have been involved in teaching a first programming course to students of physics, mathematics and informatics. Three years ago we have switched from Pascal to Java as a first programming language.

Our experience thus far has shown that despite the fact that Java is relatively clean conceptually (at least compared to C or C++), many students struggle to learn the syntax and concepts of Java and gain enough experience with programming to be able to reason about program design. An important aspect of the course are individual programming assignments, in which students have two to three weeks to design and implement a program which is then discussed individually with a teaching assistant. These discussions are invaluable for detecting and remediating the student's misconceptions about programs and program design practice. The following is a typical conversation that might take place between a teaching assistant and a student:

TA: What are these instance variables i and j in the class Matrix?

Student: Those are the loop index variables I use for various methods, like the ones for adding and multiplying matrices.

TA: But why are those declared as instance variables? Surely i and j are not actual properties of a matrix.

Student: Yes. I originally had declared those variables locally in each method, but I figured that I could make the program shorter and simpler if I moved the declarations to the object's scope.

TA: Isn't that dangerous? It is quite difficult for me to check whether these methods will work correctly. And suppose one method called the other and both used the same index variable, or that multiple threads called these methods simultaneously. That would mix things up.

Student: Yes, I suppose so.

This conversation reveals a number of implicit assumptions and misconceptions that the student has about what it means to design classes and programs. The student moved the declarations to the object level because he is aware that simplicity and elegance of programs is highly valued in program design culture. But this particular simplification is rooted in a misguided notion that simplicity is achieved by having less code.

From the student's point of view the program is perfectly understandable, and the experience of having the teaching assistant tell him that it is not is quite sobering. Students generally do not think about the possibility of others reading and using their code, and what that implies for the way their program should be designed. Their only immediate concern is (1) that their program compiles, and (2) that it works. Their thought processes are organized to achieve those goals, in that order. Many of these misconceptions are situated at a meta-cognitive level (Schoenfeld, 1992). They are not learned explicitly from books and lecturing, but are acquired implicitly by participating in a community of design practice.

We do not believe that direct interaction sessions can be replaced by technology alone. But what we can do is make them more effective by removing the most common misconceptions earlier in the process so that the interactive sessions can focus on other, more important issues. Our aim is therefore to design a tool, which will help students detect such common misconceptions and advise them on how to improve their work while doing it. To motivate students to actually use it, it must be conceived as a generally helpful programming tool rather than a teaching tool. Students are not aware of their misconceptions and therefore will not be inclined to actively look for them. For this reason, we will embed it in a more general hypertext documentation tool.

Design Approach

To design the system, we have followed the following approach:

1. Create a feature model (see e.g. (Czarnecki & Eisenecker, 2000)) of the features found in the many similar tools that exist on the market today. These include tools such as LINT, object-oriented software metrics (Chidamber & Kemerer, 1994), and HTML cross-referencing tools such as javadoc[1] and javasrc[2].
2. Use XML to represent Java programs at different levels of detail. For Java interfaces and code we selected JavaML (Badros, 2000) and for Java byte-code we have developed our own XML syntax called BCML (byte code mark-up language).
3. All other configuration and state information is also maintained in the form of XML. The syntax of this XML reflects the feature model developed earlier.
4. XSLT (XML transformation language (Clark, 1999)) is used for laying out source code, calculating metrics and detecting misconceptions.

By studying the programs that students had submitted in previous assignments, we were able to identify a number of misconceptions (currently some 20) that we believe cause students to write badly designed code. For each of these misconceptions we then looked for symptoms (and sometimes counter-indications) in code. For symptoms that can feasibly be detected automatically, we then select the representation (currently JavaML and BCML) which is best suited for detecting it. Finally, an XSLT template is written that matches a particular symptom and generates a suggestion for improving the design. Table 1 shows one example of such a misconception.

Misconception: The importance of encapsulation	
Symptoms	Public instance variables Direct use of public instance variables of another class
Counter-Indications	The class with public instance variables is instantiated and used only by a single other class
Measure	The number of classes (excluding subclasses) that access or update its member variables a superclass or nested class of that class

Table 1: An example misconception.

The suggestions for improvement generated are general natural language statements. It is not our intention to attempt to improve code automatically. Focus of the project is not on formal specification or verification techniques, but rather on a heuristic approach.

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[1] http://java.sun.com/j2se/javadoc/

[2] http://home.austin.rr.com/kjohnston/javasrc.htm

System Architecture

To keep a system like this maintainable and extensible we have decided to take a very strict attitude towards simplicity and architectural integrity.

- The architecture should not depend on the language used (Java) nor on its specific XML representation (JavaML). The use of XML and stylesheets allow some form of independence from programming languages and representations.
- The system architecture should be independent of the specific insights about misconceptions. It should be straightforward to add support for new misconceptions and to add new measures to detect them.
- The number of available views (e.g. class, package, inheritance diagram, index, ...) and their structure should be completely configurable, so that developers can compose and add new views without modifying existing code and users can select a view dynamically.

These principles lead to a surprisingly simple but powerful architectural design. Figure 1 shows a sketch of the system's architecture. When a request is received by the servlet, it loads a configuration file containing a description of the structure of each view. This `config.xml` file contains parameters that are placeholders for information provided by the request, such as the URL, session parameters and HTTP cookies. The system then processes the resulting XML file with the master style sheet which in turn will call upon a parser to generate XML from Java source code or byte codes and applies the appropriate templates on the resulting XML.

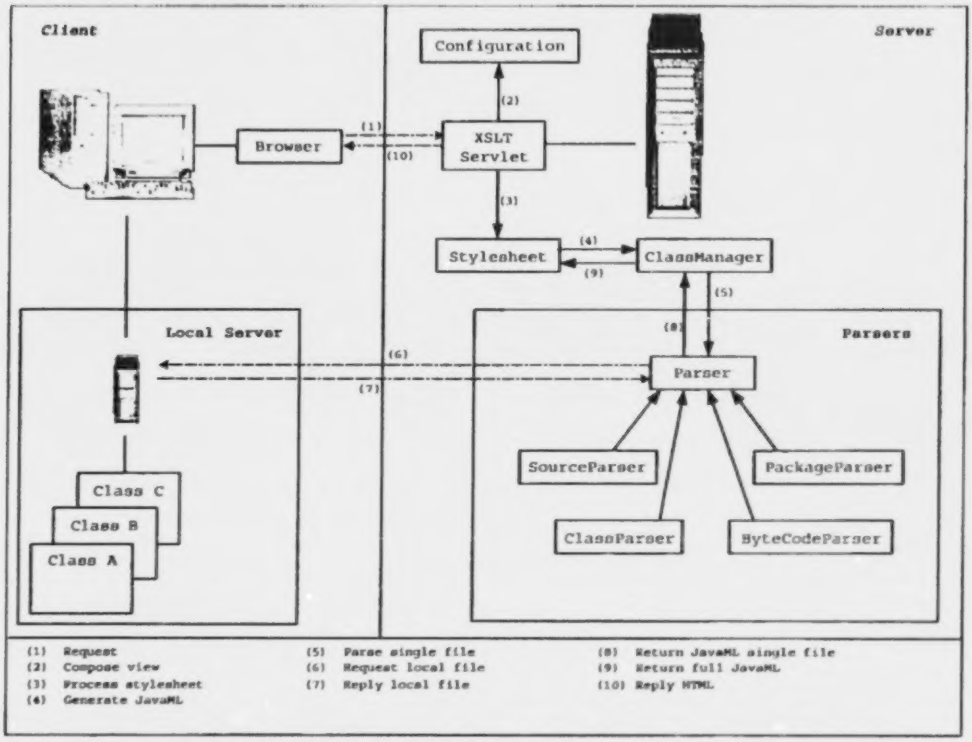
Client
Server
Configuration
(2)
Browser
(1)
(10)
XSLT Servlet
(3)
Stylesheet
(4)
(9)
ClassManager
(5)
(8)
Local Server
Parsers
(6)
(7)
Parser
SourceParser
PackageParser
ClassParser
ByteCodeParser
Class C
Class B
Class A
(1) Request
(2) Compose view
(3) Process stylesheet
(4) Generate JavaML
(5) Parse single file
(6) Request local file
(7) Reply local file
(8) Return JavaML single file
(9) Return full JavaML
(10) Reply HTML

Figure 1: Sketch of the system architecture and component interactions.

The resulting architecture is very simple in that the servlet is not even aware that it reads Java. It only deals only with HTTP, and simply calls the XSLT engine to process the configuration file. All of the particulars of locating Java files, parsing them and transforming them are local to the stylesheets.

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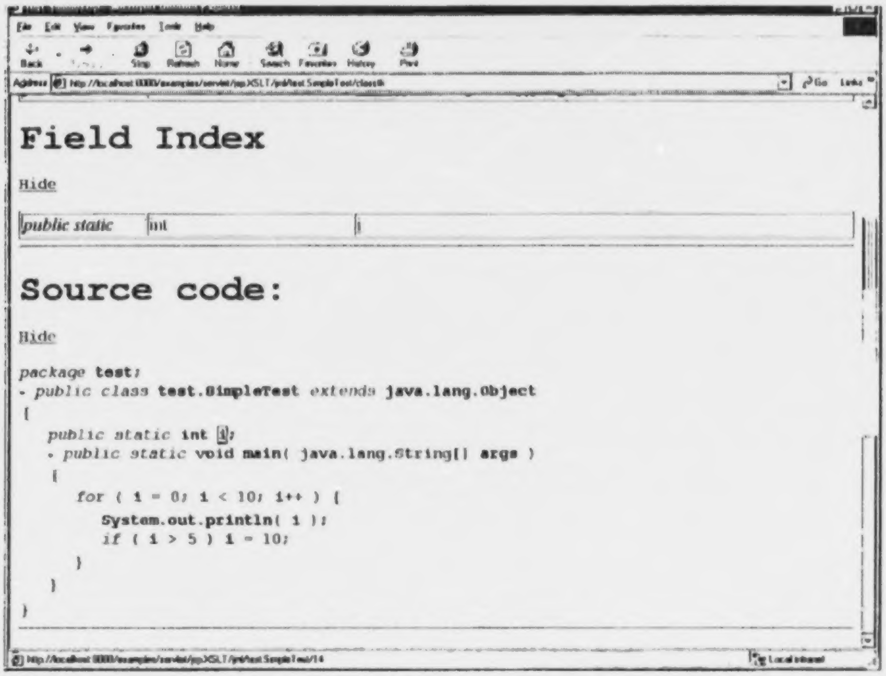
Current Status and Future Work

The current implementation provides an interface that is very similar to Sun's Javadoc. It provides package, class, usage, tree, and index pages. The difference is that the class view provides the ability to view source code for each method as well, with a feature to show the type and declaration of each variable that is referenced (illustrated in Figure 2), and one to highlight each usage of a particular variable.



Field Index

Hide

public static	int	i

Source code:

Hide

```
package test;
- public class test.SimpleTest extends java.lang.Object
{
   public static int i;
   - public static void main( java.lang.String[] args )
   {
      for ( i = 0; i < 10; i++ ) {
         System.out.println( i );
         if ( i > 5 ) i = 10;
      }
   }
}
```

Figure 2: The source code view of a class. This view has a number of useful features, such as: syntax highlighting, the ability to expand and collapse code sections, cross-links from variable references to their declaration. When the cursor is moved over a variable declaration, all its uses are highlighted and when the cursor is moved over a variable reference, its declared type is shown. Note that this class shows three misconceptions: there is a public variable, this variable is used as a control variable for the for-loop, and the control variable is updated in the body of the for-loop.

In addition, a 'metrics' and 'misconceptions' view are provided. The metrics page displays a number of standard object-oriented metrics as defined by (Chidamber & Kemerer, 1994). The other shows a number of misconceptions, as is illustrated in Figure 3.

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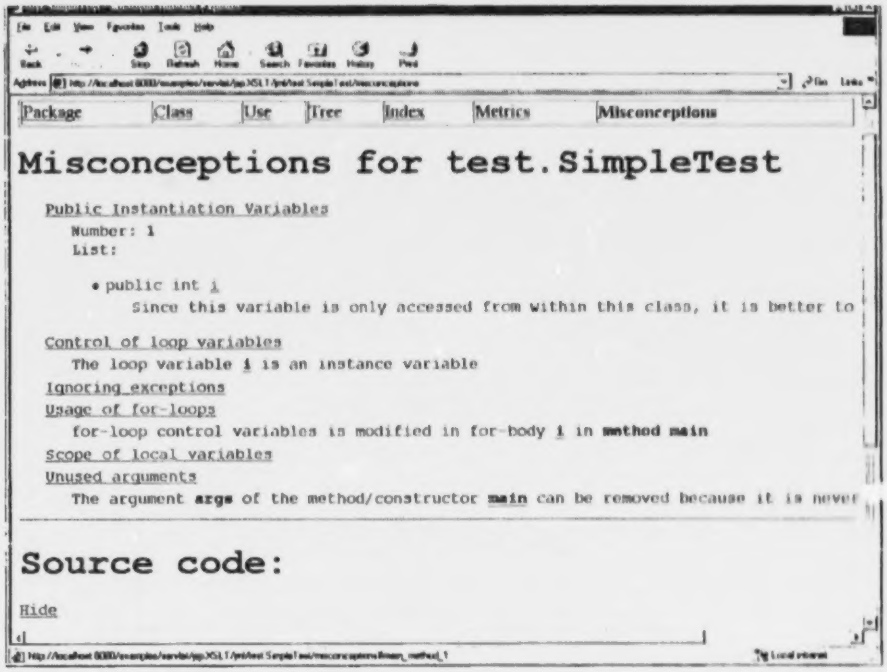

Misconceptions for test.SimpleTest

Public Instantiation Variables
Number: 1
List:

- public int i
  Since this variable is only accessed from within this class, it is better to

Control of loop variables
The loop variable i is an instance variable
Ignoring exceptions
Usage of for-loops
for-loop control variables is modified in for-body i in **method main**
Scope of local variables
Unused arguments
The argument **args** of the method/constructor main can be removed because it is never

Source code:

Figure 3: The misconceptions view, showing how the system has detected four possible problems with the code of Figure 2. It has detected that there is a public variable which could be made private; the loop control variable is an instance variable, and it is updated inside the body of the loop. The last section indicates that the argument to the 'main' method is never used (although in this case, the argument is required for another reason).

Currently we are developing measures for detecting more complex misconceptions specific to object-oriented design. The system has also been extended to that students can easily use the service remotely. This requires that their Java files can automatically be transferred to the server for processing. To allow this, the student currently has to run a small server program that allows the server to access files from his or her class path.

We intend to make the system available to students as a tool for doing preliminary self-evaluation of their assignments before handing them in.

References

Badros, G (2000). Javaml: A markup language for java source code. *In Ninth International World Wide Web Conference*, May 2000.

Chidamber, S. R. & Kemerer, C. F. (1994). A metrics suite for object oriented design. *IEEE Transactions on Software Engineering*, 20(6):476{493, June 1994.

Clark, J. (1999). *Xsl transformations (xslt) version 1.0 w3c recommendation.* http://www.w3.org/TR/1999/REC-xslt-19991116, November 1999.

Czarnecki, K. & Eisenecker, U. W. (2000). *Generative Programming, Methods, Tools, and Applications.* Addison-Wesley, 2000.

Schoenfeld, A. H. (1992). Learning to think mathematically: problem solving, metacognition, and sense-making in mathematics. In D. A. Grouws, editor, *Handbook of Research on Mathematics Teaching and Learning*. Macmillan, New York, 1992.

You Are Entering a World of Sight and Sound: The Effects of Self-Generated Images on Music Ear-Training as a Possible Alternate Teaching Approach for Music Education Within a Web-Based Environment

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Abstract:
17 volunteers were administered an online drawing environment where they generated images as a response to musical intervals, then tested on their recall of these musical intervals while using their images as cues. A paired t-test comparing pre to post treatment showed a significant effect in the online treatment ($t\ (16) = 2.759$, $p = .014$). A series of multiple regressions also yielded a significant model ($F\ (4, 12) = 4.284$, $p = .022$) with $r^2 = .588$. The findings are explained with respect to dual coding theory (Clark & Paivio, 1991; Paivio, 1971, 1990) and the generative theory of reading comprehension (Wittrock, 1990).

When examining research into web-based learning environments, the most noticeable omissions occur in music education. One of the largest obstacles to designing effective online music applications has been hardware, i.e., computers that were being used for instruction were not capable of effectively reproducing authentic sound. Though this has changed over the last six years, there is little research on how to effectively use computers to teach music. In attempting to design instructional software that seeks to teach any aspect of music (performance, composition, history, or theory), it is imperative to understand how learners process music and how this can inform effective design of musical educational media.

This pilot study is investigating some possible connections between aural, visual, and verbal information in musical ear training tasks and more specifically, the learning of musical intervals (distance between two notes). By making a connection between these modalities, a more effective method for designing music education software may be possible.

Theoretical Foundation

The research involving educational implications of musical auditory processing with respect to images is scarce. Many studies look at the relationships between verbal and visual information (Mayer, 1997, 1999; Mayer & Sims, 1994; Moreno & Mayer, 2000) or between verbal and nonverbal information (Clark & Paivio, 1991). Datteri (2000) investigated the influences of music on the perception of apparent motion in stick figures and action terms, and through Gestalt audiovisual principles concluded there may be a deeper semantic system connecting the visual and auditory modalities.

Clark, Stamm, Sussman, and Weitz (1974) examined recall of sounds that could be labeled versus those that could not be easily labeled. They concluded that dual coding theory (Clark & Paivio, 1991; Paivio, 1971, 1990) could be expanded to auditory information in the form of sounds as well. Additionally Lipscomb and Kendall (1994) examined the interaction between music soundtracks and film, suggesting that a model of motion picture perception must focus on the "*source* of meaning within both the auditory and visual modalities" (p. 88) and is therefore "individual-specific" (p. 91). In another study that examined the effects of verbal labels on music recognition, Hiraoka and Umemoto (1981) used 19th and 20th Century classical excerpts to examine how verbal labels affect the memory recall of musical passages. They concluded that the subjects who made their own imagery seemed to use it as a retrieval cue that resulted in higher recognition scores.

Thus, there may be a dual coding process in learning that exists within the auditory modality, and that by having a user generate meaning or images, a stronger connection can be made. Wittrock's generative theory of reading comprehension (1990) discusses the importance of generative meaning through reading. Could this process be similar to verbal information with regards to language?

There are several well-established theories about processing music with respect to language. The assumption that music is processed in the same way as language is far from clear, and it actually appears that there are two different systems that exist within the auditory modality, one for verbal information and one for auditory information (Sloboda , 1985).

Even if there are two different systems that exist, perhaps there are similarities in the way information is processed. Therefore, if a user were able to generate an image based on a music interval, then a stronger connection may be made between the visual and aural modalities that might result in the user learning the intervals more effectively.

Methods

Research Questions: Based on the previous suppositions, a number of research questions arises:

1. What are the effects of user-generated images on interval recognition tasks?
2. What is the relationship between user-generated images for interval recognition and a) prior music knowledge, b) prior drawing knowledge, c) music interest and d) drawing interest?

Sample: The sample consisted of 17 graduate students. While most had a limited musical background there was a mixed background in graphic design.

Materials and Procedures: The experiment involved a web-based drawing program developed in Macromedia's Flash 5.0. The participants were able to generate images based on musical intervals that were saved in a database and later used to test their interval recognition. Participants were given pre and post-tests. Other variables that were explored were prior music and drawing experience, as well as attitudes towards music and drawing through online questionnaires.

Results

In order to answer the first question a paired t-test was conducted. This showed a significant increase in scores from the pre to post-test ($\underline{t}\ (16) = 2.759$, $\underline{p} = .014$). Further analysis was performed to determine if a particular interval was recognized more often than the other intervals. The pre and post-test scores from each of the three intervals used in the study (Major 3rd, Tritone, and Perfect 4th) were then analyzed using paired-t tests. Significant differences were observed between the pre and post-tests only for the Perfect 4th ($\underline{t}\ (16) - 2.634$, $\underline{p} = .018$). In order to answer the second question a multiple regression was conducted using responses from the questionnaire to rate prior music and drawing knowledge and interest as the independent variables, and their answers from the post-test as the dependent measure. This overall model was found to be significant ($\underline{F}\ (4, 12) = 4.284$, $\underline{p} = .022$) with $\underline{r}^2 = .588$. The only variable that contributed significantly to the model was the music background score ($\beta = .574$, $\underline{p} = .039$).

Conclusions

There are several possible conclusions that can be drawn from these results. Since the Perfect 4th was the last interval presented in the study, it makes sense that it was identified significantly more then the other intervals. The results from the multiple regression indicate that having a music background may be more important than having a background or interest in drawing. In any case, the pilot study shows that the web can be used as an effective multimedia learning aid. In terms of dual coding theory, the connections between an abstract user-generated picture, abstract auditory information, and abstract verbal information may have increased the cognitive load experienced by some learners. The participants were still able to significantly improve their skills despite this, so perhaps the act of "generating" was still effective though not conscious.

The results from this study may not necessarily be attributed to the act of drawing as normal music ear-training involves the same type of rote memorization. The fact that only the last interval was significantly recalled enforces this. Since the music labels were a problem for some subjects, further research should be conducted using those students who have a stronger background in music, as well as including interface changes that might help lower the extraneous cognitive load of the treatment.

References

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review, 3*(3), 149 - 210.

Clark, M., Stamm, S., Sussman, R., & Weitz, S. (1974). Encoding of auditory stimuli in recognition memory tasks. *Bulletin of the Psychonomic Society, 3*(3A), 177-178.

Datteri, D. L. (2000). *Music, figures, and words, oh my! The influences of music on stick figures and word perception: An audiovisual gestalt investigation.* Unpublished Dissertation, Texas Christian University, Fort Worth.

Hiraoka, I., & Umemoto, T. (1981). The effect of titles on the memory for music. *Psychologia, 24*, 228-234.

Lipscomb, S. D., & Kendall, R. A. (1994). Perceptual judgment of the relationship between musical and visual components in film. *Psychomusicology, 13*, 60-98.

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychology, 32*(1), 1-19.

Mayer, R. E. (1999, April). *When multimedia works: Designing multimedia for meaningful learning.* Paper presented at the American Educational Research Association, Montreal.

Mayer, R. E., & Sims, V. K. (1994). For whom is a picture worth a thousand words? Extensions of a dual-coding theory of multimedia learning. *Journal of Educational Psychology, 86*(3), 389-401.

Moreno, R., & Mayer, E. (2000). A coherence effect in multimedia learning: the case for minimizing irrelevant sounds in the design of multimedia instructional messages. *Journal of Educational Psychology, 92*(1), 117-125.

Paivio, A. (1971). *Imagery and verbal processes.* New York: Holt, Rinehart, & Winston.

Paivio, A. (1990). *Mental representations: A dual-coding approach.* Oxford, England: Oxford University Press.

Paivio, A., & Lambert, W. (1981). Dual coding and bilingual memory. *Journal of Verbal Learning and Verbal Behavior, 20*(532-539), 532-539.

Sloboda, J. (1985). *The musical mind.* New York: Oxford Press.

Wittrock, M. C. (1990). Generative processes of comprehension. *Educational Psychologist, 24*(4), 345-376.

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Pixed : towards the sharing and the re-use of experience to assist training

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Abstract: This paper presents an overview of Pixed which is a Web-based Adaptive Educational System. The design of Pixed is based on the use of annotated notional networks to represent the user's point of view on the domain model in order to provide an interactive help based on re-using experience.

We first explain how the annotated notional network representation, together with several annotation systems, provides help to learners and to teachers. Then we introduce the automatic re-use of experiences which constitutes the other keystone of Pixed.

Keywords : Web-based Adaptive Educational Systems, Constructivism, Adaptive Hypermedia, Case-Based Reasoning.

1. Introduction

Internet success, as well as the Software companies' interest for the "educational market" pushed universities towards the web-based teaching. This unavoidable evolution modifies the teacher's role who must help learners to build their knowledge rather than being a "knowledge transmitter".

Currently, teachers do not have powerful tools helping them in using this new workspace. Most online courses are only numerical transcriptions of paper versions, and commercial training environments on the Web (WebCT [Href2], LearningSpace [Href3]) counterfeit traditional modes of teaching. This way of teaching, inspired by the programmed instruction [Ski58], is unsuited to the learner's needs [Laf96].

2. Related works

To compensate the physical absence of the teacher and to decrease the hypermedia's induced difficulties (cognitive overload [Rou98], confusion [Cas96]), research systems such as "ELM-ART II" [Web97] or "AHA!" [Deb01] try to adapt teaching material (navigation in the course and presentation of documents) to the learner, facilitating his task. Like these systems, Pixed[1] provides the learner with some help thanks to Adaptive Hypermedia [Bru01].

In the previously quoted systems, the teacher describes a course which will be transmitted in a form adapted to the learner. The knowledge thus belongs to the teacher and the system is only a media. In a close way of the Nestor navigator [Ekl99], Pixed is based on a constructivist model [Phi95] where the learner builds his knowledge representation actively by annotating and choosing documents.

Pixed also differs from the others Adaptive Hypermedia systems by re-using the system's experience. By system's experience we point out elements (traces) of training that the system records during its use. These elements, added to a basic user model, will constitute the skeleton of the cases used in a Case-Based Reasoning (CBR) engine [Aam94]. The integration of the CBR paradigm aims to help the adaptation process and to help the building of the domain model.

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[1] Projet d'Intégration de l'eXpérience en Enseignement à Distance

3. How Pixed helps

Among all the hypermedia adaptation techniques pointed out by Peter Brusilovsky [Bru96], we chose to focus our search on curriculum sequencing and adaptive navigation (3.1.) because it is on these points that we think that the projections in terms of assistance to training are the most significant. However Pixed's documents have annotation skills (3.3.) which allow the system to adapt the document presentation to the learner (3.2.).

3.1. Help learners to find their path

Pixed proposes a path in the hyperspace of the course adapted to the learner model. This model fills a part of the PAPI specifications [Pap00], and integrates an ANN (annotated notional network) [Her98]. Figure 1 presents an example of ANN. This type of network can be resume as an impoverished form of semantic network where the relations are strongly related to didactic skills.

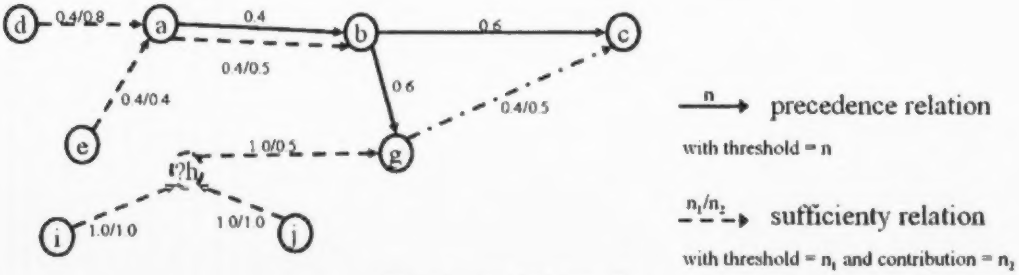


figure 1 : An ANN example

Concretely Pixed uses ANN to propose 3 helping level :

- The linear path mode : a document sequence generated from the learner model [Her99] is provided to learner. The system thus chooses notions, the presentation sequence of these notions and relevant documents. This mode is the closest to traditional teaching where the curriculum of the course is decided in advance by the teacher as well as the list of the associated documents.
- The assisted mode : the learner gets a documents sequence (with crossings possibilities) as well as a map of the corresponding hyperspace. This map only represents the notions semantically close to the notions located on the path proposed in the preceding mode. The learner can consult documents explaining notions in direct relationship with those necessary for understanding the goal notion (according to the model).
- The free path mode : in this mode, an hyperspace map is the only navigation means. The learner is free to navigate among all the course notions, and for each notion he can choose among the associated documents. However, the system offers him some advice (icons colors) on the estimated relevance of the notions according to his goal, like on the relevance of each document compared to the selected notion.

Thus the learner can choose to be more or less helped by switching his navigation mode.

3.2. Adapt the content to the learner

There are two ways of contents adaptation in Pixed :

- When for a given notion there are several relevant documents, Pixed can select which one to present to the learner. For that, Pixed takes account of the recommendations of the teachers (annotations), of the learner model and of the system experience.
- When an HTML document is selected, Pixed carries out a second adaptation by masking some parts of the document. For that, Pixed takes into account the teacher's annotations and of the learner model. The masked parts can however be consulted by learner with a click on the context beacons which announce more information.

One of Pixed's originality is that the adaptive presentation is not only based on the learner model but is also a function of the system's experience (4.) and of the document annotations (3.3.). Thus teachers and learners take part in the adaptation process.

3.3. Offer annotation tools to users

In Pixed, learners and teacher can annotate any whole document on the server, or just a parts of HTML documents. This in order to guide the adaptation but also to provide a tool allowing teachers to communicate between them and with learners. Thus we hope to stimulate a dialogue around the domain's ANN.

3.3.1. Annotating a whole document

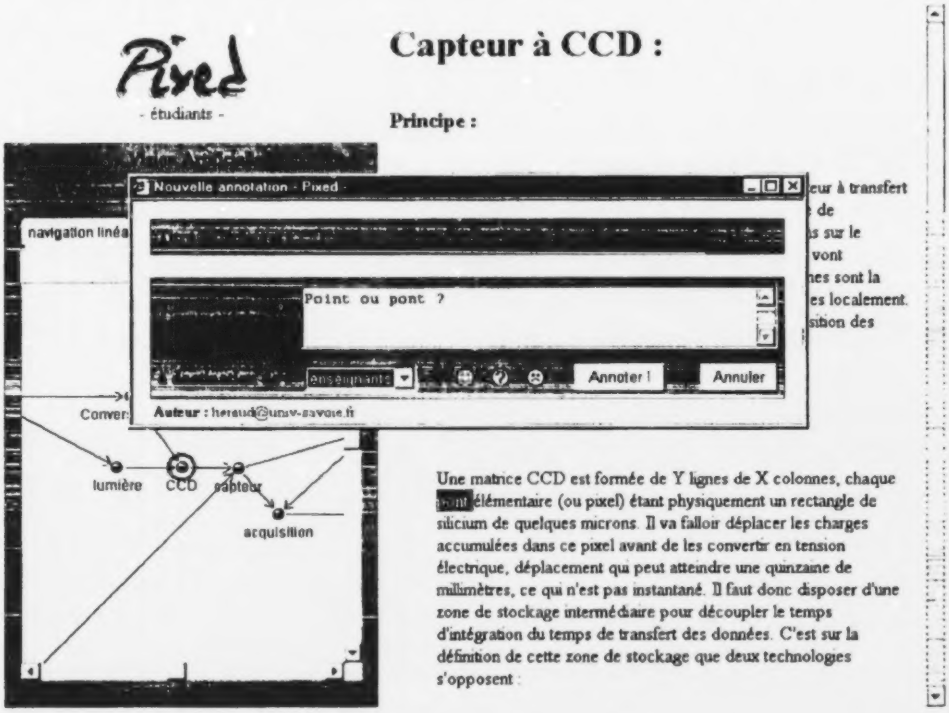
Teachers can annotate a whole document in two ways : by attaching it to a notion and by attaching a textual description to it. The interest note can be used by the system when it has to make a document choice or simply to make it available. The textual annotation being intended for a learner wishing to choose a document among those that can be consulted, or to teachers who wish to re-use a document of this course in another course.

3.3.2. Annotating a part of a document

To annotate a document's part, teachers and learners have three tools :

- The first enables them to colour parts of the text while specifying for whom (beginner, intermediary, expert) these parts are useful. These annotations will allow the system to mask parts which seem unsuited according to the learner's model.
- The second tool allows an attachment of parts of a document to notions. Teachers and learners can specify the explained notions and the necessary notions in order to understand these parts. The goal of this annotation is to guide the availability and the choice of documents.
- The last tool enables them to attach textual annotations inside the document. They can highlight the part which they want to annotate with a mouse click, then a contextual dialog box appears with annotations possibilities (figure 2). These annotations will be added to the document in the shape of small icons "notes" in the text of the displayed document.

All these annotations can be kept private or shared with other users.



Capteur à CCD :

Principe :

Nouvelle annotation - Pixed -

Point ou pont ?

Auteur : heraud@univ-savoie.fr

Une matrice CCD est formée de Y lignes de X colonnes, chaque point élémentaire (ou pixel) étant physiquement un rectangle de silicium de quelques microns. Il va falloir déplacer les charges accumulées dans ce pixel avant de les convertir en tension électrique, déplacement qui peut atteindre une quinzaine de millimètres, ce qui n'est pas instantané. Il faut donc disposer d'une zone de stockage intermédiaire pour découpler le temps d'intégration du temps de transfert des données. C'est sur la définition de cette zone de stockage que deux technologies s'opposent :

figure 2 : While reading an HTML document, the learner opens a contextual dialog box to annotate a word

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3.4. Help teachers to build a domain model

Pixed separates structure and contents of the course while proposing a much greater freedom in the edition of this structure. The hyper-textual structure does not physically exist, it is generated from an ANN built by teachers. Each teacher has his own representation which he can share with the other users. As course documents don't have hyper-textual links between them, they are added and described by the teacher (3.5.). One way of describing is to link them with notions. Pixed provides a graphical interface allowing teachers to edit and publish their ANN.

The creation and the maintenance of this model constitute an additional task for teachers, but we think that this extra work is beneficial in the long run : the domain model is represented explicitly by what will support the sharing and the re-use of modelings and documents between teachers.

3.5. Facilating the addition of interactive documents

Teachers can deposit and remove documents in the format of their choice with a description (author, date...). They can specify which main notions are explained in a document and can also give a list of notions necessary in order to understand this document. The system provides a help to teachers by pre-setting the necessary notions for understanding according to the domain's ANN. Teachers remain free to follow these recommendations by adding or removing notions of this list.

This document availability method can seem a constraint for teachers, but it allows a rapid exploitation of these documents. However Pixed leaves the possibility to the teachers of adding documents to the course without connecting them to an ANN. The document will thus not be usable in the state, but it will become so as soon as a teacher annotates it.

Pixed also offers a tool for the interactive creation of multiple-choice question set. Teachers can set them on the server like other documents, and the system can use them in the evaluation of a pupil's knowledge.

4. Integration of the system's experience

The second keystone of Pixed is the re-use of the system's experience. In this part, we'll try to explain what we call experience and how it can improve help for users.

4.1. What experience are we re-using ?

The experience of the system is composed of the training-episode's trace, that the system records during its use, stored as cases. A case is a triplet made up of an initial learner model, of his trace of navigation and of the final state of his model.

4.2. Why reusing the experience ?

4.2.1. The experience improve adaptive navigation

The use of the experience for the navigation assistance such as we conceive it can be summarized as follows : the system creates a case from new learning, then it searches in the base for similar cases. This similarity (Tversky type [Tve77]) is function of the particular distances between identical notions, of the annotations and of the final goal-notion.

The system extract the path from the adapted case obtained, then it eventually increases this path and annotates it according to the annotations of learners which were used to work out the similar cases. This adapted course is proposed to the learner which is evaluated at the end of the course. The system then learns this new case by memorizing it.

At the end of the training, Pixed also preserves the re-use trace (elaborate case + similar cases + stored case). This trace will increase one second base which allow the system to refine its measurements of similarities.

4.2.2. The experience improve adaptive presentation

When the system must choose between several documents, it integrates the experience in the evaluation of the relevance of each document. Thus a document which will have been consulted much in similar cases of training succeeds and little in cases of failed training will be favored.

When an HTML document is selected, Pixed can unmask the parts of the document that were selected in similar cases of training successes. These cases can also be used to add some annotations.

4.2.3. The experience helps the maintenance of the ANN and of the document database

The first use of the system experience is to inform teachers about the use of their course as an improved log file. So they are helped in maintaining the document database.

Modifications of relations weightings can also be proposed on a statistical principle : if a badly known notion seems more penalizing to reach the goal, the system proposes an increase in the threshold of the relation of associated precedence. The experience constitutes a significant help here, because it is very difficult for a teacher to estimate the thresholds and contributions of the relations.

Pixed helps teachers by proposing changes of their model for a better explanation of learners' successes or learners' failures. For example, if a notion announced by a teacher as preceding to a training is never consulted by learners without harming their training, Pixed will propose to teachers to call into question this relationship.

By observing the successes of learners having followed the courses proposed by the system, Pixed will be able to propose to the teacher some new links which he would not have provided in his model.

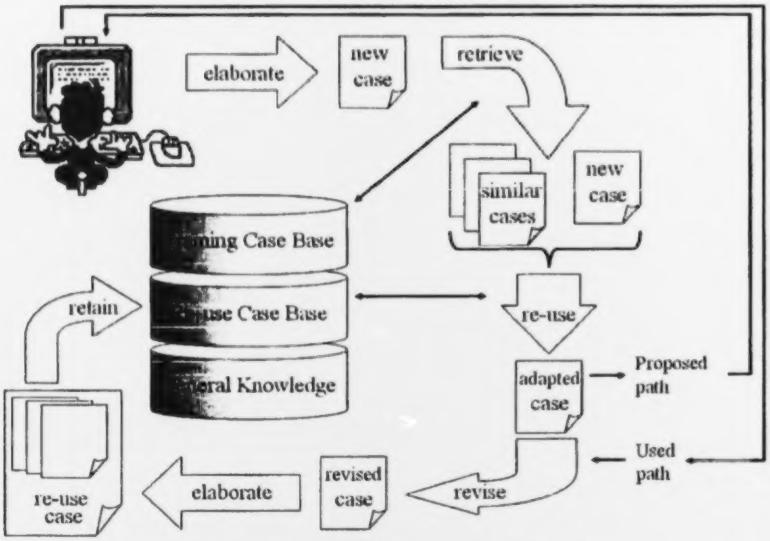

figure 3: The use of the experience in Pixed

5. Discussion

New methods of teaching must come with new educational technologies. Pixed, by separating structure and contents of the course, improves the hypertext use and also explore a new way of teaching.

We believe that this course creation methodology is adapted to training hypermedia environments and that a shared experience makes the users feel helped in their tasks.

The actual stage of our research tasks is a phase of a test with a great number of users in order to validate our approach on a greater scale.

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References

[Href1] http://welcome.to/pixed/

[Href2] http://www.webct.com/

[Href3] http://www.lotus.com/home.nsf/welcome/learnspace

[Aam94] Aamodt A. and Plaza E., « Case-Based Reasoning: Foundational issues, methodological variations, and system approaches », in AI Communications 7, pp. 39-59, 1994.

[Bru96] Brusilovsky P., « Methods and techniques of adaptive hypermedia», in User Modeling and User-Adapted Interaction , pp. 87-129, 1996.

[Bru01] Brusilovsky, P., « Adaptive hypermedia», in User Modeling and User Adapted Interaction, Ten Year Anniversary Issue, pp. 87-110, 2001.

[Cas96] Castelli C., Colazzo L., Molinari A., «Getting lost in hyperspace: Lessons learned and future directions», in proceedings of EDMEDIA'96, pp. 124-130, 1996.

[Deb01] De Bra, P., Ruiter, J.P., «AHA! Adaptive hypermedia for all», in proceedings of WebNet'01, pp. 262-268, 2001.

[Ekl99] Eklund J., Sawers J., Zeiliger R. (1999) «NESTOR navigator: A tool for the collaborative construction of knowledge through constructive navigation» in proceedings of Ausweb'99, pp. 396-408, 1999.

[Her98] Heraud J.M., «Les réseaux notionnels : un outil pour modéliser les apprenants dans une application de télé-enseignement», Rapport de DEA, UCB/ENS/INSA Lyon, 1998.

[Her99] Heraud J.M., Mille A., Jolion J.M., «Les réseaux notionnels : un outil pour guider la navigation dans un cours hypermédia», in IIIème Colloque Jeunes Chercheurs en Sciences Cognitives, Soulac, pp. 116-121, 1999.

[Laf96] Laferriere T., «Towards a society of learners», TACT, 1996.

[Pap00] PAPI (Public and Private Information) Learner, Draft 7 Specification. LMWG (Learner Model Working Group of the IEEE Learning Technology Standards Committee), 2000.

[Phi95] Phillips D.C., «The good, the bad, and the ugly: The many faces of constructivism», in Educational Researcher, pp. 5-12, 1995.

[Rou98] Tricot A. & Rouet J.F., «Chercher de l'information dans un hypertexte : vers un modèle des processus cognitifs», in Les hypermédias, approches cognitives et ergonomiques, Hermès, 1998.

[Ski58] Skinner B., «Teaching machine», in Science, pp. 969-977, 1958.

[Tve77] Tversky A., «Features of similarity» in Psychological Review, pp.327-352, 1977.

[Web97] Weber, G. & Specht, M., «User modeling and adaptive navigation support in WWW-based tutoring systems» in proceedings of UM'97, pp. 289-300, 1997.

Communication and Collaborative Learning in a Cross-Atlantic Design Course

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Abstract: Our activities in co-teaching an engineering design course across the Atlantic, i.e., at Carnegie Mellon University (CMU), USA and at Delft University of Technology (DUT), the Netherlands, at the same time, required the use of information and communication tools for communication and collaboration purposes between students and between instructors and students. In this paper we analyze the overseas communication and collaboration processes among students and instructors, and their implications for learning. We have used a theoretical framework for 'collaborative learning' and for 'stimulating active participation' for analyzing our observations and for translating our results to a broader theoretical framework. In practice, it meant that we experimented among other variables with group compositions and with instructor role descriptions. We concluded that many of the techniques mentioned in literature did enhance collaboration and learning between students, but that intense communication with overseas instructors is still a major stumbling block.

1 Introduction

The availability of various information and communication technology tools (ICT) has enticed many experiments that are aimed at evaluating the use of ICT tools in university courses. Our activities in co-teaching an engineering design course across the Atlantic, i.e., at Carnegie Mellon University (CMU), USA and at Delft University of Technology (DUT), the Netherlands, at the same time, also required the use of ICT tools for communication and collaboration purposes between students and between instructors and students.

In earlier papers (Herder *et al*, 2002; Subrahmanian *et al.*, 2001) we have reported on the use and effectiveness of tools like video conferencing and video taped lectures in the course. In this year's edition of the course we have focused on communication between students and instructors and on the role(s) of the instructors on both sides of the Atlantic. The experiments in this course are part of a large project executed at DUT, in which various instructors research the functional use of ICT in their courses (Brakels *et al.*, 2002).

The main objective of the course "Engineering Design Problem Formulation" is to teach the process of engineering design problem formulation and the role of mathematical and other modeling techniques to aid in that formulation. The pedagogical objective is to get the students to understand that articulating the right problem, based on a process of negotiation and clear representation of the problem among the stakeholders and the design team, is more important than being able to solve perfectly the wrong problem (Subrahmanian *et al*, 2001). The reason for involving students from the USA as well as from the Netherlands was that by doing so, we were able to use a "constructivist approach" to learning: showing the students that knowledge is not developed in isolation but within a social and cultural context (Brown and Duguid, 2000; Fetherston, 2001).

First, we ask groups of students to formulate a number of small design problems, to become familiar with the use of the basic framework of goals, tests, design spaces and starting points and with the use of mathematics as a language for articulating and unambiguously representing a problem. The groups are mixed groups in the sense that they include students from DUT as well as from CMU. Once they are reasonably familiar with this way to recast problems, we step up to larger group-based assignments. They are asked to read and report on books from a list we provide in the area of engineering and design. The students were to analyze the design exemplars in the books and characterize them by using the four-part description we present to aid in formulating design problems. The final, large assignments include design problems, such as design of a transportation system for Pittsburgh and the design of a water/sewage system for a new housing development near Amsterdam.

In this paper we analyze the communication and collaboration processes among students and instructors. The next section will describe the theoretical framework that we will use to analyze our results. During the course, we have experimented among other variables with group compositions and with instructor role descriptions, which will be described in the next section. The results describe our experiences with on-line participation and on-line learning, based upon a survey we held among the students after the course and based upon on our observations during the course.

2 Research Model and Approach

2.1 Introduction to the Course as an Electronic Conference

The course described in this paper required on-line communication because of distance (USA and Europe) and time difference (six hours) between the two groups of students and instructors. Based upon our experiences from running last year's course (Herder *et al.*; 2002, Subrahmanian *et al.*, 2001), in which our efforts focused on the technicalities of the use of ICT tools in teaching, we decided this year to focus on the collaboration and communication aspects between the groups and instructors. In particular, we ran the different elements of the course in different ways.

The course required students to work on formulation problems *together* by discussing the problems, posing questions to each other, critiquing and commenting each other's work, sharing the workload and decreasing the project's run time by 'leap-frogging', i.e., half of the group works while the other half of the group is out-of-office - the second half continues the work when the first half is out-of-office, etc. All communications, reports, comments and the like were to be posted in the web-based document management system LIRE' (*n*-dim group, 2001) so that all information would be retrievable for anyone at any time. This type of on-line collaboration and interaction is often referred to as a computer mediated conference (CMC).

Salmon (2000) developed a five-stage model for on-line learning and moderation of electronic conferences, which we will use in this paper as our research framework. The consecutive stages defined by Salmon are: (1) Access and Motivation, (2) Socialization, (3) Information Exchange, (4) Knowledge Construction, and (5) Development and Reflection.

For each of these steps it is important to focus on the *technical* issues, the *mutual learning* issues and the *E-moderating* issues. The technical issues have been described in our papers mentioned earlier, and we refer to those papers for the conclusions. This paper focusses on the other two issues in the five stage model, i.e., the learning issues (student - student interaction) and the E-moderating issues (student - instructor interaction). Steps three and four from the five stage model will be worked out in detail in this paper. Table 1 shows some brief previous results and implementations for the steps and issues that are not being discussed elaborately in this paper: the *technical* issues for all steps are summarized in the second column, and the *learning* and *e-moderating* issues are summarized in the two righ hand side columns for steps one, two and five.

Table 1. Application of the five stages (Salmon, 2000) to the course (bold typeset is discussed in this paper).

	Technical[1]	Learning	E-moderating
1. Access & Motivation	Communication tools	Personalities and group formation[1]	On-line course material
2. Socialization	Video conference		User instructions[1]
3. Information Exchange	Web Based Document Management System	**Collaborative learning**	**Stimulating active particpation**
4. Knowledge Construction			
5. Development & Reflection	Video clips	Evaluation & Survey[2]	

1) See, for example, Herder *et al.* (2002)
2) Executed in a face-to-face meeting

Salmon (2000) provides some advice relevant to each of the five stages. Other authors, however, provided more in-depth advice on how to stimulate collaborative learning and active participation. In particular, we have used the techniques proposed by Hiltz (1994) to stimulate active participation and collaborative learning. These techniques are briefly summarized in the next two sections.

2.2 Collaborative Learning

The ultimate goal of taking a course is to gain knowledge or learn new skills. Particularly in a course where group work is key, collaborative learning is probably dominant over traditional one-to-many learning from instructors. In order to get students to (collaboratively) learn the skills and knowledge they are required to learn, it is imperative that some techniques are being applied that support and encourage collaborative learning and student to student interaction. We have turned to Hiltz (1994) for a number of concrete collaborative learning formats and assignments. The ones that we used in the course are: students as teachers, writing groups, group or team projects, and team building.

2.3 Stimulating Active Participation

Any conference or discussion requires a moderator who is able to stimulate participants to actively participate in the discussions. For computer mediated conferences the issue is even more significant, as the moderator and participants are not in direct contact with each other. Hiltz (1994) suggests a number of techniques that may stimulate participants to engage into electronic conferences, some of which we have applied in parts of our course. The techniques used in the course in the instructor-student communications are "require regular participation," "instructors present conflicting opinions," "responding and weaving by instructors," "explicitly request responses," and "role playing."

2.4 Research Variables and Approach

Our experiences in running the course last year indicated that we needed to provide the students from the outset with some *basic* instructions about how to communicate effectively with people at a distance and with a time lag. Instead of letting each group 'invent the *communication* wheel' all over again, we pointed them toward the various opportunities besides emailing, such as chatting, telephoning or even video-conferencing.

Table 2. Application of techniques in the course.

	Assignment 1	Assignment 2	Assignment 3
Collaborative learning			
students as teachers			X
writing groups	X	X	X
group projects	X	X	X
team building		X	X
Active participation			
require participation	X	X	X
conflicting opinions			X
responding / weaving	X	X	X
request responses			X
role playing			X

Table 2 shows the techniques we applied in the various stages of the course. For the first small assignment in the course, we dropped the students in at the deep end of the pool with respect to getting the overseas cooperation to work. We provided them with basic technical support and with conventional instructor support. As the course progressed, instructions and structure became increasingly unambiguous by applying more and more techniques for collaborative learning (student-student communication) and active participation (student-instructor communication).

The following sections describe our specific implementations and experiences with the various techniques. The impacts on the learning and collaboration process have been measured by distributing a survey after the course and by evaluating the course with the students in a face-to-face meeting. Our personal observations were used with caution as a third source of information.

3 Collaborative Learning

The course was taught simultaneously at both locations by two instructors at each side during fall 2001. We were able to re-use the schedule and material (lectures, handouts) that we developed in fall 2000 when we ran the first experiment of this course. A total number of 24 students participated in the course (6 at DUT and 18 at CMU). The students were instructed about the basics on cross Atlantic cooperation in the first class, comprising communication tools and etiquette. The survey indicated that the methods for communication were reasonably clear at the start of the course, as indicated in figure 1. It shows the *number* of students that agreed or disagreed on the statements in the survey, using *scores* on a 1 (disagree) - 5 (agree) scale.

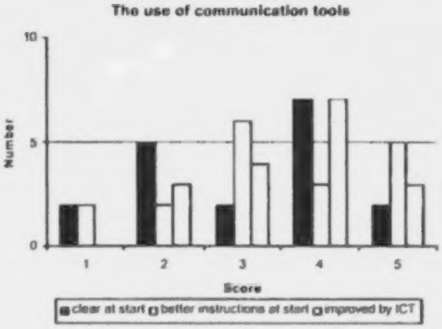

Figure 1. Communication tools in the course.

Cross-Atlantic collaboration was initiated for the first assignment by doing *group work* - groups based on personality tests of the students (Meyers-Briggs test, 2001) that spanned the two participating universities - and by forming *writing groups*, i.e., letting the students critique each other's intermediary work and reports. Some students indicated that they felt disconnected from the students at the other side of the Atlantic because they only knew each other from electronic communications. Other students divided the group work such that they had to communicate with each other as little as possible. Only towards the deadline of the first assignment, the students reformed into writing groups to critique each other's work.

In order to enhance the communication and collaboration in the groups we asked the students to form the groups for the second assignment themselves, resulting in better *team building* (Hiltz, 1994). All groups managed to cooperate more intensely on the book reports, and in most cases the reports were reviewed and critiqued by all group members. For the third assignment the groups were reshuffled again and we explicitly asked the students to present new or complex aspects of their work on the assignment in class to the other students. In addition, they were asked to pose questions to the other students. The *students* became *teachers*, which further enhanced collaborative learning in and between the groups.

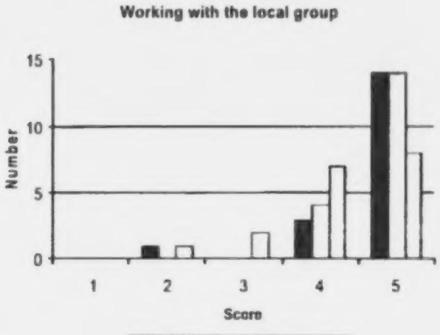

Figure 2. The usefulness, intensity and efficiency of local collaboration as compared to international collaboration.

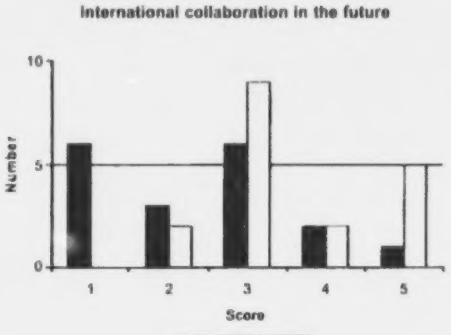

Figure 3. Students' opinions on international collaboration for future courses.

The students were asked to rate the usefulness, intensity and efficiency of the overseas collaboration compared to the collaboration with local group members. As expected from theory and observations, the results in figure 2 indeed show that local collaboration was more useful, intense and efficient. Figure 3 shows that, despite the difficulties of international collaboration shown in figure 2, the students would still rather intensify the international collaboration than cancel it.

The students were found to spend an average of 2,5 hours per week in emailing with each other, in addition to over 1 hour per week of on-line chatting and over 1 hour per week of using LIRE'. The telephone and the video clips available were used only a couple of minutes per week on average.

4 Stimulating Active Participation

The first student assignment comprised two small formulation problems. The instructors were given no specific roles other than to quickly answer questions and to teach a number of regular classes. The group assignments were mandatory and any results were to be posted into LIRE', thereby *requiring participation*. Students tended to consult their local instructor primarily and left the coordination of instructors' advice and responses to the instructors. Topics that appeared to be relevant for all the students were discussed or communicated plenary by the instructors to all students (*responding and weaving*).

For the third assignment we decided to boost active participation by applying a number of extra techniques. The instructors were given *specific roles* with particular objectives that would *conflict* with other instructors' objectives. More specifically, the students were the project contractors, one instructor was given the role of project commissioner for the design problem, while the second instructor overseas played the role of one of the stakeholders with possibly conflicting objectives. For example, we added an environmental lobbyist as a stakeholder to the design of a disposal method for an oil rig (commissioned by a fictitious oil company). Finally, we required the students to send weekly progress reports to the *overseas* instructors. By explicitly *requesting responses*, we expected that instructor-student interaction and active participation would be enhanced even further. However, the students never managed to send a progress report to any instructor, indicating that our response request did not fit their specific activities or needs. We did observe that more frequent contacts occurred between instructors (local as well as overseas) and students in the final assignment compared to the first two assignments.

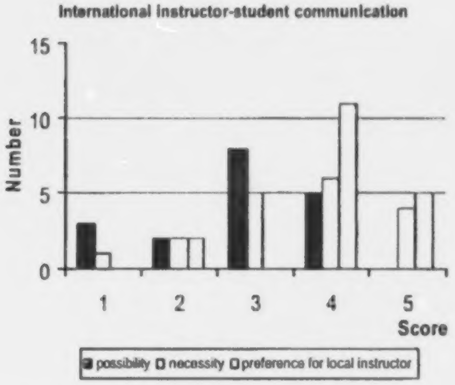

Figure 4. The possibility, necessity and preference with respect to communication with the international instructor.

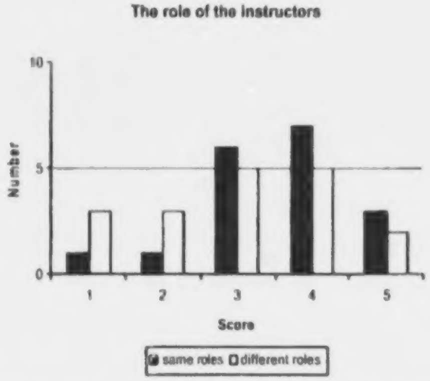

Figure 5. Preference of students on the roles of instructors in the large assignment.

The results shown in figures 4 and 5, confirmed our hypothesis of international instructor-student communication: although the international communication is necessary and feasible, the students still prefer to communicate with a local instructor. This confirms results obtained by Walkington and Maroulis (2001), who found that social presence and meaningful relationships between instructors and students are crucial for sound pedagogy, but are very hard to achieve in CMC activities. Although the role playing technique may have had the effect we aimed at, i.e., more intense communications between the two sides of the Atlantic, the opinion of the students about the role playing in the final assignment is indistinct, rendering that technique debatable for application in a cross Atlantic design course.

5 Conclusions

We have used the framework developed by Salmon (2000) to identify two important areas for improving the cross Atlantic design course, taught for the second year in an international setting. A number of techniques for these two areas, i.e., stimulating active participation and collaborative learning, were taken from Hiltz (1994) and were gradually incorporated into the course.

We found that the techniques for *collaborative learning* in a CMC environment contributed to a smoother learning process, although they did not take away fully the stumbling blocks for international cooperation. Students indicated that an intensification of international collaboration was desirable, if and only if this would be supported by appropriate communication tools, aimed at the contents of the work, but also on the social interaction between the students.

Techniques that we used to enhance *active participation*, mainly techniques applied by instructors, were found to be successful, except for the role playing technique. Our rationale for assigning roles to instructors was that we expected it to form an incentive for boosting communication between students and instructors from overseas. Students, however, preferred to talk to their "own" instructors, after which they relayed the messages to their overseas colleague students if necessary. Communication between the students was nevertheless increased which may have enhanced collaborative learning.

General comments from the students after the course have been encouraging. Most students indicated that they found the international course an interesting experiment. We should, however, increase their access to communication means that allow more social interaction than email and CMC alone. Many of the techniques we only gradually incorporated into the course this year, will be used from the beginning of the course next year.

6 References

Brakels, J, Daalen, E. van, Dik, W., Dopper, S., Lohman, F., Peppen, A. van, Peerdeman, P., Peet, D.J., Sjoer, E., Valkenburg, W. van, Ven, M. van de (2002), Implementing ICT in education faculty wide, *European Journal of Engineering Education*, Vol. 27, No.1.

Brown, J.S., Duguid, P. (2000), *Social Life of Information*, Harvard Business School Press, Cambridge, MA, 336 pp.

Fetherston, T. (2001), Pedagogical Challenges for the World Wide Web, *Educational Technology Review*, http://www.aace.org/pubs/etr/index.cfm, Vol. 9, No. 1.

Herder, P.M., Subrahmanian, E., Talukdar, S., Turk, A.L., Westerberg, A.W. (2002), The use of video-taped lectures and web-based communications in teaching: a distance-teaching and cross-Atlantic collaboration experiment, *European Journal of Engineering Education*, Vol. 27, No.1.

Hiltz, S.R. (1994), *The Virtual Classroom, Learning Without Limits via Computer Networks*, Ablex Publishing Co., Norwood, NJ, 408 pp.

Meyers-Briggs test (2001), http://me210.stanford.edu/index.html.

n-dim group (2001), *LIRE' - Living Repository*, http://www.ndim.edrc.cmu.edu/papers/lire.htm.

Salmon, G. (2000), *E-Moderating, The Key to Teaching and Learning Online*, Kogan Page, London, 180 pp.

Subrahmanian, E., Westerberg, A.W., Talukdar, S., Garrett, J., Jacobson, A., Paredis, C., Amon, C., Herder, P.M., Turk., A.L. (2001), Integrating social aspects and group work aspects in engineering design education, *Proc. of Mudd Design Workshop III: "Social Dimensions of Engineering Design"*, Georgia Institute of Technology, USA.

Walkington, J., Maroulis, J. (2001), 'Is Anyone Out There?' ICT and Pedagogy: The Significance of Social Pressure, *Proc. of International Seminar on Information and Communication Technologies in Engineering Education*, Galway, Ireland, pp.42-52.

Hinze, Bischoff & Blakowski: Jigsaw Method in the Context of CSCL

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Abstract: Group techniques and methods show great promise with respect to the learn effect, in Computer Supported Collaborative Learning (CSCL). These should result from the perspective of cognitive elaboration, the construction of shared knowledge and the possibility of multiple perspectives. However, the previous results of this research were not very extensive. Therefore we started a jigsaw in CSCL in the context of the federal flagship project, "Virtual University of Applied Sciences for Technology, Computer Sciences and Business Administration" (VFH). During the course of 'Environment oriented Management" (EoM) we tested the different assumptions and suppositions regarding the effect of the jigsaw method. In the case study we focused the evaluation on the degree of collaboration and the influence of the group method. The result was that jigsaw proved to be an efficient method to intensify collaboration in CSCL. To archive this certain conditions have to be consider. Aspects like group cohesion, individual competence, and awareness, have a significant influence on the result of the jigsaw.

1 Introduction

Teamwork is strongly associated with high degree of effectiveness and efficiency. The apparent evidence toward the superiority of cooperative vs. individual work is also transferred to the area of learning. It ist widely accepted that, "*cooperative learning is supporting the success in learning in general*" [PfWe00, pp.140]. As plausible as this statement appears, you can also state that: "*you can decide neither theoretically nor empirically which social form of learning and working is better*" [ReMa99, p.4]. Both negative and positive effects within the area of Computer Supported Collaborative Learning (CSCL) can be proven empirically in a relatively effective manner.

A way to stress the positive aspects and to minimize the negative ones is to use group work techniques.

In the context of the course "Environment oriented Management" (EoM), which was conceived and produced for use within the federal flagship project "Virtual University of Applied Sciences" (VFH), a group work technique called jigsaw was implemented.

The cooperative task to complete was structured using this method. A jigsaw uses a redundant group structure: main groups and expert groups. The group task can only be completed with the knowledge acquired in the exp ert groups, and thus with the intensive cooperation of all team members.

2 CSCL – arguments and implications

As positive impacts and arguments speaking for CSCL, three positions are taken into consideration. These positions are particularly scrutinized for their feasibility and their implications regarding the use of the jigsaw method.

2.1 Cognitive Elaboration

The possibility of cognitive elaboration in cooperative settings is valued positively and used as a main argument for the necessity of CSCL in the psychology of learning. In general one can assume that new information can be linked with the existing schemes only after it has been restructed an elaborated. One of the most effective processes of elaboration is the explanation of the learning matters from one's own point of view. Therefore teaching is the most effective way of learning. This fact is conceptualised as the perspective of cognitive elaboration [e. g. Slav93].

But the explanation of the learning matter relates only slightly, or has no impact at all on the learning success of the recipient [Webb91]. The advantages lie rather clearly on the person who gives the explanations.

Thus, a structure needs to be created which makes explanation possible for all group members – independently from group status and individual competence. Within this context the main starting point is the creation of the task. If designed as a jigsaw, one can assume that explanatory processes, independent from the status, are to be stimulated.

2.2 Multiple contexts and perspectives

Relevant for CSCL are the demands on the learning settings and the task formulated by instructional research. Significant matters include: authentic and situation-based learning settings, social and multiple contexts and multiple perspectives.

Within the framework of multiple perspectives, a learning situation is created so that the learner possesses the various possible perspectives of the task. During cooperating the group members are supposed take the perception of the other group members. Thus, alternatives can be identified and rated. As one can see, the learning goal is much more than just the acquisition of factual knowledge.

Multiple perspectives should exist in cooperative settings, however a contention with divergent positions is not inevitably necessary. Group members can, for example, ignore existing diverging opinions. Dealing with multiple perspectives should thus be anchored within the learning task as well. The jigsaw should be an effective way not only to make multiple perspectives possible, but also to present it as necessary for solving the learning task.

2.3 Construction of shared knowledge

A further reason for the use of CSCL is propagated in the situated learning approach. Within this context learning is conceived as an active, self co-ordinated, situated and constructive process.

Additionally, learning is primarily considered as shared knowledge construction [e.g. DeDu99]. Cognition and the acquisition of knowledge are socially divided activities and thus refered to the use of co-operative learning scenarios like CSCL.

Indeed, the social context is necessary, however, it is an insufficient basis for the construction of shared knowledge. Intense interaction and the construction of shared knowledge must be specifically promoted. Using the jigsaw could be one possibility for that purpose.

3 Jigsaw Process

Jigsaw is one method which makes the interdependence of group members possible, promotes interaction and cognitive elaboration, takes into consideration the principle of the multiple perspectives and contexts as well as the construction of common knowledge. In the following the course EoM will be used as an example (see Fig.1) to present the different phases of the jigsaw process [Clar85, Clar94].

After the introduction of the topic, the learning materials were divided into sections (phase 1) and the learners were divided into interest groups, which independently compiled a section of the material (phase 2). Thereby different parts of the material are covered by different interest groups. In the module EoM, the theme ecological tax was processed by three different interest groups, which each had another emphasis as well as a divergent view on the problem. The basic positions were sketched up in advance.

The first task was to identify with the position alleged for the group and to collect arguments and pieces of information to support it. From these considerations, according to the theme of ecological tax as well as from the view of the respective group, a position paper should be prepared, in which the point of view of the group is written up along with background information.

To produce multiple perspectives the participants should likewise consider how the other groups could argue their perspectives and include this in their discussions. An essential aspect was the construction of shared knowledge through intense interaction within the group. Additionally, cognitive elaboration was necessary in those areas were the focus was on bringing together the divergent opinions for the respective position paper.

In the third phase new groups were formed based on the chance principle. The scenario was an expert conference initiated by the government. At these „meetings" in which the different points of view on ecological tax were discussed, agents of all interest groups participated. For that purpose the participants had to acquaint themselves with the position papers of the other interest groups. After that the pros and cons of the individual positions were analyzed and discussed. At the end of the discussion, each group had to find a consensus and outline a course of action for the future. In a written summary the consensus found, as well as the course of action along with the underlying arguments were to be presented.

The third phase particulary intensively included the three implications mentioned above. Here, taking multiple perspectives was imperative. To prepare a common consensus paper, the participants had to take the other positions and try to understand their argumentation. Here the cognitive elaboration became more important than in phase 2. The participants had to explicitly explain the arguments for their positions in the groups. The main point is that the possibility to give an explanation is not bound to the status and/or to the competence of the participants. To achieve an adequate result, all participants had to take in turns both the role of the teacher and the role of the learner. All these processes required intense interaction and led to the construction of common knowledge.

The fourth phase included the evaluation and reflection of the results. For that purpose the consensus papers of the „expert meetings" were made accessible to all course participants. The participants were to read the consensus papers of the other expert groups and to give their opinion to the produced results. Additionally, they were asked to reflect on the group work itself, as well as on the jointly compiled results.

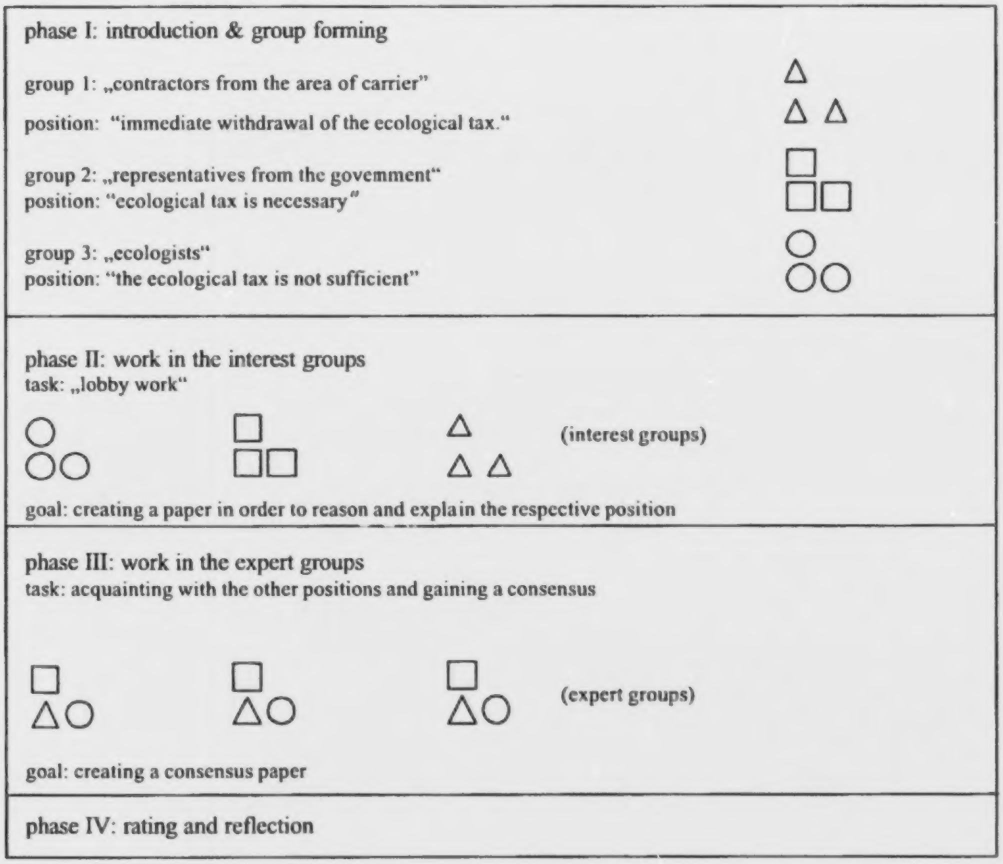
phase I: introduction & group forming
group 1: „contractors from the area of carrier"
position: "immediate withdrawal of the ecological tax."
group 2: „representatives from the government"
position: "ecological tax is necessary"
group 3: „ecologists"
position: "the ecological tax is not sufficient"
phase II: work in the interest groups
task: „lobby work"
(interest groups)
goal: creating a paper in order to reason and explain the respective position
phase III: work in the expert groups
task: acquainting with the other positions and gaining a consensus
(expert groups)
goal: creating a consensus paper
phase IV: rating and reflection

Fig. 1: Phases in the process of the group task

4 Evaluation

The empirical foundation of cooperative learning methods is largely fragmentary in Germany. Systematic comparison investigations to the employment possibilities and effectiveness controls are not widely available [Gies01]. Still more deficits can be seen in the research situation with respect to the employment of the jigsaw method in the area of CSCL. According to *Friedrich*, a.o. [FrHe99, p.126] „ *the suitability of this (...) can first of all only be assumed*".

Inasmuch as the module „EoM" has been introduced in a small scale up to now, first locally in the pilot mode of the VFH, the evaluation refers more to the current status. The primary goal of the formative evaluation was to draw qualitative statements, which refer concretely to improvement possibilities. The main question was how deep the degree of collaboration was and how the degree of collaboration was influenced by the group method.

4.1 Results

Thus, the main question was whether the group cooperation can be considered as sufficient. The majority of the participants (53%) answered this question negatively and a lower value was reached. Therefore it seems that the expectations for the concept were not realized. On the other hand, there were also explicit positive statements like; ‚*The group dynamic inspired me*' and the "*Shared responsibility for the result*". There were seen as an advantage. It was also mentioned, that the, „*creation of the consensus paper as a conclusion [...] made a lot of fun*". Considering all these facts the concept of the division of work was rated positively. This is supported by statements like „*the result crystallizes out by putting all these different pieces together. Everybody helped to put the pieces of the puzzle together and the picture got its shape from various views*". This statement emphasized the main features of the jigsaw method like cognitive elaboration and construction of shared knowledge.

How can this contradiction be explained? First of all, the result regarding the cooperation in the groups must be seen in a relative terms. Here different aspects play a role. One the one hand, the degree of collaboration in virtual groups is considered to be relatively low. Lack of cooperation is also dependent on the deficits in the computer mediated communication. The evaluation of the other CSCL projects within the framework of the VFH pilot phase produced results that generally stated that the cooperation was perceived by the majority, in part or even by the entire group, as not close enough. Thus the value in the EoM module is comparatively high.

Basically, there was a lack of awareness, i.e. of the mutual perception and based on this of the group cohesion. The production of awareness, tersely defined as „knowing what is going on" [Ends95, p. 36] is a problem that has social effects and also refers to the responsibilities of the members and groups. In pure virtual group work, basic social information is often missing. This information usually gained in the presence phase at the beginning of the course which has at least the implicit goal of getting to know one another. Providing this information likewise on a homepage or a „wanted poster" still remains not to be an optimum solution. For example there was the reference: ‚*I would like to know more precisely who the other persons are. But I don't like this to do through homepages. I surely won't like to present myself completely in the www.*"

After all, it remains difficult to find optimal solutions to quickly create a confident atmosphere and intense group cohesion that is purely computer based. One aspect are the students references that the lacking social cohesion can possibly be met in advance with a, " *virtual getting-to-know-game*". Another possibility to make getting to know each other informally possible would be '*by providing different chats about different themes at the beginning of the course* ". But all together it can be noted that the students of the pilot phase of the VFH did not or just hardly knew each other prior to the group work. There were no informal contacts like the ones they developed during a longer regular course of study at a virtual professional school. This aspect was also emphasised by the participants: "*One should get the chance to get to know the coursemates better (thus on-line over a longer time period). To my mind the social aspect plays (even under the criticism of the " loneliness" in front of the monitor) a substantial role*". However here the opinions differ. The statement that one of the central advantages of CSCL is that: "*Due to the lacking social contacts one does not become distracted from the actual group work*" shows that the expectations for group work are quite different. Thus it remains to see whether and how the problems appears in the regular teaching of the VFH.

A further complementary aspect that led to a partial negative view of the co-operation, was the lack of time. Processes, for example the discussion about the common knowledge background - the so-called "grounding" [ClBr93] - which contribute to a smooth co-operation, require a larger time framework especially for virtual groups where they take place through computer mediated communication (cmc). The lacking grounding was also stated paticularly regarding the cmc: "*I think that several clear formulations (e.g. 'I do not consider this as* *practicable') will be taken seriously through email or they will even be taken as provocative. The personal verbal expression, which in Emails is usually transferred more casually than it whould be the case in formal letters, is experienced as 'stronger'. Clear statements are often experienced as provocative and responsed arrcordingly. Thus, unfortunately, a front quickly develops*".

The time aspect is especially important for groups, because the phase of optimal performances, begins relatively late. Accordingly, the „*short time frame provided*' and the ‚*time pressure*' were mentioned as difficult aspects.

In conclusion one can say that, "*in this virtual learning atmosphere - although there is a set of communication aids available, - it is quite more difficult to find a consensus than in a real course where you can meet personally for one or two hours*". The intended processes of negotiation requires intensive interaction, therefore they need an adequate time framework.

Another aspect that showed up rather indirectly was the partial overtax of the participants with self-controlled learning. The participants have considered the autonomy, provided while dealing with the task, rather to be a lack of guidance than a chance for self-controlled learning. Therefore the lack of "*concrete clues*" was criticized. The need for strong guidance becomes clear in the following statement: "*Everyone was working on the first draft-deleting paragraphs, adding new notes with different colours and asking and/or answering questions within the same document. Thus the document became very meaningful, however it was no longer clearly arranged. I would have liked it better if there had been a concrete rule for everybody which states that, first of all, everyone has to provide his/ her own version/ approach in which the results of his/ her own internet-research are presented*". Here the adjustments to the learning process as before appeared to be as a structured and rather receptive process. Unfortunately, the self-controlled learning forms are usually less accepted than it would be didactically desirable. In particular it was shown that the positive effects of the jigsaw, in this concrete case of the shared knowledge construction, were existent but were also not always perceived as helpful.

4.2 Conclusion

All in all the result is an ambivalent picture. The jigsaw method is not only feasible on-line but also as a meaningful learning method. The advantages such as perspective change, intensive interaction with items of cognitive elaboration and co-construction of knowledge were clearly recognizable. These advantages were mainly assumed as positive by the students.

A principal requirement for successful CSCL is accurate scheduling and precise formulation of the task. In addition it is also useful to offer enough material and sources for background information.

Another condition for the effective realization of the jigsaw is the consideration of the basic conditions. Like each good learning method the jigsaw is not successful by itself. Three basic conditions played a substantial role in the case study.

One focal point were the group cohesion and the social awareness as central items of the procedure. These can be threated in different ways. On the one hand, one could execute a presence phase before the CSCL that helps to overcome the communication barriers and thus relieve the group identification.

On the other hand, with purely virtual group work it should be considered how implemented awareness supporting tools can facilitate the social, spontaneous and informal interaction and thus improve the cohesion in the group.

In addition to form groups and to perform the relatively complex task a larger time framework is required for communication, co-operation and co-ordination.

A final aspect, which should be considered likewise more specifically for the realisation of jigsaw, includes the individual capabilities and competences of the learners. Experience and knowledge of the students taking courses in further education are very heterogeneous. Collaborative learning also covers processes of self- controlled and self- organized learning. These abilities are differently distributed. There are different learning types for which CSCL is well suited however there are other for which is less suited. Finally it can be considered to implement a graded tutoring and structuring quasi "on demand".

Therefore the jigsaw is a very good method to initiate positive processes of collaborative learning in the CSCL. This also showed up in the case study. As it is the case for all complex learning forms, the organization and counterbalancing of the multiple basic conditions and factors, remain an iterative process of optimization. This offers further opportunities for empirical research, which may concern the concrete learning success needed.

5 BIBLIOGRAPHY

[CLBr91] Clark, H. H. & Brennan, S. A. (1991): Grounding in communication. In: L.B. Resnick, J.M. Levine, & S.D. Teasley (Eds.). Perspectives on socially shared cognition (pp.127-149). Washington: APA Books.

[Clar85] Clarke, J. (1985): Cooperative learning: the jigsaw strategy. Scarborough, ON: Values Education Project. Student and Community Services Dept.

[Clar94] Clarke, J. (1994): Pieces of the puzzle: The jigsaw method. In: S. Sharan (Ed.): Handbook of cooperative learning methods. Westport, Conn.: Greenwood Press.

[DeDu99] Derry, S. J. & DuRussel, L. A. (1999): Assessing knowledge construction processes in on-line learning communities. Paper presented at the AIED99, Conference of the International Society for Artificial Intelligence, Lemans France.

[Ends95] Endsley, M. (1995): Toward a Theory of Situation Awareness in Dynamic Systems. Human Factors, 37(1), 32-64.

[FrHe99] Friedrich, H. F.; Hesse, F. W.; a. o. (1999): Partizipation im virtuellen Seminar in Abhängigkeit von der Moderationsmethode – eine empirische Untersuchung. In: C. Bremer & M. Fechter (Hg.), Die virtuelle Konferenz – neue Möglichkeiten für die politische Kommunikation: Grundlagen, Techniken, Praxisbeispiele (S.119-140). Essen: Klartext.

[Gies01] Giesen, H. 2001: Aktuelle Forschung: Kooperatives Lehren und Lernen an Schulen und Hochschulen. URL: http://www.uni-frankfurt.de/fb05/ifpp/giesen/Forschung.html [16.10.2001].

[PfWe00] Pfister, H.-R. & Wessner, M. (2000): Evaluation von CSCL-Umgebungen. In: Krahn, H. & Wedekind, J. (Hg.), Virtueller Campus '99: heute Experiment – morgen Alltag? (S.139-149). Münster (Waxmann).

[ReMa99] Reinmann-Rothmeier, G. & Mandl, H. (1999): Teamlüge oder Individualisierungsfalle? Eine Analyse kollaborativen Lernens und deren Bedeutung für die Förderung von Lernprozessen in virtuellen Gruppen. München (LMU, Lehrstuhl für Empirische Pädagogik und Pädagogische Psychologie).

[Slav93] Slavin, R. (1993): Kooperatives Lernen und Leistung: Eine empirisch fundierte Theorie. In: G. Huber (Hg.): Neue Perspektiven der Kooperation (S. 151-170). Baltmannsweiler: Schneider.

[Webb91] Webb, N.M. (1991) Task related verbal interaction and mathematics learning in small groups. Journal for Research in Mathematics Education, 22 (5), pp. 366-389.

The New Four R's: Reading, Writing, Arithmetic and the Internet—Teaching Teachers to develop Web-Based Units of Instruction.

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Abstract
The New Four R's: Reading, Writing, Arithmetic and the Internet-Teaching Teachers to develop Web-Based Units of Instruction is a case study examining an online secondary methods of instruction course for post baccalaureates which requires students to develop web-based unit plans. The authors posit that in order for teachers to effectively teach with technology it must be integrated into their teacher preparation course work by modeling effective technology integration into their teaching and assignments.

Introduction

Educators will be charged with preparing students to be successful citizens and members of a society that is rapidly being transformed by technology. All of the major fields in the world of work such as engineering, medicine, transportation, manufacturing, and entertainment, the government and the military have embraced technology in order to stay current—so must education (The Milken Foundation, 2001). Yet education preparation programs are being charged with not adequately preparing preservice teachers with adequate technological and pedagogical skills to prepare students to usefully implement technology.

A study of teacher education programs initiated by the Milken Exchange on Educational Technology and carried out by ISTE suggested that "these programs should increase teachers' exposure to appropriate technology if they are to aptly prepare them for today's classrooms"(Moursund, 1998).As a professor, in a web-based distance education program, I work with students who have degrees and are seeking certification in teacher education through distance education. These nontraditional students are teaching on emergency certification or working in other jobs preparing to transition into teaching. Within these same classes, I also worked with students who have varying degrees of experience as teachers and are pursuing graduate degrees in education.

I chose as our text of study *How People Learn: Brain, Mind, Experience, and School* (Bransford, et al 2000), which is a compendium of research on people learn and subsequently how educators can teach to build upon what then know about how people learn. Bransford et al posit that there are four critical ingredients to learning environments, and those are that they must be: learner-centered, knowledge-centered, assessment-centered, and community-centered.

As I approached the design of Advanced Methods of Instruction, one of the foundation courses in teacher certification, I looked at the elements traditionally taught as part of the course: how to develop a syllabus, how to develop goals how to write objectives, how to plan units of study, and how to write daily lesson plans. I asked myself how I could take these elements and apply them pragmatically to a twenty-first century classroom? I took as a basic element of a twenty-first century classroom, access and connection to the Internet, and asked my students to develop web-based unit plans which would incorporate the four elements of an optimal learning environment. It was important to be that these be value added—that there be some purpose for them to be web-based which would enhance the learning environment.

Methodology

I chose to examine the following sources for data: my syllabus, online lessons, student responses on threaded message boards and student e-mail which referenced this assignment. In addition we examined the web-based unit plans. And finally we analyzed student assessments of their own work to ascertain how they saw themselves fulfilling the requirements of the assignment. Then we triangulated the data by comparing the results of the analysis with each other and the two students from the case studies. The questions that guided my inquiry were: How did I as an educator of pre and in service teachers use technology to model the four elements of an optimal learning environment--learner, knowledge, assessment, and community centeredness—while charging the students with the assignment of integrating technology into their own curriculum design? Did the web-based student unit plans use technology to incorporate the four elements of optimal learning? Were the web-based student unit plans value added?

The research design for this study is an action research project which I examine two case studies chosen Four different kinds of data were analyzed (document review, threaded message boards, emails, web-based unit plans and interviews). This writing is an intermediate look at the study..

Data Analysis and Discussion

A detailed discussion of the data analysis can be obtained my e-mailing the author of this paper.

Conclusions and Implications:

As a result of this study, I found that I was able to integrate traditional elements of the unit planning into a technology-enhanced curriculum after modeling technology integration in my own lessons with students, and through requiring students to participate in technology-enhanced lessons, as well as charging them to create a technology-enhanced lesson plan. I found several student developed "model" technology-enhanced unit plans, but also, had many that fell short of the mark, by just putting a unit plan which required little or no technology on the Internet. I chose two case studies from the "model" unit plans to indicate what optimally could be done. The only conclusion I can draw as to why students did not utilize technology is hypothetical at this point and not data driven. In speaking informally with students, I found it seems that students could not conceptualize that classrooms they teach in would have access to basic technology such as the Internet, or would have computer in the classroom or nearby accessible for student use. And in my own thinking, I think that students without a lot of schema for lesson planning, and/or with limited technology backgrounds could do just enough to accomplish a traditional lesson plan posted on their web page. I also found that while I felt I explicitly taught and modeled with technology integration the four elements of learning—student-centered, knowledge-centered, assessment-centered, and community-centered and required students to have that focus in their lessons, many fell short of that mark and relied, again on traditional lesson planning without the four elements of learning and minimal technology integration.

When a professor in a teacher preparation course models the integration of technology as well as requires students to integrate technology into their course work, these preservice or inservice teachers can do this successfully. But in order to make technology an integral part of curriculum, it must be modeled in teacher education classes.. Based on the findings of this study, I suggest that traditional components of curriculum, unit, and lesson design can be incorporated in a technology-enriched assignment. Enhancing curriculum with technology does not have to be the responsibility of the technology educators. Rather, it can and in some cases should become the responsibility of teacher education professors and curriculum.

References

Bransford, J. Brown, A. and R. Cocking. (2000) How People Learn: Brain, Mind, Experience, and School. National Academy Press: Washington, D.C.

Moursan, D. & T. Belefeldt. (1999) Will Teachers be Preapared to Teach in a Digital Age. The International Society for Technology in Education: Eugene, Oregon and Milken Exchange on Education Technology: Santa Monica: California.

The Milken Foundation (2001). Information Technology Underused in Teacher Education. http://www.mff.org/edtech/article.taf?_function=detail&Content_uid1=131.

The Design and Development of an Electronic Performance Support System for University Professors in the Field of Biomedical Science and Biotechnology in Taiwan

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Abstract: This project plans to design and develop an electronic aid in collaboration with a national university (NU) in Taiwan. Using the concept of knowledge management and computer-mediated learning theories and strategies, this electronic system takes the form of electronic performance support system, which aims to provide university professors a framework for 1) effective administration of data involving teaching, 2) better organization and management of the subject matter knowledge and information, 3) successful adoption and application of technological means to transform a traditional classroom teaching method, 4) opening multiple channels of communication between teachers and students, and 5) amplifying students' motivation of learning.

Background Introduction

As society moves into the information age, changes must be made in the educational process to ensure that students will have the skills they need in the changing workplace. Soon after Electronic Performance Support Systems (EPSS) gained recognition in the corporate setting, many educational professionals and researchers began exploring the potential advantages of adopting computer technologies in different learning environments. As Scales (1994) points out, there are two trends in the educational reform movement that prepare students to keep up with the changes in the society. They are integrating electronic technology in the classroom and using EPSS as a tool for promoting training and support in education and in the workplace.

Thus EPSS gradually becomes visible and applicable for instructional purposes is an inevitable trend. However, I found that it has not been recognized and correctly implemented at most universities in Taiwan. This project sought potential partnership in universities where an EPSS could help professors utilize existing resources and improve instructional effects for greater teaching and learning outcome.

Project Description

This new system aims to provide a framework to facilitate both teaching and learning. This electronic framework is presented through an electronic performance support system (EPSS). The system is expected to raise the recognition of the use of EPSS in educational settings, and to introduce a new perspective of teaching, learning, and instructions. The goal of this project is to design and develop an electronic aid in collaboration with professors at the department of Applied Chemistry at National University (UN, pseudonym) in Taiwan. By adopting the concept of knowledge management and those theories and strategies of computer-mediated learning, this new EPSS will provide professors effective tools and means to: 1) effectively administrate data involving teaching, 2) effectively organize and manage subject matter knowledge or content information for anticipated learning outcome, 3) successfully adopt and effectively employ technological means to transform the traditional classroom teaching/learning format to a new computer-facilitated instructional environment, 4) increase the number of communication cannels between teachers and students, and 5) amplify students' motivation of learning by using electronic means.

This EPSS has been constructed based on the needs of the professors and students at the Department of Applied Chemistry at NU. The new system has been integrated with functions, information and knowledge structure, and instructional activities to supplement their regular teaching and learning routines. The new system was expected to incorporate a Web function so that the distance and scheduling barriers, which often occur in the context, could be overcome between professors and students.

The new system incorporates two sub-systems: one for the professors and the other for the students (Fig. 1: system functional framework). Both professors and students will need authorizations to log onto their designated menu pages. For professors, the Recourse Center, so far, has three functions: a posting board of the departmental information, a grade template for student data, and a public forum for daily conversations. The Student Menu page contains seven components. They are: 1) a news board for posting most recent course update, 2) a course syllabus containing course information and schedule, 3) problem-based learning section allowing professors to post questions or project requirement for stimulating students' thinking, 4) course material based on course calendar, 5) a discussion forum promoting out-of-class communications among all parties, 6) online tests, and 7) a system functional descriptions served as system's online help. Up to date this new EPSS is still under construction. The system framework might be changed based on users' feedback generated through the iterative design-evaluation-analysis cycle.

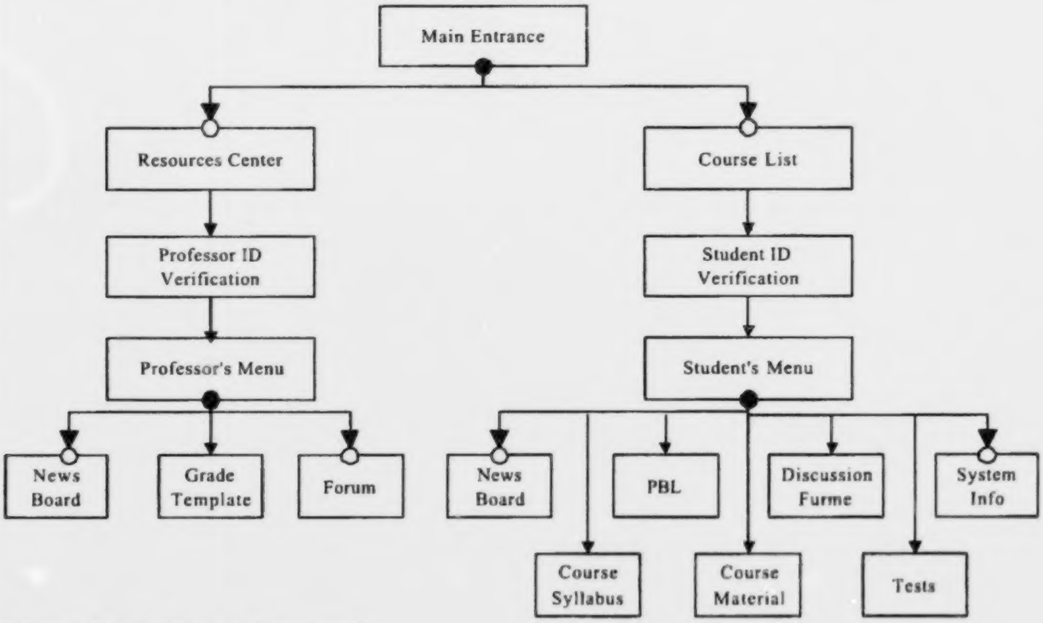
Main Entrance
Resources Center
Course List
Professor ID Verification
Student ID Verification
Professor's Menu
Student's Menu
News Board
Grade Template
Forum
News Board
PBL
Discussion Furme
System Info
Course Syllabus
Course Material
Tests

Figure 1: System Functional Framework.

References

Scales, G. R. (1994). Trends in Instructional Technology: Educational Reform and Electronic Support Systems. *Selected Research and Development, 1994*, Association for Educational Communication and Technology, Nashville, TN, 016-784.

The National SMETE Digital Library for Teachers: Realizing a New Paradigm

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Abstract: The emerging National Science Math Engineering and Technology (SMET) Education Digital Library, which is being constructed by a variety of educational institutions, is an "online network of learning environments and resources for SMET education at all levels" (NSF, 2000). It is envisioned as a premier portal to a rich array of current and future high-quality educational content and services, and a forum where resource users may become resource providers. Technical, social, and economic issues involved in developing the library are reviewed, with emphasis on implications for teacher education and instructional support.

Introduction

The National Science, Mathematics, Engineering, and Technology Education Digital Library (NSDL) is an educational vision with initial funding from the National Science Foundation (NSF)—a vision that is different from any existing library today. Projects led by universities, K-12 entities, professional associations, government agencies, non-profit organizations, and corporations are part of the Library's realization. The NSDL will be the culmination of over a decade of research and collaboration among librarians, technologists, and educators in the public and private sectors (Wattenberg, 1998).

Recommendations for a national digital library for science, mathematics, engineering, and technology education (SMETE) have focused on the need to define and interconnect user communities, establish collections and services, and develop tools that focus on learning and teaching needs.

The Internet Paradox: Is More Less?

High-quality content can be difficult and time consuming to locate on the Internet despite the increase in sites that attempt to provide searchable, usable materials for teachers and students. Digital library development must go beyond simply providing selected links on specific topics. Critical barriers for digital libraries today are as much human issues as technological ones. Even when good collections are developed, getting them known and used remains problematic in this age of Internet information overload (Zia, 2001).

The NSDL has the potential to encourage and support inquiry-driven, collaborative learning while incorporating distributed architecture to provide stability, reliability, and smooth interoperability. The NSDL has the possibility of allowing pre-service and in-service teachers to bring innovative tools and practices into their classroom in a supported and effective manner.

To some degree, the Library's debut is premised on the concept that given the right funding and organizational structure, technical solutions are either in existence but not yet well placed for optimal use and interoperability or can be developed within known frameworks in a relatively short timeframe.

A Virtual Library Vision

A prime consideration in building digital libraries is meeting users' unique needs. Therefore, the NSDL will have to provide value-added services that enhance the user experience; users must have a compelling reason to visit the Library rather than to use public search engines.

The NSDL intends to support pre-service and practicing teachers through its commitment to assuring resource quality, supporting contextual learning, fostering critical literacy skills, acknowledging access inequities, and advancing scientific understanding with many resources and services beyond traditional books and journals, including non-textual sources, lesson plans, curriculum guidelines, and tutorials.

While NSDL's focus is on SMET education content, services, infrastructure, and community, the tools and techniques that are developed and tested in this program will apply to other virtual library development. The NSF effort is seen as a prototype that can lead to further deployment in fields. In addition, NSF is developing international linkages that have the potential to create global resources for SMET education.

Progress and Achievements

The NSDL efforts began with projects focused on development and deployment. Projects are grouped into four tracks: Core Integration, Collections, Services, and Targeted Research. Universities and professional societies lead most efforts. All projects represent more than one institution and many have K-12 linkages. Project abstracts and links to project sites can be found at http://www.nsdl.nsf.gov/.

Key organizational concepts that guide NSDL progress are its distributed nature, the need for active governance that involves all stakeholders, a variable collections structure that includes those following prescribed requirements, harvested through targeted selection, and gathered with smart agents. The NSDL also prioritizes the development of a technical infrastructure that will support multiple portals for entry, and the use of multiple metadata standards to meet the diverse needs of the different disciplines and users.

Future Challenges and Considerations

Traditional roles for librarians and teachers are blurring, and the skills of each are expanding. Certainly, then, there are implications for pre-service preparation and continued professional development. To maximize its effective, the NSDL will need to go beyond an awareness campaign.

New learning resources bring opportunities to reuse and repurpose digital learning objects. New media types, such as digitized audio and video collections and data sets, are also becoming available. Recognizing the opportunities in this area, NSF and the Institute for Museum and Library Services (IMLS), have begun to explore ways in which library and museum holdings may contribute to new curricular materials (Zia, 2001).

Finally, evaluation in its many forms will be increasingly important as the NSDL continues to grow. The NSF intends for the NSDL to be a community-building resource for students and teachers; significant involvement of the country's teachers and librarians will be vital to achieving a strong program and a thriving community.

References

NSF. (2000). *National Science, Mathematics, Engineering, and Technology Education Digital Library (NSDL) Program Solicitation NSF00-44*. National Science Foundation. Retrieved January 30, 2002, from the World Wide Web: http://www.nsf.gov/pubs/2000/nsf0044/nsf0044.htm

Wattenberg, F. (1998, October 15). *A national digital library for science, mathematics, engineering, and technology education*. D-Lib Magazine. Retrieved January 30, 2002, from the World Wide Web: http://www.dlib.org/dlib/october98/wattenberg/10wattenberg.html

Zia, L. (2001, March 15). *Growing national learning environments and resources network for science, mathematics, engineering, and technology education*. D-Lib Magazine. Retrieved January 30, 2002, from the World Wide Web: http://www.dlib.org/dlib/march01/zia/03zia.html

Media^2 - Media for Media: A content management based learning system integrating students in the teaching process

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Abstract: This paper presents the structure of a system that supports interactively teaching on multimedia material. The system has many advantages with respect to existing systems: it is not proprietary, and allows portable data on many operating systems. It supports communication over networks, both synchronous and asynchronous. It allows students to deposit information and comments into the system itself. It has strong support for reusability of the teaching material. It also permits navigation in the material at the metalevel of topic maps. A critical review on what has been done and what still has to be done is also carried out.

1. *Introduction*

The development of Computer Based Learning systems has a long history, which dates back to the late fifties [Cro59]. At first, such systems were command-line or menu based, and allowed limited interaction to the user. Users were allowed to read some text material, and automatic tests could be performed on the progress of learning. Such systems were very limited in scope and had little advantage with respect to traditionally learning based on books.

With the development of graphical user interfaces (Mac, Windows, Amiga,…) and the rise of authoring tools like hypercard [Goo87], the presentation of learning material got more complex, allowing the insertion of pictures, animations, video and audio elements and interactive elements to the teaching material. The more variety in the possibilities of the systems, the more complex the system became, and therefore the more expensive to develop. Today, the wide availability of internet connection and multimedia capable computers has brought into computer based teaching software yet another new level of complexity. Both teachers and pupils can work on the material independently from location, in a synchronous or asynchronous way, and can communicate online whenever problems arise. Not only, but the distribution of content to a wider audience and the possibility of distributed real time collaboration raise new questions, both from the computer science point of view, due to the necessary management of large amounts of text and multimedia material, as well as for the effectiveness of inter-human communication over networks. Moreover, the amount of information present on the network makes it difficult to organize, maintain and search through the material.

Together with the University of Applied Sciences in Bielefeld, the University of Bielefeld, the School of Film and Television (HFF) Konrad Wolf in Potsdam and the School of Arts in Berlin (HdK), the Bauhaus-University Weimar has decided to offer a study course in Media enrolling online students. Moreover, also "regular" students of all five institutions should be allowed to use the material for their study courses.

The main goal of the project is to develop a system, a framework for teaching and for content material. The material is stored in the framework itself, permitting students of the faculties involved to learn material at the undergraduate level using the computer. As a first step, traditional physical presence based teaching will be expanded by allowing students to use the system. Once completed, the system will support the use of computers in three different scenarios:

- By a tutor in a lecture, live in the classroom

- By a student, synchronously or asynchronously, at home and complementary to presence based teaching
- By a student in distant education, as sole connection means to the curriculum

It is well known that one third of the knowledge built during University studies is derived from exchange of information among classmates. The system allows therefore students to make annotations on texts, to integrate and develop new material, and provides control mechanisms for allowing such student generated content to be fed back into the teaching system itself.

To facilitate searching in the material, and to support alternative navigation paths through the material, a meta layer based on topic maps [Bie99] is laid above the basic contents. The user will be able to navigate through the abstract mesh of the material freely, almost following its quest for information. Extended usage of topic maps is still at its infancy, and looks a promising technology since it allows a flexibility which is barely available when crawling through the material itself.

The Bauhaus-University Weimar has already developed interactive courseware for Civil Engineering, [HofSch01, HofSch00]. The new system bases on the strengths of the previous system called Mambo, which was a test bed for the use of multimedia in distant education. Focus is now set not only on reusability of content, which improves the cost factor, but more on user centred design of the framework, especially when it comes to Computer supported collaborative working (CSCW). Also new are the integration of topic maps, CSCW and communication elements through the system.

2. *Description of the System*

2.1 Main systems features

Based on an overview of state of the art learning platforms in the second half of 2000 [Com01,Com01a], no XML-based, cross media publishing capable system was then available, which would have allowed to add the features needed for the goals listed in the last section. As a result, it was decided to implement such a system around existing, commercial content management systems, allowing to concentrate on the features missed and at the same time aim for professional features like scalability and security (locking, roll-back, and so on). The use and application of open standards wherever possible permits content portability to other systems.

Figure 1 shows a schematic structure of the systems architecture and functionality. The system is built around two commercial software systems residing on a server (centre of Fig. 1) and extended using self developed or adapted software.

Next we describe the elements and their functionality of the system with the help of three use cases – content creator, teacher and student.

2.2 Content creator role

The left side of Figure 1 shows the authoring clients, where content creators (authors and media producers) access the content stored and managed on the servers. The check in/out process is simple – the users check out text or binaries using an editor or a media client, which locks access to these elements for other users.

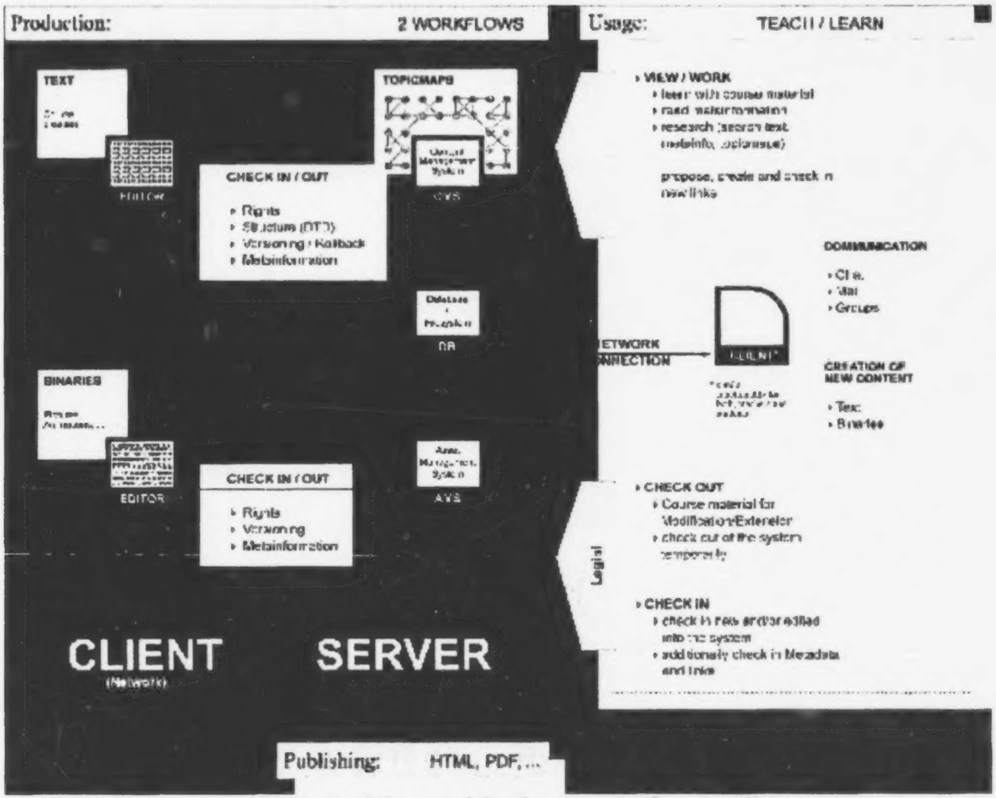
Production:
2 WORKFLOWS
Usage:
TEACH / LEARN
TEXT
EDITOR
TOPICMAPS
Content Management System
CMS
CHECK IN / OUT
Rights
Structure (DTD)
Versioning / Rollback
Metainformation
VIEW / WORK
learn with course material
read metainformation
research (search text, metainfo, ...)
propose, create and check in new links
COMMUNICATION
Chat
Mail
Groups
Database
DB
NETWORK CONNECTION
CLIENT
CREATION OF NEW CONTENT
Text
Binaries
BINARIES
EDITOR
CHECK IN / OUT
Rights
Versioning
Metainformation
Asset Management System
AMS
CHECK OUT
Course material for Modification/Extension
check out of the system temporarily
Logical
CHECK IN
check in new and/or edited into the system
additionally check in Metadata and links
CLIENT
(Network)
SERVER
Publishing:
HTML, PDF, ...

Figure 1 : Scheme of the frameworks functionality

These clients are connected via TCP/IP and authorized through an LDAP system to access the Server, on which two management systems are responsible for the content. The Content Management System (CMS) used is "Sorman CMS"[Sor01]. Its role is to take care of all XML-based content (text, tables, equations, and the structure of the content). The second system used is an Asset Management System (AMS), which is used to store raw data (binary data, such as pictures, video sequences, animations and audio data). We chose to use "Cumulus 5 Enterprise Edition" by Canto [Can01] for this task.

Content is created either by teachers with experience in the production of multimedia material or by professionals, which work as contractors for the teachers. Together, they develop the media units to be implemented, thus meeting both didactical and technical requirements.

All primary content has to be created adhering to existing standards and well-documented file formats as far as possible. For text and structuring this means XML, for the binaries proprietary formats are avoided as much as possible. This is supported by the need of client side operating system independency – many of the proprietary file formats cannot be viewed or played on machines using Linux or Solaris as operating system.

2.3 Teacher role

In case of a new course to be created, a teacher usually does most of the writing and mark-up of text himself. This is different for multimedia production, where expert media professionals have to support the teacher both by suggesting the media which are going to be used for the purpose as well as by checking the compatibility of the teacher's desires with the

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specifications concerning usability and reusability. This includes applied technologies (file formats etc.) as well as font size, colour schemes, line widths etc. ensuring usability with different output devices.

As more and more material is stored in the system, it will become possible to reuse text or media elements from other users. We believe that this is the only economically feasible way of handling the use of computers in education, since otherwise the production cost of quality material is too high. All material set in the system gets semi-automatically indexed during insertion. Metadata is then added to the data inserted. Thus, the topic map of the new material can be generated in an easy way.

2.4 Student role

Basically, student work is divided into three different fields: learning with course material, communication and creation of new content.

The learning with course materials is done via a client computer, from where the student logs into the system and participates in courses he has signed up for. The planned structure of the courses will make it possible to have the student pass simple tests before he can access further material, if desired by the teacher. Additionally, obligatory participation in chats, discussions or simple tests can be added to the curriculum of a course.

In cases where people are performing goal oriented searches in the system and are not following the course, topic maps can be used for navigation. Topic maps are abstract meshes of "entities" which one might think of as terms, concepts or objects, and meaningful connections between them. These topic maps do not contain learning material themselves, but can link to them using "occurrence" links pointing towards the object. One can imagine topic maps to be a meta layer above the course material. Once a student has problems understanding the meaning of the courseware he is following, he is allowed to leave the course structure "upwards" to the topic map and reorient himself there by locating his position within the map. He might then go to another connected topic and from there back to the course material to continue "grazing" on the material.

Communication is needed at different levels, depending on the teaching methods being used. Tutoring via e-mail is provided throughout all courses, as well as discussion forums and chat lines, and videoconferencing.

Also, means are provided for inserting the new material generated by communication into the system. Students are also encouraged to insert homework, or seminar work, or comments into the system itself. The first purpose of this practice is to allow the student to present his results in front of others, to discuss them and finally to improve his knowledge and share it with others. Some of the student material can be used by the teachers themselves, once it has been screened by an expert ensuring its quality. This allows a more rapid growth of the material than it would be possible when done only by the teachers.

2.5 Integrating commercial software

The two commercial systems employed are responsible for managing text, binary data, and topic maps. They provide the following advantages:

- Both systems come with built in mechanisms protecting users from inadvertently deleting data by providing so called "roll back" functionality, which, like an undo function, allows to go back to an earlier state of the work. Furthermore, both systems proved to scale to a larger number of concurrent users working on content at the same time, which is important for daily use in a University.

- Both systems are accessible on a programming level to adapt them to additional needs. Existing APIs provide functionality which can be used to "glue" other, self-developed programs to them.
- Experience [HofSch00] has shown that two main workflows can be differentiated, one concerning text and ordering of content, the other concerning the creation of binaries like pictures, animations, films, or interactive programs. The separation of these workflows is sometimes difficult, as most authors are not used to outsource the production of binaries, but can be supported by dedicated management systems. Especially with binaries, it is necessary to have good support for describing, searching and viewing to reduce production time and cost.

These systems serve as a query-able backend and repository for the data generated by the teachers and the students.

3. *Conclusions and future work*

We have presented a system structure for a system that supports teaching interactively with multimedia material. The system has many advantages with respect to existing systems: it is not proprietary, and allows portable data on many operating systems. It supports communication over networks, both synchronous and asynchronous. It allows students to store information and comments into the system itself. It has strong support for reusability of the teaching material. It also permits navigation in the material at the meta level of topic maps.

The current implementation state is the following: the CMS and AMS are running and provide the basic functionality of the system. The development of a first prototype for the underlying multimedia data types has been finished. The first document type definition has been drafted. The first integrated prototype will undergo a first evaluation at the end of February 2002. Courseware is being developed while regular courses are taking place: an analysis of the teaching methods in the different course types is being done.

It proved a real challenge to develop a common language between extremes such as engineering, the humanities (specifically cultural studies) and fine arts. Studying media involves competences from the arts, from the humanities, from economy and from technology. Especially when it comes to teaching methods and ways to formalize different approaches, often different worlds collide. Obviously, people from such different fields of work have quite different understandings of science, work, and especially teaching. Such differences pop up at each step in the conception phase, and it is sometimes a big challenge to find a common ground.

This explains why it is far less easy to modularise learning material as it has been thought from an engineering background. Complex topics of cultural studies are usually taught in seminars, and base on a strong personal interaction between the teacher and the pupil. Reproducing this situation in a virtual e-learning environment is a challenge, both from the technical as well as from the communication point of view.

Also non trivial is the task of having teachers producing material which is usable by the system. The material itself is often not clearly modularised, nor is it tagged with the name of one or more concepts, so that the creation of the topic maps has often to be done by hand through indexing the material delivered, and modules are inconsistent within the system. This could be solved through issuing guidelines for the creation of the material.

Publication of content stored in the management systems is from a technical point of view not as difficult as it has been a few years ago. We plan to connect a cocoon-engine [Apa01] to the content management system, which will do rule based conversions suitable for both screen and paper publication. Further publication to other output devices should be no problem, as long as suitable media for the device is available and marked up accordingly.

The question of user management is one which seems more technical than anything else. We hope to find this assumption confirmed as we develop the part of the system responsible for that. We will look in rather fine detail into the problems arising from questions like user-defined annotations to text, as we believe to find some technical surprises there.

The navigation using topic maps has been mentioned above. A first prototype is being developed allowing for 3D-interaction with topic maps, to allow both users and creators of topic maps better interaction with the system in three-dimensional virtual spaces.

Support of specifications is needed when describing the content in metadata and grouping content to learning material. Currently it is evaluated in how far full support of specs like EML, IMS, LOM and SCORM is feasible and useful, or if such a specification should be adapted to specific needs like CanCore did [Can01a] – especially as at the time of this writing the project group is trying to develop a first, prototype, document type definition.

In the field of communication many things like e-mail, chat, newsgroups, blackboards and the like have been in use for quite some time. An overview of current, mainly open source solutions will be evaluated for incorporation into the system. Other means like whiteboard sharing and video conferencing will be looked at at a later stage of the project.

Acknowledgements:

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References

[Apa01] Apache cocoon homepage [Online] Available http://xml.apache.org/cocoon/ (Accessed December 19, 2001)

[Bie99] Michel Biezunski, Martin Bryan, Steven R. Newcomb, ed. (3 Dec 1999). ISO/IEC 13250:2000 Topic Maps: Information Technology -- Document Description and Markup Languages

[Can01] Canto Software AG, Cumulus 5 Enterprise Edition [Ondine] Available http://www.canto.com/content/products/editions/enterprise/enterprise_main.html (Accessed December 19, 2001)

[Can01a] Cancore – Canadian Core Learning Resource Metadata Protocol [Online] Available http://www.cancore.ca/ (Accessed December 19, 2001)

[Com01] Comparison of Web Based Course Environments - Evaluation grid. [Online] Available http://www.edutech.ch/edutech/tools/grid_e.asp (Accessed December 19, 2001)

[Com01a] Comparative analysis of online educational delivery applications. [Online.] Available http://www.ctt.bc.ca/landonline/ (Accessed December 19, 2001.)

[Cro59] Crowder, N. A (1959) Automatic Tutoring by means of Intrinsic Programming, in Galanter, E (Ed) 1959, Automatic Teaching: The State of the Art, Wiley, NY.

[Goo87] Goodman, Danny (1987) The complete HyperCard handbook., Bantam Books, NY.

[HofSch01] Tobias Hofmann, Thore Schmidt-Tjarksen. (2001, June 25-30). MAMBO - Experiences from developing, implementing, and evaluating a multimedia -enhanced distant education learning system. In Proceedings of ED-MEDIA 2001: Norfolk, VA 23514-3728 USA: Association for the Advancement of Computing in Education (AACE).

[HofSch00] Tobias Hofmann, Thore Schmidt-Tjarksen (2000). Mambo – the report. [Online] Available http://www.uni-weimar.de/Bauing/wbbau/projekte/mm/downloads/mamboreport_eng.pdf (Accessed December 19, 2001)

[Sor01] Sörman Information AB, The Essential Solution for XML/SGML Objects [Online] Available http://www.sorman.se/products/cms/index.asp (Accessed December 19, 2001)

Utilizing Educational Media Technology to Enhance ESL Sheltered Content Instruction

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Abstract: This short paper discusses the unique ways in which educational media technology can help meet the instructional needs of ESL (English as a Second Language) students in the regular content area classrooms. One of the most promising pedagogical approaches for working with ESL students in the regular classroom is called Sheltered Content Instruction, but finding the appropriate materials for the regular classroom teacher to use in reaching the goals of this approach can be difficult. However, with some simple blending of the Internet and media technologies already in place in most content area classrooms, this challenge can be reduced. This paper discusses the theoretical potential of using Internet and media technology to meet the goals of Sheltered Content Instruction and demonstrates the practical viability of this merger by briefly describing a step-by-step construction of a Sheltered Content Instruction Electronic Learning Module.

Background: ESL Sheltered Content Instruction

Currently there is a rapid rise in the numbers of ESL students in American schools. The ESL research community is working to develop teaching methods that can assist in the difficult task of teaching content area academic knowledge to students having limited English proficiency. One of the most promising pedagogical approaches for working with ESL students in the regular classroom is called Sheltered Content Instruction. The focus of Sheltered Content Instruction is to teach academic, or content area subject matter to ESL students using more comprehensible or "sheltered" English in the spoken and written forms (Eschevarria & Graves, 1998). This involves consistently providing context clues such as gestures and visual aids, along with reading-level appropriate learning materials, and, ideally, other interactive stimuli to guide ESL students through their content learning. This type of approach is designed to be utilized in the regular classroom by content area teachers who have received some training in teaching ESL students, and who have the resources available to provide the sort of scaffolding needed to meet the goals of Sheltered Content Instruction. Finding the appropriate materials for the regular classroom teacher to use in reaching the goals of this approach can be difficult. However, with some simple blending of the Internet and media technologies already in place in most content area classrooms, this challenge can be reduced.

Technology Use

Technology use in ESL instruction is developing (c.f. Feyten, et al., 2002). The fluidity of student learning needs from one ESL learner to another should make the use of computer technology to target learning activities to specific learning needs a common solution. However, in conducting a search for web sites, it becomes evident that the Internet does not typically have technology applications recommended on specific Sheltered Content Instruction sites. In addition, sites that present detailed information about Sheltered Content Instruction do not have recommended sites that teachers could use. Consequently, the opportunity to integrate technology into the ESL classroom in a Sheltered Content Instruction context poses certain obstacles. The focus of this paper is to explain how it is possible to blend the concepts of Sheltered Content Instruction with readily available technology so that content area teachers with ESL students can develop appropriate and interesting learning materials that accomplish intended ESL student learning outcomes.

Specifically, aligning web-based content area reading materials with student readability levels is one technique that teachers need to be able to do as quickly as possible. Copying text and putting it in a Word document allows a teacher to quickly assess the readability level. Once the text is in a Word document, it can be chunked into shorter narratives and organized with multimedia. Readability can then be adjusted by using synonyms to make text and passages more available by lowering or raising the language to a student's reading level. The shorter blocks of text also can be presented through text-to-speech software and allow students to focus on the content without tripping over words that take so long to decode that reading comprehension is diminished. Once there is familiarity with these approaches, a more ambitious use of technology is the development of specific learning modules on the web, or with a CD, or using a PDA that beams students' work from one appliance to another for review and comment. These technologies present the information to be learned through a student or teacher presentation that is age appropriate, motivating, and educationally sound.

Sheltered Content Instruction Electronic Learning Module (SCIELM)

A sample SCIELM could be developed by a regular content area teacher using the following steps: 1) identify the content reading assignment that the majority of the class will complete; 2) search the Internet for similar content material online that is written at a more appropriate reading level for the ESL student(s); 3) copy and paste the text into a Word document and run grammar check to determine the reading level of the text; 4) substitute words and phrases as necessary for further alignment with ESL student abilities; 5) add graphics or other multimedia as available; 6) assign readings. Additionally, this sort of SCIELM could very effectively be developed within a Virtual Learning Circle environment (Thomas & Hofmeister, 2002) which would allow for continued asynchronous academic interaction regarding the textual material.

References

Echevarria, J. & Graves, A. (1998). *Sheltered content instruction : Teaching English-language learners with diverse abilities.* Boston: Allyn & Bacon.

Feyton, C.M., Macy, M.D., Ducher, J., Yoshii, M., Park, E., Calandra, B.D., et al.(2002). *Teaching ESL/EFL with the Internet : Catching the wave.* Upper Saddle River, NJ: Merrill Prentice Hall.

Thomas, M. M., & Hofmeister, D. (2002). Virtual learning circles: Utilizing online message board interactions for strengthening literacy development. Manuscript in preparation, Central Missouri State University, Warrensburg.

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Web-Based Surveys: A Comparison to Paper-Based Surveys.

The use of web-based surveys in educational research is growing in popularity every year (Solomon, 2001). And as familiarity with technology increases, survey methodologist and researchers alike will find developing and implementing web-based surveys can help to preserve valuable resources as well as speed the collection and analysis of data. When compared to paper based surveys, serious measurement issues have overshadowed the benefits that web-based surveys can bring to the researcher (Dillman, 2001). This disparity between paper based and web-based survey methodologies have created the need for further study into the effect that web-based surveys might have on data and its subsequent evaluation. Web-based surveys are a relatively new area of research. Kiesler & Sproull (1986) published one of the first experimental surveys on the differences between email surveys and postal mail surveys. With the exception of this article and a few others, the sheer paucity of research into the reliability and validity issues of web-based surveys is troubling. This creates measurement issues because we currently do not know what impact the design of the web-based survey will have on data, nor do we know whether the answers respondents supply on web-based surveys will differ significantly from those provided via a paper-based survey. It is clear that web-based research is a new and untested tool, with further research needed, especially in web-based survey design and implementation as well as a closer comparison of web-based and paper based responses (Dillman, 2001).

The purpose of this study is to determine whether the serious measurement issues of web-based surveys can be overcome through proper implementation and design, and whether the web-based survey will yield equivalent results to those obtained from a paper based survey. In order to examine these questions, researchers will present results from the administration of two like -content survey forms (paper and pencil and web-based) that were administered in a quazi-experimental design to over 300 participants of a teacher training session. This sample provides unique opportunities into determining relative validity and reliability of the web-based survey by non-randomly assigning teacher to control and experimental groups based on previous web experience so that there is equal representation of web abilities in both groups (Roberts & Onwuegbuzie, 2000).

Preliminary results from analyzed data indicate the following responses to the above research questions. First, web-based surveys were more likely to provide complete results by improving examinee fidelity (e.g., accidentally missing an item, skipping blocks of questions or pages, forcing responses to all items). Second, because of completed teacher response, reliability estimates tended to be higher since alpha is negatively affected by persons randomly missing items (Roberts & Onwuegbuzie, 2000). Third, the ease of transfer of data from an already established database to a statistical analysis program in the web-based survey ensures that there is no error when researchers are transferring data from paper to the computer (as in the paper and pencil version). This can prove an important issue in both quantitative and qualitative research. Fourth, as with the previous point, data entry time is dramatically reduced for researchers. And finally, the combination of the above four points in favor of web-based surveys is advanced by the fact that web-based survey lost no reliability or validity in the transfer from paper and pencil form (as will be shown by the data).

Dillman, D.A., & Bowker, D.K. (2001). *The web questionnaire challenge to survey methodologists.* Working paper retrieved February, 2002, from http://survey.sesrc.wsu.edu/dillman/papers.htm

Kiesler, S., & Sproull, L. S. (1986). Response effects in the electronic survey. *Public Opinion Quarterly,* 50, 402-413.

Roberts, J. K., & Onwuegbuzie, A. J. (2000, November 16). *Alternative approaches for interpreting alpha with homogeneous subsamples.* Paper presented at the annual meeting of the Mid-South Educational Research Association, Bowling Green, KY.

Solomon, D.J. (2001). Conducting web-based surveys. *Practical Assessment, Research & Evaluation,* 7(19). Retrieved February, 2002, fromhttp://ericae.net/pare/getvn.asp?v=7&n=19

Learning English Modal Verbs with the Aid of Didaktos

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Abstract: This paper reports an ongoing Ph.D. program conducted at Department of Didactics and Educational Technology, University of Aveiro, Portugal. The program undertakes to improve English grammar teaching and learning within the field of the English modal verbs at university level employing Didaktos (Didactic Instructional Design for the Acquisition of Knowledge and Transfer to Other Situations) (Moreira et al. 2001), a prototype shell designed on the basis of Cognitive Flexibility Theory (Spiro et al. 1987; 1988; 1989; 1991a; 1991b; Spiro & Jehng 1990).

The paper describes an ongoing study of university students learning English modal verbs in a hypermedia learning environment, *Didaktos* at Department of Didactics and Educational Technology, University of Aveiro, Portugal. The hypermedia shell is designed following the theoretical orientations of Cognitive Flexibility Theory, a constructivist theory of learning and instruction in complex and ill-structured domains at advanced stages of learning.

Spiro and his collaborators contend that learning and instruction in complex and ill-structured domains require multiple representations, multiple explanations, multiple analogies and multiple dimensions of analysis. The central claim of the theory is the metaphor of a criss-crossed conceptual landscape expounded by Ludwig Wittgenstein in *Philosophical Investigations* (Wittgenstein 1997). The same materials should be revisited at different times, from different points of view, in different contexts, for different purposes, in rearranged instructional sequences so as to master complexity in understanding and achieve knowledge transfer in new situations. Moreover, the theory provides a solution to the widely reported problem of disorientation in hypertext systems as the user is never more than one link away from the focus of instruction.

The principles of Cognitive Flexibility Theory are best implemented in hypermedia systems because non-linear links can be established to allow for multiple dimensions of knowledge, for multiple interconnections across knowledge components and so on. In accordance with the guidelines of Cognitive Flexibility Theory, Didaktos offers teachers the possibility to present any domain of knowledge through cases divided into chunk-size scenes in different media. The scenes are codified with multiple perspectives together with information on description and context of each scene and thematic commentaries. Furthermore, teachers can build special sequences traversing among the scenes so that users' attention can be called to differences in superficially similar scenes and similarities between apparently different scenes. Students can view the cases one by one, consulting the description and context of each scene, getting access to the thematic commentaries; look for scenes in which particular themes are relevant and follow the pre-defined special sequences.

English modal verbs are selected as the domain under study as they pose difficulty to learners irrespective of their mother languages and noted by their irregularity and complexity embracing various conceptual domains. The problem is aggravated by the traditional out-of-context, oversimplified and fragmentary teaching methods. Modal verbs will be presented in authentic examples of use in diversified genres such as poetry, speech, play, fiction, song, movie, news broadcasts and so on. Cases will be analysed from distinct but complementary perspectives: normative grammar, systemic functional grammar, communicative grammar, semantics and relevance theory. Besides sequences will be drawn among the scenes to show the relationship between modal verbs and time reference, modal verbs and interpersonal relationships, modal verbs and speech acts as well as modal verbs in direct/indirect speech, and modal verbs in formal/informal use.

University students learning English as a foreign language will participate in the experiment assigned to three groups: the control group, the experimental group (consisting of the passive sub-group and the active sub-

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group). We propose implementing two different orientations of the same learning hypertext with contrasting manners of navigation: organising contents in a linear, traditional way and in a flexible, non-linear way. The control group will study the cases in a linear, traditional way while the two experimental groups will be engaged in a flexible, non-linear environment. The control group will look at "view cases sequentially" and "look for specific themes" while the experimental groups will also have access to "get special sequences". The difference between the two experimental sub-groups is that subjects of the active one will be given more autonomy in interacting with the hypertext. Instead of being offered the thematic commentaries and special sequences as what the passive sub-group will be exposed to, they get the opportunity to provide answers by themselves before checking their answers with the information in the hypertext.

It is expected that the study will yield the following results:

- Subjects of the three groups will make similar performance in post-tests that assess factual knowledge.
- Subjects of the experimental groups will perform better than those of the control group in post-tests that assess procedural knowledge.
- Subjects of the experimental groups will obtain better results on the post-tests than on the pre-tests assessing procedural knowledge in comparison to those of the control group.
- Subjects of the active sub-group will obtain better scores than those of the passive sub-group in post-test assessing procedural knowledge.
- Subjects assigned to the active sub-group will hold a more positive attitude towards the hypertext and the experience than those assigned to the passive sub-group.
- Subjects' epistemological learning beliefs and preferences will change after the treatment.
- The epistemological learning beliefs and preferences differ in gender.

References

Moreira, A., Almeida P., & Raposo, R. (2001). Didaktos (Didactic Instructional Design for the Acquisition of Knowledge and Transfer to Other Situations) Beta Version.

Spiro, R., Vispoel, W.P., Schmitz, J.G., Samarapungavan, A. & Boerger, A. E. (1987). Knowledge acquisition for application: cognitive flexibility and transfer in complex content domains. In B.C. Britton & S.M. Glynn (Ed.), *Executive control in processes in reading*. New Jersey: Lawrence Erlbaum Associates, 177-199.

Spiro, R., Coulson, R. L., Feltovich, P. J & Anderson, D. K. (1988). Cognitive Flexibility Theory: Advanced Knowledge Acquisition in Ill-structured Domains. *Tenth Annual Conference of the Cognitive Science Society*, 1988, Hillsdale, NJ: Erlbaum, 375-383.

Spiro, R., Feltovich, P., Coulson, R & Anderson, D. (1989). Multiple analogies for complex concepts: antidotes for analogy-induced misconceptions in advanced knowledge acquisition. In S. Vosniadou & A. Ortony (Ed.), *Similarity and analogical reasoning*. Cambridge: Cambridge University Press, 498-531.

Spiro, R., Feltovich, P. J., Jacobson, M & Coulson, R. (1991 a). Cognitive flexibility, constructivism, and hypertext: random access instruction for advanced knowledge acquisition in ill-structured domains. *Educational Technology*, XXXI, 5, 24-33.

Spiro, R., Feltovich, P. J., Jacobson, M. & Coulson, R., (1991 b). Knowledge representation, content specification, and the development of skill in situation-specific knowledge assembly: some constructivist issues as they relate to cognitive flexibility theory and hypertext. *Educational Technology*, XXXI, 9, 22-25.

Wittgenstein, L. (1997). *Philosophical investigations*. Oxford, Prentice Hall.

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An Experimental Comparison of Effects of Lively and Lifeless Animated Characters on Comprehension and Attention Performances in Multimedia Presentation

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Abstract: The paper reports the effects of animated characters in multimedia presentations on comprehension and attention. The results showed that the lively character did not influence learner's comprehension of presented material; nevertheless, they showed the significant differences of the effect of lively character in recall performance. In addition, because pedagogical benefits of different learning environments tend to be significant among individuals, this paper revealed that introverts had significantly greater recall performance than did extroverts.

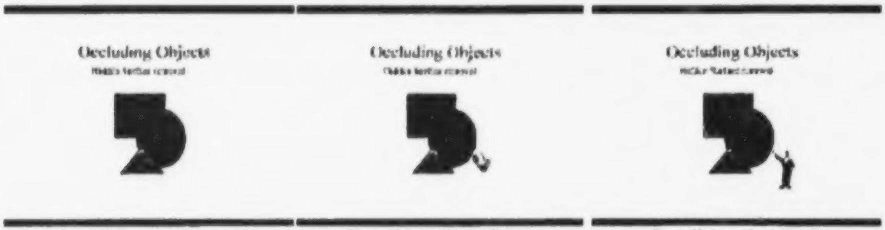
Introduction

Drawing attention and active engagement are pedagogical techniques for designing effective multimedia presentation. The value of directing attention is based on cognitive information processing theories which hold that attended information consumes more cognitive resources and is more thoroughly processed than unattended information. Research reports that anthropormphic computer interfaces have more capabilities for drawing users' attention and engaging them in active tasks than nonanthromopormphic interfaces (Dehn, & van Mulken, 2000). Therefore, human-like characters could be more effective presenters or guiders in multimedia presentations where comprehension and recall of materials need to be enhanced.

The focus of this study is to examine the effects of anthropomorphics on comprehension and attention in multimedia presentations of technical content. With respect to (King, & Ohya, 1996; Laurel, 1997), in this study a *lively character* was defined as a human-like representation, which is capable of displaying emotional expressions, while a *lifeless character* was an object or a part of human form, which was not able to express emotions. The study measures the degree of attentiveness attributed to animated characters by their effects on incidental learning, measured as the accuracy of recall performance for attended visual messages and the number of errors in recall performance for unattended visual messages. This study also examined the effect of animated characters as a function of the participant's degree of extroversion.

Manipulation

In this study the PowerPoint slides used in an actual computer graphics course were used. The script for each slide comprised of both the instructor's explanation and a sequence of locations to which attention should be directed. The manipulation of the characters accounted for three conditions as screen examples in Figure 1.



Condition 1: Control Condition 2: Lifeless Condition 3: Lively

Figure 1: Screenshot examples of Pointing Behaviors

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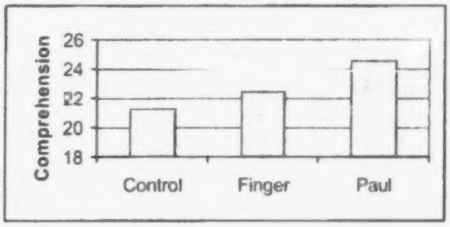
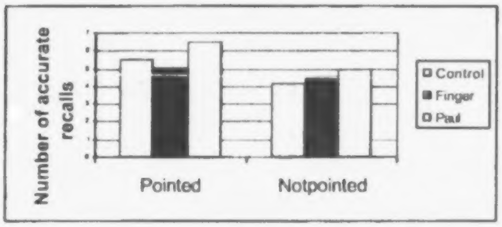
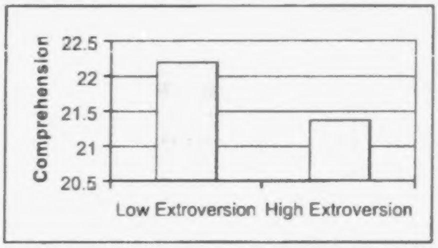
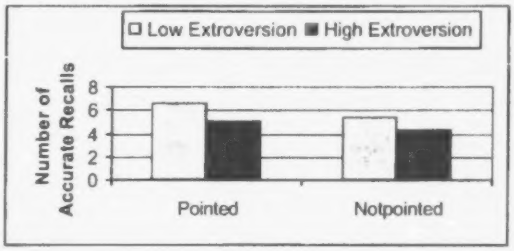
Findings and Conclusion





An analysis of variance showed that there were no significant differences of comprehension among three conditions. For attention, there were significant differences of recall involving the pointed objects (F(2,27)=4.40, $p<0.022$), while there were no differences of recall involving objects that were not explicitly pointed. The post-hoc analysis resulted that the subjects in the lively character condition had better recall involving the pointed objects than the subjects in the lifeless character condition.





With respect to the degree of extroversion, the results of t-test showed that there were no significant differences on the comprehension between the low and high extroversion groups. However, the results showed that the subjects in the low group had better recall involving objects explicitly pointed out than the subjects in the high group ($t_6=2.298$, $p<0.025$).

The results correspond to the previous studies (Andre, Rist, & Muller, 1998) in which the personified characters did not contribute to the students' comprehension of technical materials. Nevertheless, the lively character was better able to draw student's attention to the messages that were being presented than the lifeless character. Therefore, although lively animated characters may not help learners digest presented materials, they can be an effective peripheral learning tool for directing attention. This study also found that introverted learners had better recall involving objects in the presentation than extroverted learners. This may result from difficulty that extroverted learners find in maintaining concentration in non-interactive environments since they prefer non-structured materials with lots of collaborative activities and interactivity. Introverts, on the other hand, benefited from the structured material and quiet learning environment suggests that personality should be taken into account when designing multimedia presentation.

References

Andre, E, Rist, T., & Mueller, J. (1998). WebPersona: a lifelike presentation agent for the World-Wide Web. *Knowledge Based Systems*, 2(1), 25-35.

Dehn, D. M., & van Mulken, S. (2000). The impact of animated interface agents: a review of empirical research. *International Journal of Human-Computer Studies*, 52, 1-22.

King, W. J., & Ohya, J. (1996). The Representation of Agents: Anthropomorphism, Agency, and Intelligence. In *Proceedings of the ACM Conference in Human Factors in Computing Systems -- CHI'96* (pp. 289-290). NY: Association for Computing Machinery.

Laurel, B. (1997) Interface agents: Metaphor with character. In J. M. Bradshaw (Ed.), *Software Agents*, (pp. 67-77), Cambridge, MA: MIT Press.

Situation, Problems and Pedagogycal Prospective of the Mexican Basic Education System at Distance: Some Research Questions on Numeracy for Adults

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Abstract. SEA, the Mexican at distance system of Secondary Education for Adults is characterised by being an educational program on basic education whose aim is to fulfil needs and characteristics of the working young and adult population who has not finished nor studied secondary school. This educational proposal is based on the use of certain printed materials, TV programs and Saturday tutorship bearing in mind the adult's learning achievement processes. Furthermore, its aim is to acknowledge that the learner is an active being, capable of developing study skills to achieve autonomous learning. In this paper we emphasise on Saturday tutorship on numeracy as an observant instrument which has produced information on the system's efficiency. Especially regarding the tutors requirements in order to promote learning autonomy.

Introduction

An Open System on Basic Mathematical Education in Mexico

On the 21st of May 2001 it was published in the Official Federation Diary the 295 Agreement about the Secondary School at Distance for Adults. This document states that: "The general aim of the Secondary Education at Distance for Adults (SEA) is to offer a model on Education based on needs and special characteristics of the adult population who remained behind regarding further education. In this, it is expected to help adults develop knowledge, skills, attitudes and useful values to face distinct problems, as well as getting access to higher educational levels." This system provides learners with two learning guides of mathematics (*Square Accounts*, SEP, 1998, for beginners and *Figures, Problems and Solutions*, SEP, 2000, for advanced level), based on calculus and problem solving, to lead and help them along eight months of instruction. In addition, and with the purpose of backing up learning activities, 36 support and 18 tutorial TV programs are transmitted. Finally, there are Saturday tutorships which provide further support to those learners whose doubts arose when studying.

From the pedagogical point of view, the main objective is to acknowledge adults' experience and needs, developing knowledge from adult life contexts, to study contents meaningful to life and continual study. Also, to improve studying methods to become an independent learner and last, to set up a way of assessing according to the approach.

Problems Coming up within the System and Research Methodology

Adult's autonomy for studying

Here, adult education is essentially basic education addressed to people older than 15. Adult education arises as a result of the educational system's inefficiency, and has specific connotations, socially as much as political and economical (Schmelkes y Kalman, 1994).

One of the fundamental principles is to acknowledge the adult person as an active being in his or her learning process. Adult education should fulfill different requirements from those pertaining to common education, due to the fact that it is focused, in great extent, to working people who have certain responsibilities distinctive to adults. Thus, education should not absorb learner's full time and effort. On the other hand, adult's interests are different from those of children, as most adults expect to apply or get immediate benefit from their studies commitment.

Numeracy through problem solving

Both texts of calculus and problem solving are organized in units whose content is shown from problematic situations and immersed in contexts assumed to be close to adult life. Taken as a syllabus axis, for instance, trading, health, etc. But without neglecting formal mathematical knowledge and consequential generalizations. Under these pedagogical principles, the aim is in fact, that students develop mathematical skills and learn mathematics by building them up, identifying, selecting and using strategies adopted by mathematicians.

Due to the fact that some teachers do not know how to make up mathematics and doubt their own mathematical skills (Santos, 1997), some questions arise: How does the SEA-tutor face the concrete curriculum proposal in his hands? How to achieve that (or what learning actions carry out for this purpose) the tutor in this educational system could build up a wide criterion to be able to decide, and formulate the kind of answers he will be giving to his or her students?

Saturday tutorships: Realm of interaction and meaning negotiation

In fact, acknowledgement, meaning build up or productions are being developed during the interaction process itself (Hoyos, 1998). Meaning assignation is rather given from a joint process in which the teacher thinks of the student's work in order to state a suitable question or proposal to allow him elicit different meanings. Then, with the purpose of identifying the main components intervening in this system's tutorship, we carried out an exploratory study (Amador, 2000) with one of the SEA tutors trainer and three workers[1]. The following results were obtained: A) In spite of tutor's efforts to regain the learner's previous experiences and knowledge, he is not always successful. Usually, because the tutor forgets to retrieve the idea adults brought up on this subject and focus on the procedure; B) Each participant made up a different interpretation of the guide-text. Some times, such interpretations may be taken as wrong or not conclusive; C) Tutorship sessions were a negotiation realm for interpretations arose from the text and for helping the adult learner in his or her ongoing learning.

As a means of conclusion: A Prospective on research and re-education at distance for SEA tutors

It has been detected that tutors try to cover in one session the learning students should develop in five sessions of independent study. May be an important number of SEA students are not developing their skills for independent study. Therefore, their study activities are sometimes restricted to tutorship session. How often is this practice repeated? Which constitute the possible causes of this phenomenon? In what way do this affect mathematics learning? What obstacles hinder SEA students from developing skills for achieving independent study? One of our research hypothesis is that technology, communication and telematics will provide new perspectives regarding the open and at distance education system discussed in this paper. These new resources may be advantageous allies to endure initial practices of mathematical communication, at least between re-educators and tutors. It may be feasible to reproduce in the SEA, during the Saturday tutorship, communicative practices that could produce achievements in learners' autonomy.

References

Amador, E. (2000). *Análisis del papel de la asesoría en la educación a distancia: El caso de la aritmética en Cálculo y Resolución de Problemas.* Tesis de Maestría en Educación Matemática. México: UPN-SEP.

Hoyos, V. (1998). Revisitando la construcción de significado en torno a las ecuaciones lineales con dos incógnitas: Observaciones empíricas con estudiantes de 16-18 años de edad. *Didáctica. Investigaciones en matemática educativa II.* México: Grupo Editorial Iberoamérica.

Santos T., L. (1997*). Principios y métodos de la resolución de problemas en el aprendizaje de las matemáticas.* México: Grupo Editorial Iberoamérica.

Schmelkes, S. y K, J. (1994). *La educación de Adultos: Estado del Arte. Hacia una estrategia alfabetizadora para México.* México: Centro de Estudios Educativos, A.C.

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[1] The three workers have daily jobs, are older than forty and finished elementary education. They were a locksmith, a secretary and a customers flow supervisor in a dining room. In a whole, three tutorial sessions were carried out under the SEA system, on the subject of decimal numbers; all of them were videotaped, transcribed and analysed.

The Use of Multiple Representations in a Web-Based and Situated Learning Environment

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Abstract

This article presents the development and evaluation of a web-based lesson with multiple representations that is developed to cultivate situated learning. The quasi-experimental method along with semi-structured interviews was used to investigate the effects of a web-based lesson on science learning at the senior high school level. Three classes of second-year students from two senior high schools in Taipei were selected as the participants for this study. The total number of participants was 110 including 49 males and 61 females. The statistical results indicated that (a) student conceptual progress almost reached the significant level ($t=1.98$, $p<0.051$) before and after the experiment, (b) there were significant differences between the conceptual progress of male and female students on their conceptual progress before and after the experiment ($F=11.48$, $p<0.001$), (c) computer logs also showed that less male students participated in the online discussion than female students did, and that (d) most students had positive opinions about this web-based lesson. The qualitative data analysis indicated that some students thought that the web-based lesson, named Lesson Rainbow, provided a daily-life situation could promote their motivation on learning and help them integrate knowledge.

Keywords: Web-Based Learning, Situated Learning, Hypermedia, Science Learning

Introduction

Many researchers have suggested that computer hypermedia and networking technology are effective tools to simulate realistic situations when a realistic situation can not be provided in a traditional classroom (Winn, 1993; Hay,1996; McLellan, 1994; The Cognition and Technology Group at Vanderbilt, 1997; Harley, 1993). If learning activities can make a connection between the real situation and its underlying theory, it is realistic to learners (Moor et al., 1994). If computer multimedia can simulate realistic situation in a meaningful way, it can make learners to immerse in and to feel it realistic. This study attempts to develop a web-based lesson according to the theory of situated learning and to examine how the Internet supports student situated learning.

Internet technology can not only integrate the advantages of traditional CAI into instruction but also provide a variety of learning environments from self-directed learning to individual learning, one-to-one interactive learning, group learning, and situational learning (Mason, 1995). With the Internet, students are able to work with current data that are much more up-to-date, and authentic than the material in textbooks. Online resources can help students make connections between their schoolwork and the concerns of people in the real world. In these ways new technologies can make learning and curriculum more generative (Wiske, 2000). Many researches have shown that web-based instructions produced positive effects on student learning motivation, scientific attitude and learning efficiency (Hsu & Thomas, in press; Krajcik, 2000; Edelson, 2001; Hoadley & Linn, 2000). Most of these researches concluded that the positive effects came from careful designs on web pages, learning materials and web managements. The benefits of web-based instructions are not reaped automatically but only come as a result of careful planning.

In this study, we chose the theory of situated learning as the theoretical base for the development of a web-based lesson, named "Lesson Rainbow". It is because most teaching contents and processes in school activities do not start from real-life situations. This produces students who can not apply their learning to solve problems in real life or work related situations. Educational reform in many countries focused primarily on lifelong learning and transfer of what students learn to real-life situations (Ministry of Education in Taiwan, 1999; National Science Education Standards, 1996). Situated learning emphases that learning occurs in real situations and the construction of knowledge is in the continuous interaction between humans and situations (Brown et al., 1989; Lave & Wenger, 1991; McLellan, 1996). This leads students to gain synthetic knowledge instead of inert knowledge. Three realistic situations can be used in class: (1) taking students to the real workplace; (2) immersing students in an authentic or similar situation; (3) providing students an anchoring context (McLellan, 1996). This study used flash animations to immerse students in an authentic situation, a trip to the northeast in Taiwan.

Goldenberg (1995) claimed that we can not expect to understand how students learn if we look only at the student's facility with one representation or student's handling of each representation in isolation. It is limited to understanding students' understanding when research is preformed only in a single-representation environment because it is hard to tell whether a particular observation is or is not merely an artifact of that representation. In a multiple representation environment, the researcher can easily discriminate between surface confusions about any one representation and true misconstructions of the concept. Multi-representational simulations embedded in a situated learning environment provide scaffoldings and context for students to explore the simulations. Some multi-representational simulations are designed in Lesson Rainbow. Through the Internet, we record student actions in detail so that we can describe a web-based environment that instantiates this approach, and we analyze formative

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evaluation data to test the hypothesized mechanisms of learning. This study attempts to investigate how multiple representations support students with different learning preference on the construction of their scientific concepts, whether students with different learning character tics prefer difference functions design in the situated learning environment, and how students benefit from multi-representation simulations in a situated learning environment.

Method

This research project employed the quasi-experimental method along with semi-structured interviews to investigate the effects of a web-based lesson on science learning at the senior high school level.

Participants

The participants for this study were selected from two senior high schools (called as School A and School B) in Taipei. They were second-year students and their majors were social sciences. There were four classes who enrolled in Earth Science class at School A and two of them were randomly chosen as our participants including forty-four males and forty-two females. One of two classes who enrolled in Earth Science class at school B was selected randomly as the sample including 16 males and 30 females. Totally, the participants were 132. After excluding invalid data, the number of the valid participants was 110 (49 males and 61 females).

Instrumentation

In addition to the web-based lesson (called as Lesson Rainbow), there were three other instruments, a test, a questionnaire and a follow-up interview, that were developed to collect data on student conceptual progress and their opinions about the web-based lesson. Experts validated all instructions used in this study. The characteristics of each instrument are shown as follows:

Lesson Rainbow: McLellan (1996) suggested there are eight key components included in situated learning: stories, reflection, cognitive apprenticeship, collaboration, coaching, multiple practices, articulation of learning skills and technology. Five of these were designed in Lesson Rainbow except for cognitive apprenticeship, coaching, and articulation of learning skills. How did we apply situated learning theory to Lesson Rainbow? The learning activities are designed with story-based animations to display situations, discipline-integrated themes to integrate the concepts of mathematics, physics, biology and earth sciences, problem-based assessments, social interaction to empower knowledge construction, and implicit hints to scaffold student learning. Associated with the design of animated tutorials(Berger et al., 1994), we provide some analytic or problem-based questions which can guide students apply, analyze and synthesize data or information shown in the Lesson Rainbow. Animated tutorials aim to increase new concepts into students' schema so the computer program provide only guiding feedback but not correct answers. The learning tools provided in Lesson Rainbow include an electronic notebook, an equation editor, a discussion board, and an electronic map. The mapping between these components and Lesson Rainbow is shown as below (see Table 1):

Table 1: Mapping between the Components of Situated Learning and the Designs of Lesson Rainbow

Component	The mapping design of Lesson Rainbow
Stories (Story-based animations)	The animation design displays realistic situations about a story about a trip to the northeast coast in Taiwan.
Collaboration (Discussion board)	The function of asynchronous online discussion provides students with an opportunity to form a virtual learning community for collaborative learning.
Multiple practices (Animated tutorials)	The formative tests following after each unit in the story provide students multiple practices.
Reflection (An electronic notebook)	The electronic notebook that was designed as a learning tool helps students reflect and take notes on what they are learning.
Technology (Internet technology and multi-representational simulations)	Hypermedia and network technology display learning materials to students.

Test: A test was conducted to detect student understanding of the concepts related to rainbows, humidity, and condensation. There were 23 items on the test, which were validated and was examined for reliability (The Cronbach α= 0.76) before the formal experiment.

Questionnaire: A questionnaire with 34 Likert-type items was used to conduct student opinions about the design of this web-based lesson. Four dimensions in the questionnaire solicited opinions on interface design, situation design, the design of learning tools and the overall design of Lesson Rainbow. The Cronbach α of the questionnaire was reported as 0.87.

The follow-up interviews: Semi-structured interviews were conducted to investigate student understanding of the relative concepts and to collected their opinions about the lesson. Twenty students (8 males and 12 female s) were selected for interviews based on specific purposes. Each student was interviewed for 20-30 minutes.

Procedure

This study included three stages: (1) The preparation stage (01/2000~11/2000): In this stage, the major work was to develop Lesson Rainbow and the instruments. After a pilot study, the instruments were validated and revised for the experimental stage. (2) The experimental stage (12/2000~1/2001): A pretest on the concepts was conducted in the week before the experiment. In the experiment, students received a training session for one hour and completed Lesson Rainbow in two hours. The week after the experiment, a posttest on the concepts and the questionnaire were administrated. The selected students received follow-up interviews a few weeks later because we needed time to analyze the data and determine typical cases for the interviews. (3) The data analysis stage (1/2001~5/2001): Data analysis and concluding remarks were the major jobs in this stage.

Data Analysis

The data were analyzed in several ways. In order to examine if there was a significant difference between before and after treatments, the paired t-test was used to compare the pretest and posttest scores on concepts. A mixed design of repeated ANOVA was used to test the hypotheses that stated male and female students had a significant difference before and after the experiment. We used descriptive statistics for the analysis of each item in the questionnaire and used Chi square to test if there was a significant difference among the four dimensions (the opinions on the interface designs, the design of situations, the design of learning tools and the overall design of Lesson Rainbow.) in the questionnaire. The collected data was analyzed using SPSS (Statistical Package for Social Science, version 7.0). The assumptions of normal distribution and homogeneity of variance for dependent variables were tested before applying statistic methods, t test and ANOVA. If the dependent variable did not display a normal distribution, the significant level was cut to 0.04 in order to reduce the Type I error (Stevens, 1996). Qualitative data were coded and summarized to show a deep understanding of student learning processes and perspectives using the web-based lesson, Lesson Rainbow.

Results and Discussion

It was hypothesized that there was a significant difference between student pre and post concept tests. For Lesson Rainbow, the mean for the pretest was 16.7 with a standard deviation of 2.32. In contrast, the posttest mean was 17.4 with a standard deviation of 2.45. The result of repeated t-test showed that there was nearly a significant difference (at a 0.04 significant level because of the abnormally-distributed scores of tests) between student pretest and posttests on concepts ($t= 1.98$, $p<0.051$; The data is shown in Table 2).

The pretest mean was 16.6 for male students and that for female students was 17.0. In contrast, the posttest mean for male students was 16.5 and that for female was 18.1 (The data is shown in Table 4). The result of mixed design of 2X2 ANOVA showed that there was a significant difference between male and female student performances on the pretest and posttest ($F=11.48$, $p<0.001$; The data is shown in Table 5). Few male students said that the animations in Lesson Rainbow were not as attractive as online games in interviews. Their low attention to the learning materials leaded to their low performances on the posttest. Computer logs also showed that less male students participated in the online discussion than female students did. This may reduce male students to construct their knowledge when they used Lesson Rainbow. These two reasons made male students could not learn better than female students.

Table 2: Summary Table for Paired-t test

N=110	Mean	S.D.	t Value	P
Pretest	16.7	2.32	1.98	0.051
Posttest	17.4	2.45		

$p< 0.04$

Table 3: Descriptive Statistics

	Male(N= 49)		Female(N= 61)	
	Mean	S.D.	Mean	S.D.
Pretest	16.6	2.22	17.0	2.39
Posttest	16.5	2.55	18.1	2.14

Table 4 : Summary Table for Two Way ANOVA

Sources	df	SS	MS	F	Sig

Before &After(A)	1	17.01	17.01	3.22	0.075
Gender(C)	1	63.11	63.11	11.48	0.001
Interaction(A* C)	1	15.79	15.79	2.99	0.087
Residual(A* S)	108	570.20	5.28		
Residual(C* S)	108	593.60	5.50		

$p < 0.04$; $p < 0.01$

The data from interviewing the 20 students showed that most students thought the web-based lesson was more interesting than textbooks because of the animations and interactions. The online discussions made students feel more involved in the learning activities. Five of the twenty students suggested that the teacher should participate in the online discussion with them because sometimes they did not know how to solve problems without the teacher's scaffolding. A student said in his interview: " If the teacher could participate in the online discussion, it would increase the interactions and cleared confusions. I would learn better if the teacher involved in the online discussion." Different students have different needs in a web-based learning environment. Few of them need teachers' assistances because they are lack of skills on communication and reflective thinking. It is advised that the well-trained teachers involve in online communications with students in order to help weak students overcome their obstacles.

Conclusions

This study investigated the effect of a web-based lesson (Lesson Rainbow) developed to cultivate situated learning. A realistic situation served as a bridge to connect student daily-life experiences and constructing knowledge. Most students had positive opinions about Lesson Rainbow. From the interviews, some students said that the animations for the simulated authentic situations could promote their learning motivation and immerse them in an interesting context for meaningful learning.

Networked technologies supported collaborative work in which the students combined components or worked together to make successive drafts (Wiske, 2000). Social learning theory emphasized the value of dialogue and collaboration in helping students to develop and articulate their understanding. In order to reach effective cooperation, students needed to share ideas, adventure and argue with others so that they could come to reasonable interpretations of the subjects they were studying (Blumfnfeld, et al., 1997). Students can compare the varied views of a topic and enhance cohesive understanding of science from a well-designed online asynchronous discussion. In this study, Lesson Rainbow succeeded in helping students to integrate knowledge by evoking discussions to search for answers to the questions following realistic situations. When students communicate with others, they retrieve their pre-knowledge and reconstruct concepts. Meaningful learning occurs when students interact with others or environments (Savery & Duffy, 1995). Therefore, online asynchronous discussion designed for a situated learning environment can promote knowledge integration.

References

Brown, J. S., Collins, A., & Duguid, P.,(1989). Situated cognition and the cultural of learning, Educational Researcher, 18(1), p32-42.

Blumfnfeld, P. C., Marx, R.W., Soloway, E. & Krajclk, J., 1997. Learning with peers: From small group cooperation to collaborative communities, Educational Researcher, 25(8), 37-40.

Diehl, Rancy & Schank (1995). Multiple Representations for Improving Scientific Thinking. (ERIC Document Reproduction Service No. ED392842)

Edelson, D. C.(2001) . Learning-for-use: A framework for the design of technology-supported inquiry activities. Journal of Research in Science Teaching, 38(3), 355-385.

Harley, S.(1993) . Situated learning and classroom instruction. Educational Technology, 33(3), 46-51.

Hay, K. E.(1996) . Legitimate peripheral participation, instructionism, and constructivism: Whose situation is it anyway. In McLellan, H.,(Eds.) , Situated Learning Perspectives(pp.89-99) . Englewood Cliffs, N.J.: Educational Technology Publications.

Hoadley, C. M., & Linn, M. C.(2000) . Teaching science through online ,peer discussion: speakeasy in the knowledge integration environment. International journal of Science Education, 22(8), 839-857.

Hsu, Ying-Shao, & Thomas, R. A. (in press). The impacts of a web-aided instructional simulation on science learning. Accepted by International Joumal of Science Education..

Krajcik, J. S(2000) . Advantages and challenges of using the World Wide Web to fosters sustained science inquiry in middle and high school classrooms. Published in the 8th International Conference on Computer-Assisted Instruction, Taipei, Taiwan.

Larkin, J. H. (1983). The role of problem representation in physics. In D. Gentner and A.L. Stevens (Eds.), Mental models. Hillsdale, NJ: Erlbaum.

Lave, J. & Wenger, E(1991) . Situated learning legitimate peripheral participation. NY: Cambridge University Press.

Mason, J., (1995). Issues for teacher education. Published in AusWeb95: The First Australian WorldWide Web Conference.

McLellan, H., (1994) "Situated Learning: Multiple Perspectives," In McLellan, H.,(Eds),Situated Learning Perspectives(p5-15).Englewood Cliffs, N.J.: Educational Technology Publications.

McLellan, H.(Eds.)(1996) . Situated learning perspectives . Englewood Cliffs, N.J.: Educational Technology

Publications.
Ministry of Education in Taiwan,(1999). National standards of 1-9 science and technology curriculum. Taipei, Taiwan: Ministry of Education in Taiwan.
Moore, J. L., Lin X., Schwartz, D. T., Campbrll, O., Hmelo, C., & Cognitive and Technology Group at Vanderbilt (1994) The relationship between situated cognition and anchored instruction: A response to Tripp. Educational Technology, 34(10) p28-32.
National Academy of Science, (1996). National Science Education Standards. Alexandria, VA: National Academy Press.
Riedling, A. M. (1999). Distance education: The technology-What you need to know to succeed, an overview. Educational Technology Review, 12, 8-13.
Savery, J.R., & Duffy, T.M. (1995). Problem base learning: An instructional model and its constructivist framework. Educational Technology, 35(5), 31-37.
Stevens, J.(1996)(3rd Ed) . Applied multivariate statistics for the social science. Mahwah, NJ: Lawrence Erlbaum.
The Cognition and Technology Group at Vanderbilt. (1990) .Anchored instruction and its relationship to situated cognition. Education Researcher, 19(6) , 2-10.
The Cognition and Technology Group at Vanderbilt (1997) .The Jasper project: Lesson in curriculum, instruction, assessment, and professional development. Mahwah, N.J.: Lawrence Erlbaum Associates Publishers.
Wilson, B. G. (1995). Special section: constructivist learning environments. Educational Technology, Sep-Oct 1995, 25-30.
Winn, W.(1993) . Instructional design and situated learning: paradox or partnership. Educational Technology, 33(3), 16-21.
Wiske S. (January 2000). The Potential of Computers and Networks for Teaching, Learning, and Ongoing Assessment to Enhance Understanding.

The effects of metaphor on computer users' mental models and information search behaviors

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Abstract

The purpose of this study is to compare the effects of single versus multiple metaphors in computer expert and novice users' change of mental models as well as information search performance. Related issues, such as mental models, differences between novice and expert users, and effects of single versus multiple metaphors will be reviewed first in this paper, followed by the discussions of methodology and expected results. The research findings will suggest useful guidelines in designing metaphorical interfaces in the area of human-computer interaction.

Introduction

People often use metaphors to build bridges from the known to the unknown. In the area of human-computer interaction, metaphors have been used by practitioners to design computer interfaces to facilitate user learning since 1981. As to their effects in facilitating user learning, studies show that metaphors may better help novices in learning computer programs, because they have less complete mental models compared to the mental models of experts. However, the effects of metaphors on experts may be questionable.

Metaphor (conceptual model) vs. mental models

The use of conceptual models (or metaphors) to help users construct their mental models has been advocated by several researchers. A mental model is an internal model that an individual uses to facilitate interaction with the environment, with other individuals, or with technology (Norman, 1983). When people interact with a new system, they formulate mental models of that system and continue to modify their mental models to get a workable result.

Eberts (1994) notes that designers apply their conceptual model to the design of interface, and this model is conveyed to users through display representation. In order to understand the operations of the system, users need to develop mental models of the computer tasks. The mental models of a computer user will continuously change with the increase of one's computer experience. Metaphor is a type of conceptual model. By explaining the workings of the system, good conceptual models help users to form more comprehensive mental models of the system. There is a close relationship existing between the provision of metaphors and the formation of more comprehensive mental models, which results in better performance as users carry out computer tasks. However, this relation has not been well examined by researchers.

Expert / novice users

Expert and novice users differ in the degree of the integration of their knowledge, but even experts may still possess fragmentary mental models; that is, their "mental models continue to be specified by both assimilated and fragmented components" (Sebrechts, Marsh, and Furstenburg 1990, p376). Because novice users possess less computer knowledge and their mental models are more fragmented than expert users, the use of metaphors will be most useful for novices who are learning new computer systems. In the present study, the researchers will also compare the effects of metaphorical interfaces on novice and expert's information search performances as well as the chance of their mental models.

Single metaphor vs. multiple metaphor

According to Gentner's (1997a, 1997b) structure mapping theory, the major advantage of a metaphor lies in the relationship of objects with the metaphor. The unified structure of an integral metaphor allows users to see the interrelationships between elements in order to identify each element's function. On the other hand, mismatches happen in situations in which the attributes and relations of a single metaphor can not be perfectly correlated with the attributes and relations of the target domain. This is especially true when the target domain is so complex that no individual model can fully explain anticipated behavior. In this case, the use of multiple metaphors to design interfaces may be a solution (William, Hollan, and Stevens, 1983). A study (Hsu, 2000) compared the effects of single metaphor and multiple metaphors in designing interfaces, the findings show that interface cues from multiple metaphors helped subjects to find a greater number of accurate answers in a shorter time. However, little was known about what change happened in subjects' brain. It may be a better way to use the think aloud method to explore subjects' changes of mental models of the system.

Methodology and expected findings

The independent variables in the study are the three interfaces with different degrees of structural cues derived from single or multiple metaphors. The dependent variables are the subjects' search performances in terms of the accuracy of their search results, time spent on each task, navigational paths chosen for completing each task, and their satisfaction. Another variable to evaluate is their mental model. Interview and questionnaire will be used to collect data regarding the change of subjects' mental models. A total of 90 college students will be used as the subjects to perform some information search tasks. Some of the subjects will be asked to perform think aloud tasks to further identify their change of mental models.

The researchers are collecting experimental data and the analysis will be completed in June 2002. It is expected that the research findings will suggest useful guidelines in designing metaphorical interfaces for users with different degrees of computer expertise.

References

Bielenberg, D. (1993). Interactive design and the mythical intuitive user interfaces. Journal of Interactive Instruction Development, 6 (2), 14-19.

Eberts, R. E. (1994). User Interface Design. Englewood Cliffs, NJ: Prentice Hall.

Gentner, D. R. (1983). The acquisition of typewriting skills. Actc Psychologica, 54 (1-3), 233-248.

Barriers Encountered Using WBI to Deliver Courses

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Abstract: The purpose of this study is to determine and compare faculty perceptions regarding the use of WebCT in selected public universities in the Midwest on United States. Specifically, the study examined the demographic characteristics of faculty who deliver courses using WebCT and barriers encountered in their use WebCT. The Web-based survey was sent to 300 faculty members who use WebCT to deliver courses in the selected Midwestern universities. The data were analyzed using descriptive and inferential statistics. Primary conclusions to emerge from the study include the following. (1) The majority of university faculty who use WebCT to deliver courses in the Midwestern United States are female. (2) Most WebCT courses are offered both on and off campus. (3) The majority of faculty believe WebCT is moderately ease to learn and use. (4) Lack of time and heavy instructional load are the greatest barriers for faculty using WebCT to deliver courses.

Introduction

As technological innovations continue to change and expand, it becomes increasingly necessary to support faculty in adopting innovations to keep up with the educational demands of the 21st century. These demands include the changing learning environment, computer-aided instruction, Web-based course management, and distance education Web-based Instruction (WBI) is defined as an innovative approach for delivering instruction to a remote audience using the World Wide Web as the instructional delivery system (Khan, 1997). Currently, WBI is growing faster than any other instructional technology (Hill & Raven, 2000). I has been used not only in exclusive distance programs but also in supporting face-to-face traditional classroom instruction. According to research conducted by McIsaac & Gunawardena (1996) distance learning is the fastest growing form of education and there will be a continued expansion of Web-based technologies in higher education. Although new technology is creating new educational challenges and opportunities, it also creates new problems. Moreover, WBI is primarily a mechanism for delivering instructions, it cannot resolve problems created by inadequate or poor teaching. As the Web will be increasingly used as a teaching and learning medium, it is important to consider the emerging roles of instructors and learning environments (Shotsberger, 1997). Consequently, as expanding and improving instructor usage is the key to enhancing the success of WBI, increasing attention has been focused on faculty assistance and student's needs. This present study investigated faculty perspectives of delivering courses using WebCT in Web-based Instruction. The purpose of this study is to determine and compare faculty perceptions regarding the use of WebCT in selected public universities in the Midwest United States. Specifically, the study examined the demographic characteristics of faculty who delivered courses using WebCT and any barriers encountered in their use of WebCT. The following questions were considered in guiding this study:

1. What are the demographic characteristics, in terms of age, gender, tenure status, rank, academic teaching areas, level of training, and location of course delivery, of faculty who utilize courses using WebCT?
2. What is the extent of barriers encountered when faculty deliver courses using WebCT?

The Study

The population for this study consisted of all faculty members who use WebCT for delivering courses in four selected public universities located in the Midwest on United States. The Web-based survey was sent to 300 faculty members who use WebCT to deliver courses at selected universities. Out of the 106 surveys returned, 52.8% were in the 36-50 age bracket. Regarding faculty status, most faculty were in the tenured group. In addition, more assistant professors (32.1%) participated in the study than professors (21.7%), associate professors (20.8%), and instructors (20.8%). The majority of faculty in the study were in the School of Education (38.1%) and College of Arts and Sciences (30.5%). Regarding the level of skill as a WebCT user, a large group of faculty (49.1%) rated themselves at the intermediate level. Nevertheless, more faculty participating in the study were delivering WebCT both on and off campus (54.3%) than off campus exclusively (6.7%).

Lack of time (time consuming) ($\underline{M}$ = 4.25) and heavy instructional load ($\underline{M}$ = 3.50) are the greatest barriers for faculty using WebCT to deliver courses. Other barriers reported by faculty are lack of technical skills, lack of incentives, lack of technical support, lack of technical training resources. The least important barriers faculty indicated for delivering courses using WebCT were class size too large ($\underline{M}$ = 2.59) and lack of personal interests ($\underline{M}$ = 2.67).

Conclusion

The majority of faculty responded that WebCT is moderately easy to learn and use; however, lack of time and heavy teaching loads are the greatest barriers and weakness associated with delivering courses using WebCT. For many years, a systems approach has been adopted as essential to the successful practice of instructional design among industries and education for many years. When a system approach is applied to Web-based instruction, departments, administrators, teaching assistants, instructional designers, technical supports, students, and training programs are integrated. As a matter of fact, education is one of the few areas where division of labor or specialization is still not practiced to any extent (Kearsley & Moore, 1996). Individual teachers who develop and deliver their own courses try to be effective curriculum designers, evaluators, motivators, group discussions facilitators, and content experts as well. Kearsley & Moore (1996) claimed this is a huge waste of human resources. Williams & Peters (1997) also reported that the current atmosphere in major research universities is still competitive, not collaborative.

Time and resources are inevitable obstacles to developing good WBI. Neither the teacher nor the technology alone can make WBI work. One solution would be for faculty members with similar courses to collaborate and share their expertise and resources. To establish an instructional team involving faculty peers, TAs, student technology fellows, and technical support persons could help by sharingthe workload and designing the program to accommodate both courses.

WBI will benefit from supportive faculty input resulting in technological advancements. In spite of providing fundamental technical skills, there is also a need to regularly provide and update faculty knowledge about the technological developments and strategies that impact teaching and learning that will foster collaboration by faculty with common curricular interests.

Reference

Hill, J. R., & Raven, A. (2000, October). Online learning communities: If you build them, will they stay? Poster session presented at the *ITFORUM*. [On-line]. Available: http://it.coe.uga.edu/itforum/paper46/paper46.htm

Kearsley, G., & Moore, M. G. (1996). *Distance education: A systems view*. Belmont, CA: Wadsworth.

Khan, B. H. (1997). Web-based instruction (WBI): What is it and why is it? In B. H. Khan (Ed.), *Web based instruction* (pp. 239-244). Englewood Cliffs, NJ: Educational Technology Publications.

McIssaac, M. S., & Gunawardena, C. N. (1996). Distance education. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp.403-437). New York: Simon and Schuster.

Shotsberger, P. G. (1997). Emerging roles for instructors and learners in the web-based instruction classroom. In B. H. Khan (Ed.), *Web-based Instruction* (pp. 101-103). Englewood Cliffs, NJ: Educational Technology Publications.

Williams V., & Peters, K. (1997). Faculty incentives for the preparation of Web-based instruction. In B. H. Khan (Ed.), *Web-based Instruction* (pp. 107-110). Englewood Cliffs, NJ: Educational Technology Publications.

A Tool for Creating, Editing and Tracking Virtual SMIL Presentations

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Abstract: The ability to easily find, edit and re-use content adds significant value to that content. When the content consists of complex, multimedia objects, both the difficulty of implementing such capabilities and the added-value are multiplied. A distributed archive of SMIL presentations was built and indexed using tools, developed by the authors, which enable digitized videos of lectures to be automatically synchronized with their corresponding PowerPoint slides. In addition a full-text and keyword search interface was developed. As the archive grew, it became clear that the ability to edit, update or customize existing presentations by deleting, adding or replacing specific slides without re-filming the entire lecture was extremely desirable. This paper describes the application that was built to satisfy this need and the changes necessary to the original metadata schema to ensure that editions could be easily tracked and new versions of presentations easily managed.

1 Introduction

The use of digital, synchronised, multimedia presentations in education is increasing and as the volume of presentations available grows, so does the need for tools to facilitate the re-use and management of these presentations. Presentation editing tools, which permit updates, additions and concatenations of existing presentations, whilst maintaining synchronization and updating metadata, can improve the quality of the content and reduce the time involved in production and indexing. Simple functionality such as *cut, copy, paste* and *delete* would enable educators to re-use existing presentation segments, update presentations with more recent or topical material and customize presentations for particular audiences, without having to re-film the entire lecture each time.

This work is part of an ongoing project [1] in which a set of tools were developed to automate the synchronisation of digitized lecture videos with their corresponding PowerPoint slides. These tools, described briefly in the next section, enable the cost-effective, streamlined production of SMIL presentations and associated metadata for archival and searching. Such online presentations provide an extremely useful educational resource, particularly in a distance learning environment. However, as the size of the presentation archive grew, so did the need to edit, update or customize existing presentations by deleting, adding or replacing specific slides without re-filming. The economic benefits associated with such re-use are obvious. This paper describes the *PresentationEditor* application which was developed to satisfy this need.

In developing an editor for the synchronised multimedia presentations a number of requirements were identified. Firstly the editor should maintain the synchronization of the video and PowerPoint slides, automatically, without need for user input. Secondly the metadata created for the presentation must be updated to reflect the changes made, who made them and when they were made. The system also needs to record details of the composition of new 'virtual' presentations (i.e., presentations that are composed of edited segments of previous presentations, but which have never been presented in reality) to enable accurate, fine-grained (full-text or keyword) searching across the presentations. Finally it is important that the editor is easy to use and lightweight. No knowledge of SMIL or the underlying structure of the presentation should be required in order to use the application.

In the next section we describe previous related work and how the work described here differs from and builds on top of that.

2 Previous Work/Background

DSTC's SMIL Presentation Project [1] developed a suite of tools to cost-effectively create and index synchronized PowerPoint/Video presentations for deployment either on the Internet, CD-ROM or a LAN. The PresentationLogger records the time that each PowerPoint slide is displayed. The PresentationIndexer collects the metadata about the pres-entation in a semi-automated fashion and creates an XML file containing a complete description of the presentation, its contents and structure. The PresentationBuilder/Archiver creates the finished SMIL presentation and stores the metadata as a separate stand-alone XML file or inserts the metadata into a database. An Internet search and browse interface [2] has also been built and can search either flat XML files or utilise the database for more efficient searching. Figure 1 shows the system components and architecture. In this paper we describe the PresentationEditor component, at the bottom of Figure 1.

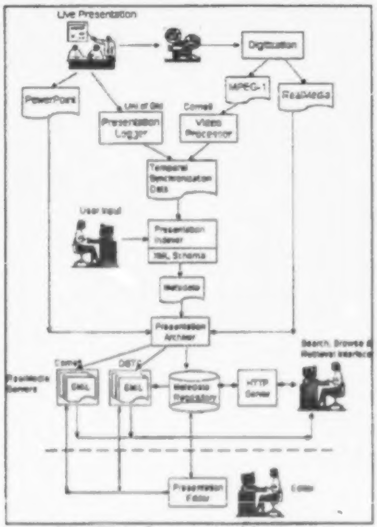
Live Presentation
Digitisation
PowerPoint
MPEG-1
RealMedia
Uni of Qld
Presentation Logger
Cornell
Video Processor
Temporal Synchronization Data
User Input
Presentation Indexer
XML Schema
Metadata
Presentation Archiver
Search, Browse & Retrieval Interface
RealMedia Servers
Cornell
DSTC
SMIL
SMIL
Metadata Repository
HTTP Server
Presentation Editor
Editor

Figure 1: System Architecture

Synchronized Multimedia Integration Language (SMIL 1.0) [3] is a W3C Recommendation designed for choreographing web-based multimedia presentations which combine audio, video, text and graphics in real-time. It uses a simple XML-based mark-up language, similar to HTML, which enables an author to describe the temporal behaviour of a multimedia presentation, associate hyperlinks with media objects and describe the layout of the presentation on a screen. Since this work was started, the W3C SYMM (Synchronised Multimedia) Working Group has released the SMIL 2.0 Recommendation [4] which extends the functionality contained in SMIL 1.0 by enabling interactivity in multimedia presentations, advancing the timing model and improving the accessibility features. In the work described here we have used SMIL 1.0 to layout the presentations spatially and to temporally synchronize the video and PowerPoint slides. Possibilities for improvement exist as SMIL 2.0 is more widely deployed and more SMIL 2.0 tools/players become available.

SMIL has the following advantages to offer:

- Dynamic generation – similar to HTML this makes for easy, cheap alterations to presentations as opposed to complex and intensive digital editing
- Platform independence – as a W3C recommendation, SMIL is not a proprietary technology and hence does not tie the implementation to particular platforms or programming languages;
- Network and client adaptability – SMIL provides a switch tag which can be used to dynamically choose the most appropriate media object to stream, depending on client display capabilities or connection speed e.g., use audio instead of video for low bandwidths;
- Ready availability of SMIL players – there are nine SMIL 1.0 players available covering a wide range of platforms [5]. The most popular of these are Apple's QuickTime 4.1, Microsoft's Internet Explorer 5.5 Browser and RealNetworks' RealPlayer 8.

Figure 2 illustrates the Replay interface for browsing and viewing SMIL presentations.

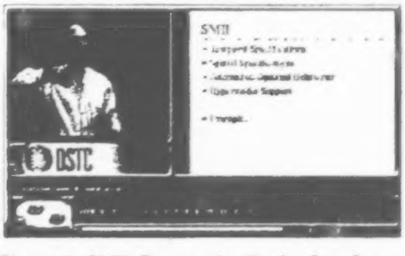

Figure 2: SMIL Presentation Replay Interface

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A number of commercial and research tools are available for multimedia and SMIL editing. These include RealPresenter [6], RealSlideshow [7], Fluition [8] and GRINS [9]. RealPresenter and RealSlideshow are specifically for generating multimedia presentations while Fluition and GRINS are general SMIL editing tools. While the Real tools provide good support for generating basic multimedia presentations, they lack the metadata required for fine-grained searching and archiving of multimedia presentations or for recording changes or tracking versions. In addition, the presentation interfaces are somewhat restricted and the Slideshow tool, which has perhaps the most user-friendly interface, is limited to only providing audio with the slides. GRINS and Fluition are both very capable SMIL editors but assume a level of technical knowledge far above that which could reasonably be expected in this case. They also do not provide any support for complex and fine-grained or editing event metadata.

Hence the major goal of the work described in this paper was to develop a tool that provides a simple, intuitive, graphical user interface which supports presentation editing and a metadata model to enable both fine-grained searching and re-use tracking. The next section describes the system design and functionality.

3 System Description

The *PresentationEditor* is a Visual Basic application that exploits the temporal information and media links contained within a presentation's *metadata* (XML) file to divide the presentation into manageable self-contained segments which can be manipulated to implement easy editing. Each segment consists of a video component (video source, start and end times) and its associated metadata (pointer to corresponding PowerPoint slide, keywords, text etc.), expressed as an XML file. Using a graphical user interface, these segments can be cut, paste, reordered or moved within and between presentations to create new virtual presentations. Once the rearrangement of the presentation is complete, the editor generates the new RealMedia video and the new SMIL file which represents a synchronized presentation. The PresentationEditor also includes search facilities to help the user find relevant segments for insertion into the new presentation and previewing facilities for viewing draft presentations during editing.

Figure 3 illustrates a typical editing process in which the user creates a new virtual presentation by combining parts of existing presentations with new segments that have been filmed to replace outdated sections of the original presentation.

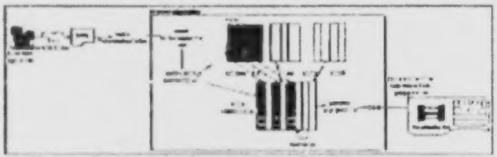

Figure 3: Steps in the creation of a virtual presentation

The PresentationEditor incorporates and integrates the following functionality:

- Search tools to find and retrieve relevant presentation segments;
- Ability to cut, copy and paste of segments both between and within presentations;
- Re-ordering of slide/segments through drag-and-drop;
- Direct updating of metadata for the presentation;
- Automatic adjustments to indexing and temporal synchronization information resulting from post-production editing of the video;
- Updating and correction to segment contents;
- Previewing of draft presentations during editing;
- Saving of updated metadata XML files;
- Re-construction of edited video files (RealMedia) and creation of new presentations (SMIL).

Figure 4 illustrates the graphical user interface to the PresentationEditor. The interface includes a video replay window, a PowerPoint slide window and an editing panel. In the example in Figure 4: extra slides have been added to the original presentation ("6: Metadata Standards" and "5: Metadata Requirements"); the original slide 6 has been deleted and the order of the slides in the original presentation have been rearranged using drag-and-drop tools in the bottom editing panel.

Figure 4: PresentationEditor Interface

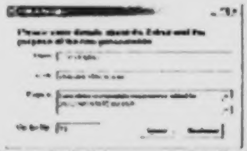

Figure 5: Editing event details form

4 Changes to the Metadata Model

A metadata model was developed for the original system, which enabled both coarse and fine-grained discovery of complete presentations and individual slide-segments respectively. The resource discovery of complete presentations was supported through metadata such as: *presentation location, lecturer, department, institution, description*. The search and retrieval of segments was possible through either full-text or keyword searches over the textual content of each PowerPoint slide. The segment-level metadata consisted of: *source, keywords, text, start and end time, duration, related materials*. The XML Schema corresponding to the complete metadata model for the original system is available at [10].

The development of the *PresentationEditor* demanded certain changes to the original metadata model. The recording of additional metadata associated with "editing events" was required to ensure effective tracking of re-use and version control. This additional metadata included:

- details of the person who performed the editing (the editor's Name and Email);
- when and why they did this (Date Modified, Purpose);
- the version number of the new presentation;

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- the source of new segments and their associated media objects.

Figure 5 shows the form displayed during the creation process for the new virtual presentation, to gather this additional metadata. The Date.Modified field is updated automatically by the application. The user is given the option to ignore this metadata update if they feel that there have been insufficient changes to warrant the presentation being defined as a completely new version or new presentation.

In addition, certain metadata associated with the original base presentation may no longer be applicable (e.g., presentation location) and may need to be deleted or modified. Changes to the "segment" metadata were also required. A "segment" is no longer purely a video component but is now a presentation component – containing both slide and video components which require two sets of associated temporal data. The slide component consists of a pointer to a PowerPoint presentation, the slide number within that presentation, an image location and the temporal location of the segment within the presentation. This timing information will change if the segment is relocated within the presentation. The video component consists of a source file, start and end times and duration. This temporal information identifies the section of video within the source video that should be displayed with the segment and does not change if the segment is moved. These alterations support the concept of a segment object that can be independently moved within and between presentations and therefore provides critical support for effective editing.

The changes to the metadata model described here demanded alterations to the *PresentationIndexer* application and the legacy metadata files in the existing archive. Because the metadata is expressed as XML files, these modifications were relatively simple to implement. Once the *PresentationIndexer* was updated, the legacy metadata XML files were rapidly regenerated. Alternatively the metadata files could have been easily regenerated through mechanisms such as XSLT or a simple script. The XML Schema corresponding to the new metadata model is available at [11].

5 Problems and Limitations

Whilst the segmentation approach has a number of advantages in this context, it may not be suitable for all lecturing styles. The indexing and synchronization of our SMIL presentations is based on the assumption that the video can be precisely segmented according to slide changes and that within each segment, the lecturer only refers to the currently displayed slide. However some presenters may refer to slides other than the currently-displayed one or begin an introduction to the next slide whilst the previous slide is still displayed. Such situations can lead to incongruities between slides and video content. Irrelevant and distracting information may be present or valuable and important information could be misplaced.

A lack of continuity between contiguous video segments recorded at different times or at different places, is an obvious problem that may occur within "virtual" presentations and distract viewers from the content. A presenter may be wearing different clothes, or have a different hairstyle between contiguous slides. Background and lighting may vary widely within a single virtual presentation. The extent to which this variation disturbs viewers and detracts from the learning experience needs to be assessed.

Originally the presentation incorporates a single continuous video but after editing and the rearrangement of presentation segments, the video consists of a collection of separate video segments in a particular order. The segmentation and reorganisation of the video components can be time- and resource-intensive and result in decreased video quality and reduced playback performance. Consequently the *PresentationEditor* provides two alternative options for generating the virtual presentation. The first option involves dividing and then recombining the video to create a single digital video object which plays in parallel with the synchronised slide images in exactly the same manner as the original presentations. The second approach involves the creation of a SMIL file which defines the start and end times of a sequence of video sections - giving the illusion of a continuous video file playing in parallel with the slide images. Both solutions offer advantages and disadvantages. Choosing to divide and recombine the video is extremely time consuming, CPU-intensive and restricted by a number of factors including video frame sizes. It also requires a large amount of storage space and the quality of the final video is reduced. Never-the-less, the playback quality is reasonable with no loading or seek problems and there is a single video file associated with the presentation. Using SMIL timing to artificially rearrange the video file results in greatly reduced playback quality. The player must load the video file to the requested start time at the beginning of each presentation segment which can cause disruptions in the synchronisation. However this second approach is cheaper, faster, more flexible and less reliant on external factors such as video size or quality and, since the video file itself is not changed, the video quality remains the same.

The *PresentationEditor* operates primarily through the manipulation of flat XML files, either SMIL files or metadata XML files. The application does not support the direct editing of digital media objects such as the video files or PowerPoint slides. While this functionality may be useful, it can also be complex and resource intensive and maintaining synchronization would be problematic. One of the advantages of the SMIL Presentation Tools is that they rely solely on manipulation of textual descriptions and thus avoid expensive and complex digital video editing.

6 Conclusions and Future Work

6.1 Conclusions

The *PresentationEditor* tool described here has the potential to increase the value of multimedia presentation content and enable more efficient and cost-effective production of distance learning resources by maximizing re-use, providing more effective metadata and facilitating ease of management. It provides educators with greater flexibility in the development, maintenance and management of a digital multimedia presentation archive - allowing them to improve, update and customize digital multimedia presentations for specific audiences and to provide a richer, more flexible means of learning, with a minimum of time, effort or cost.

6.2 Future Work

Our immediate objective is to deploy this application within a university department and to carry out user trials to obtain feedback from lecturers/content creators and students on the user interface and the application's usefulness as a tool for building and re-using effective online learning resources.

Future improvements in multimedia players and streaming technologies are expected to result in improvements to the SMIL presentation development tools, the replay interface and the *PresentationEditor*. For example, RealNetworks have recently released the RealONE player [12], which includes the ability to display related hyperlinks and references. Upgrading the system to SMIL 2.0, which provides greater interactivity and embedded metadata [13], should also result in further changes and improvements.

Finally, an area of research requiring more work is that of customized dynamic SMIL generation. In a manner similar to that of third generation HTML web pages [14], it may be possible to combine semantically-related mixed media objects to dynamically generate knowledge-enhanced SMIL presentations, which have been customized for particular users or a given set of constraints.

References

1. Hunter J., Little S., Building and Indexing a Distributed Multimedia Presentation Archive using SMIL. European Digital Library Conference 2001, http://archive.dstc.edu.au/RDU/staff/jane-hunter/ECDL01/ECDL01.html
2. SMIL Online Lecture and Presentation Archive, http://sunspot.dstc.edu.au:8888/smil/
3. Synchronized Multimedia Integration Language (SMIL 1.0) Specification, W3C Recommendation, 15 June 1998, http://www.w3.org/TR/REC-smil/
4. Synchronized Multimedia Integration Language (SMIL 2.0) Specification, W3C Proposed Recommendation, 05 June 2001, http://www.w3.org/TR/smil20/
5. SMIL Players, http://www.w3.org/AudioVideo/#SMIL
6. RealPresenter, http://www.realnetworks.com/products/presenter/index.html
7. RealSlideshow, http://www.realnetworks.com/products/slideshow/index.html
8. Flution, http://www.confluenttechnologies.com/
9. GRINS, http://www.oratrix.com/GRiNS/index.html
10. XML Schema for Original Presentation Archive, http://archive.dstc.edu.au/RDU/staff/jane-hunter/ECDL01/ECDL01.html#AppendixA
11. XML Schema for Editable Presentations, http://sunspot.dstc.edu.au:8888/smil/edmedia/schema.xml
12. RealONE player, http://www.realnetworks.com/solutions/ecosystem/realone.html?src=rnhmfs
13. The SMIL 2.0 metadata element, http://www.w3.org/TR/smil20/metadata.html#edef-metadata
14. Jacco van Ossenbruggen, Towards Second and Third Generation Web-based Multimedia, WWW10 2001

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Cognitive Tools and User-Centered Learning Environments: Rethinking Tools, Functions, and Applications

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Abstract: This paper introduces and analyzes problems and issues in the design and use of cognitive tools in open, user-centered learning environments, introduces a classification scheme for tool functions, and showcases several tools in a current educational hypermedia research and development effort. Implications for future research and development in the design and use of cognitive tools in hypermedia learning environments are addressed.

Background

Many hypermedia applications support open-ended, user-centered, interactive constructivistic learning environments (Hannafin & Land, 2000). In hypermedia, multimedia resources are linked dynamically in web-like form. Hyper-links emphasize expanding versus constraining the user's access to multimedia resources, thereby supporting a myriad of potential uses and learners. Hypermedia systems "open up" knowledge domains and support learners in exploring issues of unique interest and need (Hannafin & Land, 1997). Hypermedia systems can also facilitate construction via student-centered exploration, manipulation, and inquiry (Allen & Hoffman, 1991; Oliver & Hannafin, 2000).

Despite considerable interest and potential, however, "open" hypermedia systems present unique challenges to both designers and users. Due to the absence of explicit pedagogical support typical in direct instruction, users can become disoriented and overtaxed cognitively in open hypermedia learning systems (Roselli, 1991). A principal cause of disorientation and cognitive overload is the quantity of simultaneous, and largely undifferentiated, multimedia resources available. The learner is responsible for accessing, selecting, organizing, and analyzing information according to his or her unique needs (Jonassen & Grabinger, 1990; Land & Hannafin, 2000), but the systems provide little guidance. Learners are often ill-equipped cognitively to navigate vast multimedia networks and interpret their meanings.

The shift in pedagogical control to the individual involves providing more than resources of increasingly powerful multimedia images; it involves the deployment of well-reasoned strategic uses of *available* multimedia resources. The shift requires more than procedural assistance; it requires tools that scaffold the open-learning processes of diverse learners for varied purposes. The purpose of this paper is to describe and illustrate the functions of cognitive tools in hypermedia learning environments.

Cognitive Tools: Functions and Examples

Cognitive tools include both mental and computational devices that support, guide, and extend the cognitive processes of learners. They can amplify cognitive functioning and facilitate the creation of personal knowledge (Pea, 1985; Salomon, Perkins, & Globerson, 1991). Within hypermedia environments, cognitive tools enable learners to regulate the amount, sequence, and flow of available resources, make metacognitive judgments while navigating, and evaluate relevance (Park & Hannafin, 1993). Cognitive tools may also assist users in locating key information, recording or modifying available resources, connecting available resources, generating and linking personally relevant ideas with existing multimedia resources, and creating individual pathways that link the various multimedia resources contained in the system.

Tools are not inherently cognitive independent of the manner in which they are used. Their functions vary based upon the manner and context of their use (Jonassen & Carr, 2000). In some instances, a given tool might be used to collect information (e.g., text, illustrations) from a hypermedia learning environment; in others, the same tool might be used to organize relationships among various resources.

Information-Seeking Tools

Information-seeking tools are especially important for open-ended hypermedia learning environments. Information-seeking tools extend the learners' ability to identify the availability of key information, locate it, and differentiate the nature of the information. Information-seeking includes recognizing and interpreting the problem, establishing a plan for searching, conducting the search, evaluating the results, and if necessary, repeating the process iteratively. Metacognition research suggests that the ability to reflect on actions while searching is critical to success during learning in open-ended environments (Duffy & Knuth, 1990). To enable learners to establish a plan of search, conduct the search, and evaluate the results, cognitive tools should help learners to monitor their information-seeking activities.

In practice, information-seeking activities are influenced by many learner attributes: prior domain knowledge, motivation, cognitive styles, familiarity with learning environments, and gender. Cognitive tools, therefore, support three interrelated seeking functions: locating, viewing, and retrieving relevant information.

Information-Presentation Tools

Information-presentation tools support learners as they attempt to understand the information they encounter. Such tools allow learners to access, then represent, information in varied ways. In open-ended hypermedia learning systems, users frequently encounter too much information. Consequently, they are often unable to identify or establish relationships among information. Thus, information-presentation tools also need to help users to manage cognitive load (Oren, 1990).

Effective information-presentation tools extend three basic capabilities: 1) the ability to select relevant attributes and details while ignoring the irrelevant; 2) the ability to select information that enhances interpretation; and 3) the ability to provide alternative representations. The same information can be represented in a variety of forms, such as verbal statements, mathematical expressions, voice narration, tables, and illustrations. Appropriately represented information helps learners to act on their beliefs, construct higher-order relationships, and establish conceptual associations.

Knowledge-Organization Tools

Effective knowledge-organization tools enable learners to manipulate representations and relationships, promoting unique interpretations of, and relationships between, the information encountered. When learners attempt to organize vast amount of new information, they tend to oversimplify; the scope and complexity is often difficult to grasp. Accordingly, while some details may become well-organized, important relationships are often organized inappropriately or incompletely. Knowledge-organization tools, which allow learners to organize knowledge from various perspectives and dimensions, enable learners to establish key relationships among to-be-learned concepts.

Perhaps the most important function of knowledge-organization tools is the ability to tentatively structure (or restructure) information as it is encountered. This enables learners to construct working models of the domain under study. Knowledge-organization tools allow learners to manipulate information from various perspectives, helping them to organize concepts multi-dimensionally. To lessen cognitive load, knowledge-organization tools help learners to simplify organization and reduce *unnecessary* task complexity.

Knowledge-Integration Tools

Knowledge-integration tools support the connecting new with existing knowledge. One way to facilitate integration is to elaborate and upgrade one's mental model. Cognitive tools can facilitate conceptual understanding by supporting the testing of presumed relationships between newly organized knowledge and existing knowledge. Salomon (1993) suggested that computer tools may be especially useful in executing lower-level, tedious computational and graphic operations, allowing to the learner to focus on hypothesis generation.

Some cognitive activities may seem beyond the reach of users because assistance is unavailable to help establish connections between new information and existing knowledge. Knowledge-integration tools can help to bridge this gap. For example, *Sherlock I*, a computer-based environment for avionics troubleshooting, supports hypothesis testing by providing multiple paths for technicians to explore and coaching the technicians as they test their hypotheses (Lajoie, 1993). The hierarchical structure of the problem is modeled using a menu interface. Learners can constrain or expand problem parameters systematically as they test the limits of alternative hypotheses.

Knowledge-Generation Tools

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The creation of unique learning artifacts is an important component in constructionist views of learning. Knowledge-generation tools help users to manipulate and generate unique interpretations and to represent newly generated knowledge flexibly and meaningfully. Allowing learners to represent newly generated knowledge, using different perspectives and modalities, is essential to deep understanding. *Handy*, a hypermedia editing tool, enables users to construct scenes and present them via computer (Nix, 1990). The user can generate and re-order scenes according to individual goals, interests, and needs. The scene can integrate source media such as videodisc, audiotape, synthesized voice, digitized voice, animation, and graphics.

Cognitive Tools in Practice: *The Human Body*

The Human Body is an interactive CD-ROM based on the TV series, *The Universe Within Human Body*. *The Human Body* was designed and developed by instructional designers, TV producers, subject matter experts, teachers, and multimedia developers. This open-ended hypermedia environment contains approximately 1,000 individual multimedia-enhanced database screens featuring computer graphics, digital video, sound, and text that support learner-centered, constructivistic learning in introductory anatomy and physiology (Iiyoshi & Kikue, 1995, 1996).

A variety of information-seeking tools are provided such as an alphabetical index, keyword search, hypertext and hyperpicture links, and concept maps. These tools enable learners to locate information they need from various perspectives; using their prior knowledge, conceptual relationship among text and pictorial information, and domain structure. For example, using the *Structure Map* tool illustrated in Figure. 1, the learner can determine the availability of a concept using a hierarchically-structured map of each human body system. All components are displayed using both visual images and their corresponding names. The related information for each topic can be accessed by clicking the image or term of each concept. This tool provides a topical overview of related terms and concepts, as well as a means for accessing any or all of the terms and concepts.

Tools are also provided to support information selection and embedding into presentations. The *Bookmark* tool shown in Figure. 2 allows the learner to "flag" key information they encounter, then subsequently access that information quickly and accurately. The learner can place a bookmark on any information screen, and generate a list of all selected screens. In effect, the cognitive load associated with ongoing review is managed by selecting screens for subsequent review.

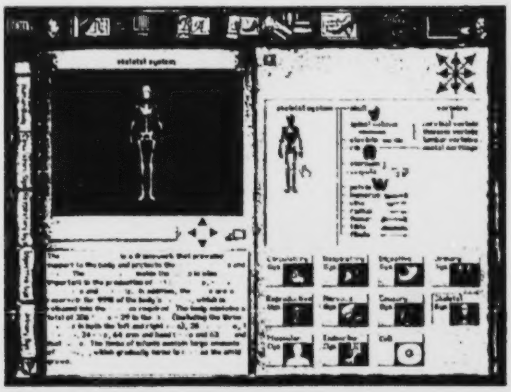

Figure 1: *Structure Map*

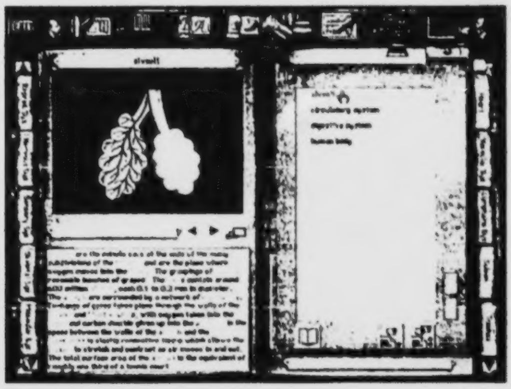

Figure 2: *Bookmark*

As previously noted, tools are not inherently cognitive; the context and nature of their use determine whether or not the tool augments, extends, or enhances the cognitive processes of users, and the manner in which such processes have been influenced. Stated differently, the same computer tool can support multiple cognitive processes. For instance, the previously described *Structure Map* presents a detailed concept map of each system also helps the learner to construct and elaborate the relationship between and among the systems and their components. Likewise, the *Bookmark* also enables learners to traverse selected information screens in user-customized ways.

The *Text Memo* tool, shown in Figure. 3, also supports information organization. It allows the user to elaborate or annotate information contained in any information screen. When a learner writes a memo, the corresponding screen is automatically bookmarked. This electronic memo can then be linked to other information within the system. The tool aids not only in information organization, but also supports the development of user-specified, customized links.

To integrate newly organized information into pre-existed knowledge, metacognitive tools are provided. *Path Tracker* plays back all the information screens the learner went through since beginning study. This helps

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learners to monitor what they have learned for better integration of their knowledge. Another example is *Reviewer* (Figure. 4), which allows learners to monitor the information screens they examine. The ratio of the number of screens examined to the total screens in a particular component or a system is displayed. The tool is useful to identify the distribution of information they have looked through the system.

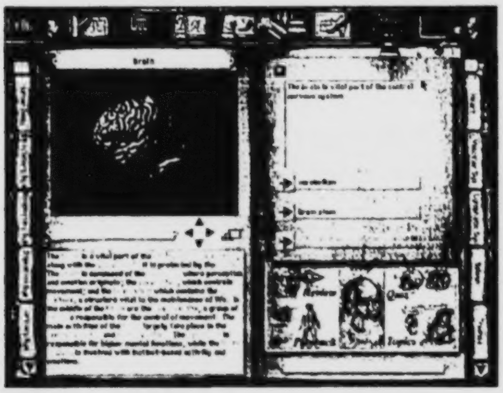

Figure 3: *Text Memo*

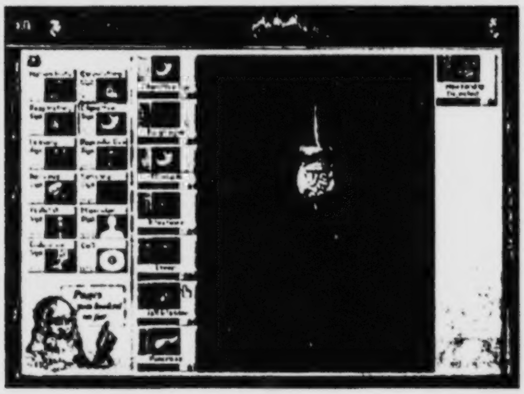

Figure 4: *Reviewer*

In addition, some tools aid learners in both integrating their knowledge as well as in generating new knowledge. The *Presentation Maker* enables learners to create individual collections, combining information screens and their personal comments. As shown in Figure. 5, users can organize bookmarked and/or annotated resources via the *Text Memo* tool to indicate how the body reacted to create a personal affliction (e.g., heart attack of a family member). System contents are both modified according to unique experiences and integrated with the experiences of each individual user. In the presentation mode illustrated in Figure. 6, each screen can be displayed according to the user's specifications.

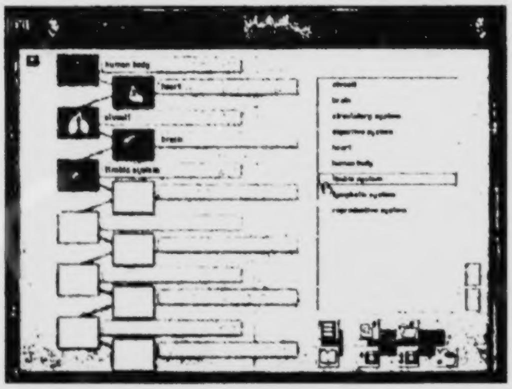

Figure 5: *Presentation Maker* (Authoring Mode)

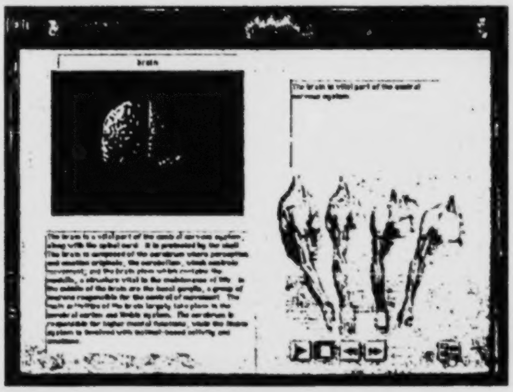

Figure 6: *Presentation Maker* (Presentation Mode)

Implications

Hypermedia systems provide open-ended environments for learner-centered, constructivistic learning. However, learners' cognitive resources are often overtaxed when exploring these vast information networks, limiting their ability to use the systems effectively. Although tools have supported cognitive processes in directed learning contexts, research is needed to better understand *how* they support processing in open-ended learning environments. Several significant research issues remain related to the design and use of cognitive tools.

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Facilitation of Tool Use

Simply providing cognitive tools with open-ended hypermedia systems ensures neither usage nor success. We need to better understand how to facilitate the use of multiple tools; we also need to learn more about how creative users actually employ the tools we provide. Providing a variety of tools may be important to accommodate learners with different prior knowledge and tool-use skills. While it is evident that well-designed and implemented tools can facilitate, it is also apparent that tool use can hinder learning and performance. The cognitive load associated with tool use can actually increase rather than lessen the demands of the learning task. Individuals must often invest considerable cognitive resources learning how to use a tool; this problem becomes magnified as the number and variety of tool features increase. It is important to determine how tool use can be facilitated—both prior to as well as during use—to support user-centered learning.

Domain-Free Tools Versus Domain-Specialized Tools

The rapid growth in open hypermedia systems, such as the World Wide Web, suggests a paramount need for generalizable cognitive tools. However, such tools have rarely been developed much less validated. Increased attention to the design of generic cognitive tools, rooted in theory and research on human cognition and open-ended learning rather than particularized domain nuances, is needed. It may be possible to provide "meta tools" that help learners to construct and customize tools needed for a content domain, that is, to select and adapt from a suite of tools that are well-known and broadly applicable. While the widespread interest in tools that are uniquely crafted to support learning in particular domains has proven the viability and utility of cognitive tools, research on scalable tools is needed.

Evaluation of Tool Use

In order to examine how cognitive tools are used to support learners with open-ended hypermedia learning environments, close evaluation of actual tool use is critical. Several significant questions need to be addressed.

(1) Are tools used as initially intended?
(2) Do patterns of cognitive tools utilization exist?
(3) How do individuals use multiple cognitive tools in their learning?

The proposed research is of significant potential consequence. Few researchers have immersed themselves in issues of design, and few designers are attuned to available research and theory. Tremendous interest has been generated in open learning environments, but little research and theory is available to guide or support the interest. We have taken large steps, but we may not be making needed progress. Neither the research nor the applied community has been, or will likely be able, to singularly advance the state of the art. Greater convergence of interest and expertise between theoreticians and practitioners is needed.

References

Allen, B. J. & Hoffman, R. P. (1991). Varied levels of support for constructive activity in hypermedia-based learning environments. In T. Duffy, J. Lowyck, & D. Jonassen (Eds.), *Designing environments for constructive learning*. Springer-Verlag, Heidelberg.

Duffy, T. M. & Knuth, R. A. (1990). Hypermedia and instruction: Where is the match? In D. Jonassen & H. Mandl (Eds.), *Designing hypermedia for learning*. Springer-Verlag, Heidelberg.

Hannafin, M.J. & Land, S. (1997). The foundations and assumptions of technology-enhanced, student-centered learning environments. *Instructional Science*, *25*, 167-202.

Hannafin, M.J., & Land, S.M. (2000). Technology and student-centered learning in higher education: Issues and practices. *Journal of Computing in Higher Education*, *12*(1), 3-30.

Iiyoshi, T. & Kikue, K. (1995). *The universe within human body: Development of hypermedia in Japan*. Paper presented at the annual meeting of the Association for Educational Communications and Technology, Anaheim, California.

Iiyoshi, T. & Kikue, K. (1996). *Constructivistic learning environments: Five principles of designing educational hypermedia*. Paper presented at the annual meeting of the Association for Educational Communications and Technology, Indianapolis, Indiana.

Jonassen, D. H. & Carr, C.S. (2000). Mindtools: Affording multiple knowledge representations for learning. In S. Lajoie (Ed), *Computers as cognitive tools: no more walls.* Lawrence Erlbaum Associates, New Jersey.

Jonassen, D. H. & Grabinger, R. S. (1990). Problems and issues in designing hypertext/hypermedia for learning. In D. Jonassen & H. Mandl (Eds), *Designing hypermedia for learning*. Springer-Verlag, Heidelberg.

Land, S., & Hannafin, M.J. (2000). Student-centered learning environments. In D.H. Jonassen, & S. M. Land (Eds.), *Theoretical Foundations of Learning Environments* (pp. 1-23). Mahwah, NJ: Erlbaum.

Lajoie, S. P. (1993). Computer environments as cognitive tools for enhancing learning. In *Computers as cognitive tools* (Edited by Lajoie S. P. and Derry S. J.). Lawrence Erlbaum Associates, New Jersey.

Nix, D. (1990). Should computer know what you can do with them? In D. Nix & R. Spiro (Eds), *Cognition, Education, and Multimedia*. Lawrence Erlbaum, New Jersey.

Oliver, K., & Hannafin, M.J. (2000). Student management of Web-based hypermedia resources during open-ended problem solving. *Journal of Educational Research, 94*(2), 75-92.

Oren, T. (1990). Cognitive load in Hypermedia: Designing for the exploratory learner. In S. Ambron & K. Hooper (Eds), *Learning with Interactive Multimedia: Developing and Using Multimedia Tools in Education*. Microsoft, Washington.

Park, I., & Hannafin, M. (1993). Empirically-based guidelines for the design of interactive multimedia. *Educational Technology Research and Development, 41*(3), 63-85.

Pea, R. D. (1985). Beyond amplification: Using the computer to reorganize mental functioning. *Educational Psychologist* **20**, 167-182.

Roselli, T. (1991). Control of user disorientation in hypertext systems. *Educational Technology* **31**, 42-46.

Salomon, G. (1993). On the nature of pedagogic computer tools: The case of the writing partner. In S. Lajoie & S. Derry (Eds), *Computers as cognitive tools.* Lawrence Erlbaum Associates, New Jersey.

Salomon, G., Perkins, D. N. & Globerson, T. (1991). Partners in cognition: Extending human intelligent technologies. *Educational Researcher* **20**, 2-9.

Using Emerging Technologies to Develop and Share the Knowledge of Teaching and Learning Online

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Abstract: This paper analyzes problems and issues in making knowledge of teaching and learning visible and sharable online. It also describes some of the ongoing research and development efforts at the Carnegie Foundation's Knowledge Media Laboratory that advance this work through the use of emerging technologies. Implications for future research and development are also addressed.

Background and Rationale

The Carnegie Knowledge Media Laboratory (KML) uses some of the newest technologies to challenge one of the oldest problems in education—making the knowledge of teaching and learning visible and sharable through the use of multimedia and the Internet. Beyond increasing the quantity or availability of materials for teachers to use, the KML hopes to support the development of a qualitatively different approach to professional development: one which views faculty as critical producers of knowledge and the Internet as a new medium through which they can represent and exchange aspects of their practice and knowledge that often cannot be captured in conventional written texts.

In order to accomplish this mission, the work of KML addresses three critical issues. First, merely documenting what goes on in a classroom or course does not communicate what teachers have learned or the ideas and expertise they have developed. For example, if one were to film every hour of class time and put every document related to a class online, it would be extremely difficult to make sense of all that material or to figure out why the teacher had designed the course as they did or what they had learned in the process. It would be like looking at all the field notes that an anthropologist collected or all the data from an experiment without any of the rationale, context, or analysis that the anthropologist or scientist provides in a book or document. Second, even if many teachers do succeed in developing and producing books, videos, websites or other products that reflect the knowledge implicit in their teaching, there are few means for helping other educators or the wider public to find and take advantage of those that may be most useful for them. Third, even if faculty members can find a wide range of examples of the scholarship of teaching relatively easily, there is no guarantee that they will choose to do so. It may take considerable time before people discover how to take advantage of and build on the knowledge of teaching and learning that can be represented in multimedia and online materials.

Over the past three years, the KML has pursued a set of activities which address these problems. In particular, since few models or examples exist that can give faculty a chance to imagine how they can use the online environment to create new and more powerful representations of their practice, we have worked with accomplished faculty in both K-12 and higher education to create a small number of multimedia websites (Figure 1 & Figure 2).

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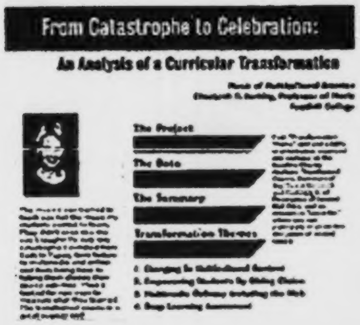
From Catastrophe to Celebration:
An Analysis of a Curricular Transformation
The Project
The Data
The Summary
Transformation Themes

Figure1: Website Example 1

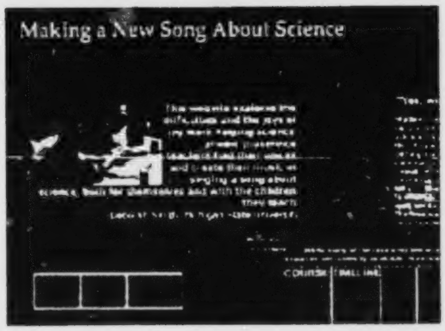

Figure 2: Website Example 2

These sites model how teachers can organize carefully selected materials, images, videos, and reflections that make the ideas and expertise that go into their teaching public and available for others to examine and build upon (Cambridge, et al., 2001). In order to make it easier for faculty to create these kinds of sites and CD-ROMs, DVDs, or videos in which they articulate their ideas and examine their practice, we have also developed a small set of resources and formed an online gallery and exhibition space for the display of their multimedia work. In addition, we have established a virtual workspace that now supports the review and exchange of work by over two hundred scholars who are participating in the Carnegie Academy for the Scholarship of Teaching and Learning (CASTL).

At the KML, we are currently working with the groups and individuals affiliated with the Foundation's programs to expand this work by:

- Inventing new means for faculty to develop and represent the knowledge needed to design powerful learning experiences.
- Constructing the tools and resources that faculty can use to develop and represent their knowledge,
- Fostering the exchange and use of that knowledge in more effective educational programs.

Ultimately, we believe that these activities will help to ensure that the tremendous energy and resources that are being invested in putting courses and resources for both teachers and students online actually lead to significant improvements in teaching, learning, and professional development.

In education, with the development of the Internet and digital media in particular, the latest wave of changes in technology are making their way into the lives of teachers and students. While equity of access remains a constant concern, one can imagine a time in the not too distant future when students and teachers in many different communities can have computers and Internet hookups and communicate and exchange information and ideas with their peers; when they can use digital cameras and video to conduct research and record their work to present to others; and when they can design and take advantage of a wide range of online classes for their personal, academic and professional development. But how will they take advantage of the opportunities to use these new technologies to share ideas that can improve teaching and learning?

The impact of new technologies on the educational system depends on a host of factors outside the control of a single organization or initiative. At the same time, the Carnegie Knowledge Media Laboratory is poised to carry out the kind of research and development that can demonstrate how new technologies can transform key aspects of teachers' work and professional development. Through strategic initiatives and the national reach of the Carnegie Foundation, the KML can help educators to build the understanding, resources, and support needed to use emerging technologies in new ways to transform the development and dissemination of knowledge among teachers at all levels.

Making Teaching Visible

Already teachers can get access to lesson plans, standards, syllabi and other teaching resources through the Internet. In some cases, they can see the work of students in other schools and classrooms by

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visiting recently created school websites. Nevertheless, while the possibility to place many of the artifacts and resources of teaching online seemed particularly promising initially, in our work at the KML we have seen that simply making a large number of teaching-related materials available through the Internet does not provide easy access to the ideas and expertise that went into the development of those documents.

For example, the Internet is often used primarily to present the same kinds of lesson plans or syllabi that one can receive in a paper format. Furthermore, although some sites link these lesson plans with related resources, student work, or, increasingly for K-12 work, lists of standards, relatively few integrate sites these materials with the reflections and examinations by faculty that can make visible the thought that went into the design of courses or lessons or what the faculty member learned in the process. As a result, many critical aspects of teaching and learning – classroom discussions and interactions, relationships among students and between teachers and students – remain invisible and unexamined and the culture and character of classroom activity remain undocumented. Under these circumstances, viewers cannot easily assess the value of many of the materials that exist online or learn much about how to build them into their own teaching practice.

In contrast, the websites that the KML has helped to develop over the past three years explore new ways of integrating teachers' reflections and conclusions about their teaching with extensive collections of their materials – including syllabi, assignments, student work, rubrics, images from the classroom, and videos of classroom discussions and presentations (Iiyoshi, Hatch, and Pointer, 2000). Over the next five years, we seek to expand this initiative on "making teaching visible" to develop new and even more succinct and accessible formats for organizing and displaying teachers' knowledge and to explore the possibilities for creating school websites that capture and convey the ideas and practices of particularly effective programs and institutions in K-12 and higher education.

Building Teachers' Knowledge

In addition to the growth of online teaching materials, numerous campuses and organizations are at work creating online courses and web-based learning platforms. Already, many universities have "virtual offerings" – for students, alumni and others – and organizations like the "virtual high school" are creating online classes that give younger students across the country access to faculty and subjects that might not ordinarily be available to them. Web CT, Blackboard, and other companies are establishing online platforms that foster communication and the sharing of resources among students and faculty. But so far these courses and platforms are used primarily for the conventional delivery of information not the production of knowledge or the generation of new ideas. In order to create "knowledge-building systems" in which many faculty can share their ideas and build on the work of others, they need tools and resources that even those without extensive technical expertise can use to make their teaching visible.

The KML is currently developing a variety of tools and online portfolio templates that can be built into online learning platforms (Figure 3 & Figure 4). In conjunction with articles, presentations and online guides already in development, these tools and templates will provide faculty with the means to collect and organize their teaching materials and make what they have learned available to others. Furthermore, we will work with those who are developing these platforms to take advantage of the possibilities that these kinds of tools and others can offer to faculty. By prototyping tools and templates in this way, the KML will increase the chances that faculty across the country have relatively easy access both to the materials and expertise of their colleagues.

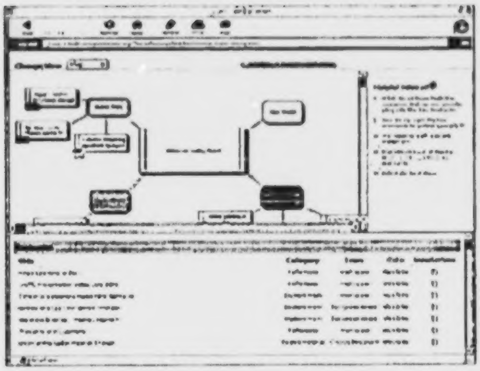

Figure 3: Tool Example

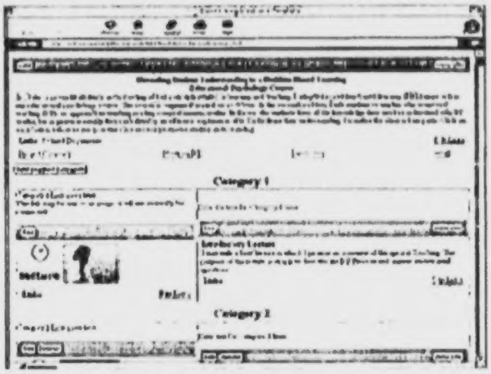

Figure 4: Portfolio Template Example

Creating a Professional Knowledge-Base

Along with the growth in the forums and platforms for sharing their examinations of classroom practice online, faculty at many levels are also encountering more online opportunities to discuss one another's work. Many schools, departments, disciplines, and professional organizations are already sponsoring listservs, discussion forums, "virtual chats," and online conferences. However, our experiences at the KML and our work with others in the field suggest that these resources remain underused; they remain the province of those who are most interested in technology, and they do not necessarily lead to the level of critique and discussion that can promote significant and widespread improvements in teaching practice.

In our own work at the KML, we have created a "gallery for the scholarship of teaching and learning" (http://www.carnegiefoundation.org/KML/) in which faculty can view some of the multimedia examples that we have developed in conjunction with CASTL faculty (Figure 5). Furthermore, we have pioneered the development of a virtual workspace that can support the review and exchange of many aspects of teaching including videos, images, student work, assignments, reflections, and articles and presentations (Figure 6). This workspace has grown into a rich resource with contributions from over 200 faculties from the K-12 and higher education programs of the Carnegie Academy of the Scholarship of Teaching and Learning (Iiyoshi, 2000). Yet, despite the possibilities of the virtual environment, the faculty who view these materials often respond in the same way that they do to materials they find in journals or hear about in workshops or presentations. While they refer to and draw on these materials, they seem to be more likely to use this material "offline" either in the development of their own work or in face-to-face discussions or private email exchanges.

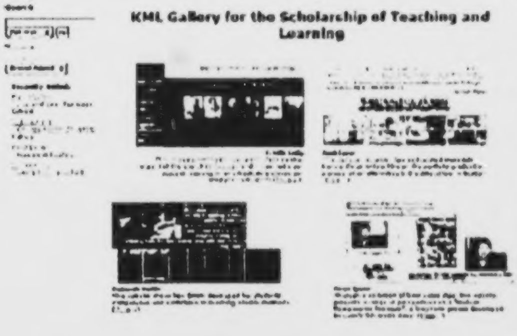

Figure 5: KML Gallery

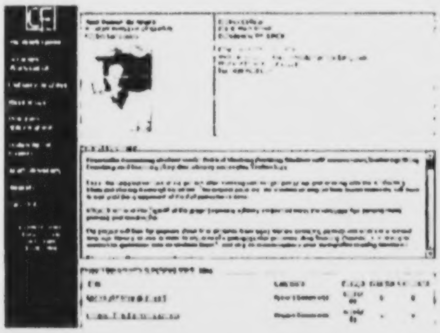

Figure 6: Carnegie Workspace

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In order to better understand how to stimulate and support online opportunities for communication, exchange and peer review, in the next year we plan to examine the most effective sites and contexts for the exchange and development of knowledge of teaching. To follow-up on that research, in conjunction with our partners in other Carnegie programs, we plan to establish a small number of web forums, galleries and exhibition spaces that create a context to display representations of classroom practice, and more significantly, foster the critical examination and use of those representations. For example, as part of a major initiative on learning in the liberal arts carried out by Carnegie and the Hewlett Foundation, we expect to work with selected liberal arts colleges to create websites that capture their approach to learning and provide the materials and information that can be used to assess that approach. Ultimately, we expect that these sites could be accessed through a web-based gallery that facilitates comparisons and fosters exchanges across colleges. In this manner, we hope to contribute to the development of a professional knowledge-base that extends beyond the individuals and across institutions.

Imagining a Future that Demands High Quality Teaching

Together, these major initiatives of the KML are designed to contribute to a future in which many faculty members can be involved in very different kinds of activities than they engage in today:

> We imagine that faculty will begin planning learning activities by looking not only at related syllabi and lesson plans but also by examining the analyses, ideas and knowledge that have gone into the teaching of their colleagues. In the process, they will also be able to access student work and faculty comments and evaluations so that they can develop their own capacity to judge their students' learning and compare their students' performances to others.
>
> During their courses, faculty will put many of their assignments and resources online, and students will be able to submit some or all of their work in an electronic form. As a result, as the course proceeds or afterwards, with relatively little effort, faculty will be able to create web pages or "electronic portfolios" that illustrate significant findings and analyze key artifacts and resources.
>
> After the completion of a course, should they wish to, faculty could contribute their web pages or "portfolios" to archives and forums organized by their school, discipline, or professional organizations. These archives and forums could provide a platform for deep and rich discussions of the teaching taking place in many levels across the country. In turn, these models of teachers' work and the related discussions could inspire others to make changes in their own practice and document the results.

While these activities focus directly on using new media and emerging technologies to develop a high quality teaching force and create an accessible professional knowledgebase, they also create opportunities for many people to see what really goes on in classrooms. By making teaching public online, for the first time, administrators and policymakers will be able to see what really goes on inside schools and classrooms. Should faculty or schools and colleges wish to, they will have the materials and the means to help parents and other members of their school communities to see beyond grades and test scores, instead, they will get a glimpse of the kinds of classes and work in which students are involved. As some schools and colleges make the teaching that goes on inside them public, students and their parents may well begin to expect to be able to view the teaching that goes on in others and to demand the kind of high quality instruction they can see in some of the most advanced schools and institutions.

It is these kinds of demands to see, analyze, and understand teachers' work that require changes in priorities. Those changes in priorities, in turn, can create changes in the ways time is spent. With new demands to see what is really going on in classrooms, K-12 teachers may be able to shift some of their time so they can engage in the kind of reflection and professional development they need to teach effectively and efficiently. Similarly, this kind of demand can begin to influence the formal and informal reward systems and provide some new incentives for faculty in higher education to focus on their teaching and give teaching the attention it deserves.

References

Cambridge, B.L., Kahn, S., Tompkins, D.P., & Yancey, K.B. (Eds.). (2001). *Electronic portfolios: Emerging practices in student, faculty, and institutional learning.* American Association for Higher Education, Washington D.C.

Iiyoshi, T. (2000). *Fostering the Scholarship of Teaching and Learning Through the use of online collaboration technologies and multimedia*, Paper and poster presented at the Center for Innovative Learning Technologies 2000 meeting, McLean, VA, October 26-29.

Iiyoshi, T., Hatch, T., & Pointer, D. (2000). *The Carnegie Foundation's Scholarship of Teaching Mission: Building community through supporting teachers' reflective inquiry process*, Paper and poster presented at the annual meeting of the American Educational Research Association, New Orleans, LA, April 24-28.

Analysis on a Web Community to Promote Inter-Classrooms Collaboration

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Abstract: The purpose of this research is to establish a community model in a large number of classrooms. "Rice Club" is a Web community to promote collaborative learning with a TV program. Teachers and students exchange their opinion on the TV program and relevant practices on the Web. The result of log analysis and interviews to the teachers show that the choice of communication tools is conducted by intentions of the teachers and their curriculum.

Introduction

NHK educational channel has been broadcasting "Okome," rice in Japanese, as a series of TV program for elementary school's students since April 2001. They learn about rice from various aspects, such as cultivation, gastronomic culture, and circulation of rice. Inagaki et al. (2001) developed "Rice Club" which works on the Web for inter-classroom collaborative learning. It has four types of asynchronous chatting board (BBS). Each BBS plays a different role for collaboration (Table.1). Kurokami et al. (1999) pointed out that it is necessary for inter-classroom collaboration to have both personal communication and classroom communication. As the solution, the four types of BBS in Rice Club is designed to cover both levels of communication.

Method

For encouraging to build the Web community, this project started with 13 invited classrooms on April 2001. The coordinators explained how to use BBS as occasion demands. By the end of March, 65 classrooms participated and 10,258 messages are currently on the BBS. We focused on the longitudinal change of the numbers of opinion on each BBS. It will reflect the qualitative shift of communication in classrooms. In addition, to grasp the purpose of teachers' usage of BBS, interviews to 13 teachers including 9 invited classroom teachers and 4 volunteer classroom teachers are conducted.

Result

From the trends of messages and the BBS (Fig. 1), the quality of the Web community shifted from training with non-friendly communication in all participants to intensive collaboration in the specific classrooms. In the beginning, they used Open-ended Type boards for a training to send topics triggered by the TV program and to find out suitable classrooms for collaboration. By September, about a half-year

Discussions among the students	Open-ended Type	General discussion about the TV program Various messages from all participating students
	Specific Type	In-depth discussion about a specific theme. Host school decide the members and topics
Presentations of the Classroom	Diary Type	Activities of the classrooms to text and pictures. Other school can send comments .
	Web Page Type	Activities of the classrooms to Web pages. Other school can send comments

Table 1. Types of BBS

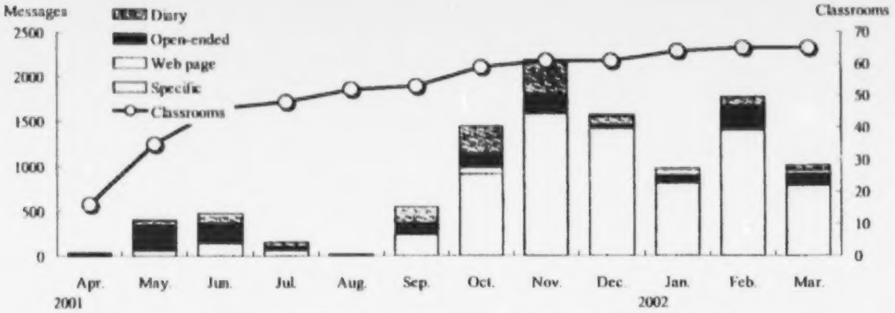
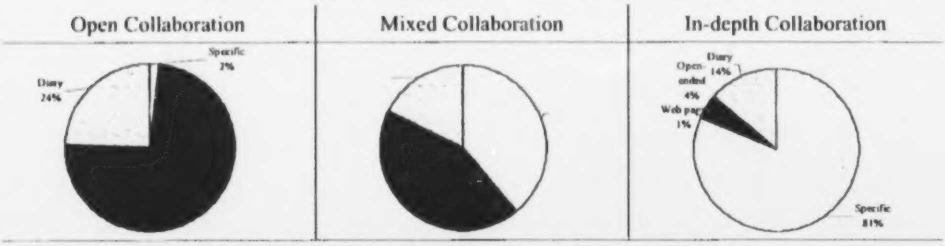


Figure 1. Number of participated classrooms and Messages



Open Collaboration

Mixed Collaboration

In-depth Collaboration

Figure 2. Messages by BBS type in three different collaborations

passed of the grade, Specific Type boards and Diary Type boards became to be used much more. The students had well consciousness for the partner and grew up messages about the focused theme in the Specific Type boards. On the other, Diary Type boards tend to use for wide open communication among various classrooms.

From the result of interviews, three types of collaboration are extracted: Open Collaboration, In-depth Collaboration, and Mixed Collaboration (Fig. 2). These differences are caused by an influence of teacher's attitude toward their practice. In open collaboration, studentes made short term collaborations with any other students from any classrooms. The teachers let their students to use Open-ended type and Diary type boards. On the contrary, the teachers who expected In-depth collaboration, had a tendency to fix the classroom to exchange opinions and narrow the argument down on a specific theme. The theme was decided through the negotiation on Specific Type board. Mixed Collaboration was used in order to the both purpose of the above collaborations.

Conclusion

From the log analysis, it is showed that the quality of community gradually changed from non-friendly communication in all participants to well-consciousness collaboration with a specific partner. In addition, it is clear from the interviews that there were three types of collaboration by the purpose: Open Collaboration, In-depth Collaboration, and Mixed Collaboration. In a conclusion, intentions of teachers were clearly concerned for collaborative learning. That is, curriculum of teachers affects process of students' collaboration. Therefore, differences in types of BBS are well understood by teachers and students and used as we designed. To promote collaboration on the BBS more, we should strengthen the feature of each BBS.

References

Kurokami, H., Horita, T., Yamauchi, Y., Inagaki, T. & Minowa, T. (2001). A Small History of A Communication Board for Collaborative Learning Among Distant Elementary Classes. *Proceedings of ED-MEDIA 2001* , Tampere, Finland, 1035-1040.

Inagaki, T., Kubota,K., Ujihashi, Y. & Kurokami, H. (2001). Designing of a Web Community to Promote Inter-Classrooms Collaborative Learning with a TV Program. *Proceedings of ICCE/SchoolNet2001*. Seoul, Korea, 217-220.

New Ways of Preparing Teachers for Technology Integration

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ABSTRACT: Alberta recently mandated an ICT Program of Studies that requires the infusion of digital technologies into core curricula and across all grades. Effective implementation of ICT demands that all teachers create inquiry-based, technology enabled learning environments for children. The design of digital and media rich learning experiences calls for a dramatic shift in teacher preparation. Student teachers must routinely encounter the effective infusion of technology in all aspects of on-campus learning as well as in classroom placements in schools. This paper describes the design, implementation and evaluation of an undergraduate seminar offered to student teachers in the fourth semester of a two-year degree program at the University of Calgary. Outlined are ways in which fundamental issues in technology integration were addressed, how successes were achieved, and how discoveries from the first two seminars direct on-going modifications.

In September 2000, teachers in Alberta, Canada began a three-year implementation process for an ICT Program of Studies (Alberta Learning, 2000). This innovative curriculum, demanding the effective infusion of technology for communicating, inquiring, problem-solving and decision-making in core curricula, raises important questions about what it means for students to think and learn with the full range of digital technologies that are so much a part of today's changed—and changing—world.

Educational technology research (Clifford & Friesen, 2001a; diSessa, 2000; Goldman-Segall, 1998; Jacobsen & Goldman, 2001; Papert, 2000, 1980) and the experience of the Galileo Educational Network (http://www.galileo.org) paint a similar picture of what thinking and learning need to look like in a knowledge era. We no longer live in a world in which information is scarce. The old certainties of a world defined by four classroom walls and impermeable boundaries have disappeared forever, replaced by global interdependencies and complex systems that require flexibility, responsiveness, and imagination. Overwhelmed by information from a wealth of sources, students desperately need the skills to create new knowledge, not just consume the old. Problems do not come neatly packaged, defined-in-advance, and amenable to the rote application of familiar strategies.

Our society can no longer afford to think of engaged learning, nimbleness, creativity and commitment to action as educational embellishments to "the basics". Multiple and conflicting perspectives are not problems to be fixed, ignored or eliminated; they are the way the world works. Our human survival depends on an ability to learn new things, imagine creative possibilities and design useful solutions in deeply ambiguous and confusing situations. It depends on our ability to teach our children how to do this, too. And thus, questions of how to prepare a new generation of teachers, many of whom have been schooled in old ways despite their relative youth, are increasingly pressing in their urgency.

NEW WAYS OF LEARNING DEMAND NEW WAYS OF TEACHING

Today's classrooms do not look much different than they did 20 years ago when schools began to invest heavily in technology. While recognizing that there are pockets of genuine innovation in classrooms, schools, and universities across North America, we feel confident in making a few generalizations about the current state of affairs. ***First***, while many school and university students are using technology in their personal lives in a wide variety of ways, they are not using computers very extensively in classrooms in order to learn effectively in a variety of subject areas. The gap between presence and use of technology is particularly wide in high school (Cuban, Kirkpatrick & Peck, 2001). In fact, there is a growing "digital divide" between what students actually do with technology at home and what they are allowed to do in school. A growing number of students routinely expect their school computers to be out of date, connectivity to be slow, networks to be unstable, and their teachers' knowledge and confidence about technology to be significantly less than their own.

A ***second*** general trend is that many classroom teachers and faculty members in teacher preparation programs lack confidence in their own ability to think broadly with technology. Conventional models of professional development, like workshops and courses, have not been particularly successful in helping educators find ways to integrate technology for learning. Related to this second trend is our ***third*** observation that even education faculty and teachers who feel confident about their own ability to use computers for professional tasks often feel uncertain about how to use technology in their teaching. Almost by default, visions for the use of technology for teaching and learning are often created by IT specialists who are not educators. Network designs and levels of student access are often determined according to what is standard, easy to monitor and maintain, rather than according to what is educationally sound. Dominant curriculum models and assessment agendas tend to emphasize course delivery and information-transfer rather than knowledge creation and designing something new. While there are thousands of examples of digital media objects and teacher-created units and lessons that claim a meaningful technology component, there are far fewer authentic images of the effective and imaginative use of technology to create new learning experiences.

Teachers and leaders in the schools and school districts are looking to new teachers to shore up the gap between technology presence and use. However, our ***fourth*** observation is that the current generation of student teachers simply do not routinely infuse technology in their own learning and teaching, and thus, too few of them graduate with the skills and experiences that are needed to transform today's classrooms. People entering the profession today are as unlikely to have experienced technology-rich, constructivist learning environments as their more experienced colleagues in schools. There is a great deal of *talk* about constructivism on North American campuses, but very few actual examples either on campuses or in schools of how to live, learn and lead in these ways.

TEACHER PREPARATION AND TECHNOLOGY INTEGRATION

A shift in thinking is required for teacher preparation that is similar to that needed in professional development for classroom teachers (Clifford & Friesen, 2001b; Jacobsen, 2002, 2001). It is simply not good enough to teach the next generation of teachers in ways we were taught. Student teachers must routinely encounter the effective infusion of technology in the normal course of their learning at the university and in their practicum placements in schools. The three of us have co-taught students teachers about integrating technology into their learning and teaching for two years. Our planning for this special topics seminar on integrating technology across the curriculum was guided by our vision of engaged learning and educational reform (Clifford & Friesen, 2001b, 1998, 1993; Jacobsen, 2002, 2001), and our commitment to address the kinds of concerns that we outlined at the beginning of this paper. Our seminar was not *about* technology; it was about teaching and thinking *with* technology. Moving well beyond skills acquisition or a focus on software applications, we instead created *a context of use* within which student teachers learned by designing learning opportunities for real children in real classrooms.

Opportunities were created for student teachers to learn in just the ways they will be called upon to teach children (Clifford, Friesen & Jacobsen 1998). We drew on what we know about good professional development practice: (1) technology is best learned just-in-time, instead of just-in-case, (2) planning, designing, implementing and evaluating are best done in collaboration with others, (3) learning must be situated in authentic, challenging and multidisciplinary tasks, (4) a culture of inquiry around technology for learning supports risk-taking and knowledge creation, and (5) teachers need intentional and meaningful opportunities to reflect on professional development and growth.

Technology Is Best Learned Just-In-Time, Not Just-In-Case

In our seminar, student teachers took advantage of new technology-enabled learning spaces in the Faculty of Education. Our learning environment leveraged the ubiquitous and unfettered access to technology in the seminar space (i.e., 16 networked workstations) and also in the larger public learning spaces (i.e., additional workstations, multimedia development suites, scanners, digital cameras, CD burners, and so on). The fluid access to technology tools, Internet access and to each other enabled students to gather around a workstation or deskspace to collaborate, and to move out into public spaces as needed. The permeable environment permitted flexible arrangements and grouping, and also provided ready access to other experts (i.e., Faculty support staff). Technology skill was developed in the context of developing a web-based portfolio, completing a group-selected focused technology task, constructing an integrated, multidisciplinary unit of studies, and carrying out an independent inquiry project in the field.

"Oh, easy for Leonardo"

Our first task seemed simple enough; students were required to engage with the program of studies, and publish a reflective response on a web site they themselves had to design and maintain. Predictably, it sent many into a tailspin (not unlike that experienced by seasoned classroom teachers and faculty members when they attempt a new technology project). Some students cried, a few complained, and many were worried about a perceived mismatch between their present ability and our expectations. Some students had created web pages before, and set to designing their web site at once. Others worked with us to learn how use the template and how to upload their finished sites to the university server. Each time a new site went up, there were whoops and squeals and broad grins of pure delight. Students felt the special rush of seeing their own work on the web. They were like parents with a newborn – even though some of the initial sites were a little plain and a bit wrinkled, they were beautiful to their creators.

Several of our students talked about "being inspired into a culture of use" which is different in kind than the application focus of many preservice teacher courses on computers. The pervasive assumption of most courses available to student teachers is that everyone needs to learn the same technology skills at the same time before they can do anything meaningful with them. Different assumptions permit new possibilities to emerge. We concentrated on just-in-time, not just-in-case, instruction with technology applications. We introduced meaningful, challenging and multidisciplinary tasks that posed complex and meaningful learning problems, and that enabled a host of possible solutions. In the context of these tasks, the three of us coached and guided individuals and groups of students to design creative solutions, and to acquire the skills and competencies they needed to solve their problem in the way they wanted to approach the task, and respected their individual starting points and needs.

Collaborative Planning, Design, Implementation And Evaluation

All of our approaches to using and learning technology in the seminar were in service of actual design tasks, not in service of learning technology for its own sake. We put student teachers in the position of the children they are going to teach. In collaborative groups, students completed one of eleven tasks initially designed for kindergarten to grade eleven students. The tasks required little prior experience with technology in order to get started. However, because of the nature of the tasks, there was no upper limit on the sophistication of technology use that was possible. Thus, there were steep learning curves for all students no matter what their starting point. Everybody got to sweat the same, all students experienced the value and necessity of working in teams to build on the strengths and diversity in the group, and everyone began with the experience of actually designing and constructing a solution to an interesting problem.

Situating Learning In Authentic, Challenging And Multidisciplinary Tasks

Planning for engaged student learning (NCREL, 2000) and technology integration requires an applied understanding of project, instructional and task design. To move beyond the "add on" approach of using PowerPoint™ or word processing as ends in themselves, teachers need to think and plan carefully about how to infuse technology in teaching and learning. Working in small groups, students collaborated on the design and development of an Integrated Unit of Study for authentic and meaningful integration of technology into one or more core curricular area.

A major requirement of the fourth semester in the University of Calgary program is that students engage in an independent inquiry project that is curriculum and practice oriented. Ideally, these are field-oriented projects at a school or Community Work Place site that enable student teachers to work side-by-side with classroom teachers and students to study essential questions to do with teaching practice. Students engage in critical inquiry in a systematic and intentional manner, contribute to ongoing efforts to improve teaching and learning at the field site, and demonstrate the understandings and skills acquired throughout the first three semesters of the Master of Teaching program. There is an expectation that the students' work will leave a legacy in the field. Inquiry projects were designed to immerse student teachers in challenging and multidisciplinary work that made a difference in the present. One of our students, Heather, learned how to construct and program Lego® robots alongside grade one and two students and their teachers in an elementary school. As the opportunity to work with robotics progressed through each grade, Heather became part of the coaching team, working with teachers and students right up to grade five. As her own expertise grew, the school came to depend on Heather's contribution, her insights and her creative solutions. She focused her inquiry project on documenting and interpreting her experiences with young children and robotics. The result of the inquiry project is not simply a research report; instead, the inquiry process fosters closer connections between campus and field experiences, observations and learning.

Creating A Culture Of Inquiry Around Technology For Learning

One of the most powerful aspects of our special topics seminar was the intentional placement of students in enriched field settings for their inquiry projects. About one third of the class worked in schools in which the Galileo Educational Network provided on-site support to teachers to design new learning experiences via effective technology infusion. In most teacher preparation programs, field placements are more generic: students are matched to schools and partner teachers according to grade and subject specialty. This approach to field placements builds on the notion that the main goal is to make sure the numbers work given certain broad category matches. It assumes that, in essence, schools and classrooms are convenient places for student teachers to "practice". Teacher associations, that vehemently argue that all teachers are equally excellent in exactly the same way, present an obstacle; to them, targeted placements smack of elitism. Our experience counters this view; we did not target "good" or "better" schools and teachers. Instead, we asked ourselves: what energies can we leverage by placing student teachers committed to developing their ability to infuse technology into classrooms with experienced teachers who are also intentionally pursuing their own professional growth in this area? Given a four-month semester, we knew that we could maximize the impact of students' on-campus work by placing them in field placements where the infusion of technology was also a priority.

Reflection On Professional Development And Growth

All certified Alberta teachers are required to complete an annual professional growth plan that includes goals, strategies and evaluation. Teachers are expected to consider the Teacher Quality Standard (Alberta Learning, 1996), the school division's goals and plans, and their own school's improvement plan when developing professional growth plans. While plans of such detail were not appropriate in a special topics seminar, we did reinforce the experience of our students throughout the whole MT program: the importance of cultivating reflective and thoughtful habits of mind about professional practice. To that end, our students prepared a professional growth plan throughout the seminar that included three self-assessments that were published as part of a web-based, electronic portfolio.

WHY DID THIS SEMINAR WORK?

The most significant indicator that our seminar was successful is the high caliber of the students' scholarship. The quality of their work, their thinking and their reflection was exemplary. Each student was able to meet seminar requirements for curriculum design, for planning and carrying out substantive inquiry, for reflection on professional growth, and for the acquisition of technology skills. We prepared a CD ROM of all the units of study that students created, and the focused tasks on which they had worked. From our perspectives both in staff development and in graduate level teaching, we have no hesitation in saying that each of our students left the class better prepared to infuse technology in their own classrooms than many experienced teachers. Many tackled inquiry projects at a level of complexity that approached performance expectations for graduate work. It was hard work. For most, there was a huge learning curve, coupled with a determination to dig in and learn what was needed in service of important ideas. That is, the culture of inquiry we talked about creating in classrooms became a living part of the seminar, itself.

Building on Diversity - We believe the exceptional degree of student success and engagement was an outcome of deliberate design and instructional decisions that were informed by our knowledge of the current state of affairs in schools and on campus. First, the space in the seminar was open enough for all students to define a place for themselves. We designed the seminar so that it required a wide range and diversity of experience, ideas and projects. From the first day, our students learned that it did not matter what grade or subject they were preparing to teach. We were not concerned whether they had extensive experience with technology or none at all. It was all right to prefer different platforms, different software, and alternative approaches to tasks than the ones we suggested. That is, we structured exactly the situation we wanted tomorrow's teachers to create for their own students. Students came to see that diversity was not a problem to be overcome, but an essential resource on which we all can draw when asked to complete complex and demanding tasks together.

Insisting on a Pedagogical Focus - Second, all aspects of the seminar were centered on pedagogical issues rather than technology issues. There are two apparently contradictory consequences of a strong initial focus on technology skills acquisition in the common kinds of workshops and courses designed for those who are new to technology. The *first* consequence is that participants often seize on one or two of the applications they first learn to use, assuming that now the job of covering technology is taken care of. This enthusiasm is apparent in how often teachers introduced to planning a technology enriched experience for students start with statements like this, "I was thinking of letting kids do Power Point™ reports on an animal they choose..." Jamie McKenzie (2000) uses the felicitous phrase "power pointlessness" to describe the careless adoption of an otherwise effective presentation tool as if it were the be-all and end-all of technology use in the classroom. The *second* consequence of an initial focus on skills acquisition is that such a focus feeds the growing sense of panic that sets in when many of us squarely face a harsh, but often unspoken reality about technology: no mere mortal can keep up with the innovations. No one in a classroom is going to win the race against new hardware, new applications, and new capabilities. There is always a new version, a new digital device or a new idea coming down the pipe. Considering the range of applications now available to students and teachers, and the rate at which new versions are introduced, it is easy to feel overwhelmed even by finding a starting place.

When student teachers can be convinced to give up the idea that they need to know *this* application, and *this* application, and *this* application, and accept that they will never know everything about every piece of software, they undergo a transformation. Many suddenly feel liberated. They feel a burden lifted when we say to them, "Look, there is no way you will ever be faster, more fluent, or more knowledgeable about the technology that is out there than all of your students. And you know what--that's okay. It actually gives you a whole lot more room to get important things happening. There are some things that the kids will always do better than you. Let them. And there are important things that they need to be taught. *Your job as a teacher is to design rich and meaningful learning experiences*. They don't know how to do that. You have to figure out what these applications are good for. The kids will figure out how to drive them."

It is often the ideas that accompany technology integration that intimidate teachers and university faculty alike. Teachers sometimes ask us, "If I start letting the kids use all this technology, what's happened to my role as a teacher?" Of course, what they are really asking is what will happen to *me?* Do I still have anything of value to offer? Confident technology users ourselves, we know that deep understandings of the character of inquiry-based learning and knowledge construction have never been more important than they are in digitally rich environments (Clifford & Friesen, 2001a; Jacobsen & Goldman, 2001). It is entirely possible to do foolish things with powerful tools just because they are there. Our challenge was to help our student teachers develop fluency with *teaching and learning with technology*, not just with technology, itself. A critical awareness of issues to do with technology integration was revealed when one of our students wrote to us about her reaction to the ICT program of studies and our talk about teaching and learning as the primary focus of the seminar. "I thought", she told us, "that only people who were *against* technology ever raised questions about ethics and values and what is worth doing. I was amazed to find it in the ICT program of studies, and to hear the three of you say critical things, too".

Team Teaching – The three of us worked collaboratively with one another and with the support staff who were available to assist our students. The seminar was enacted through the genuine collaboration and diverse range of skills that are required to get complex things done. We depended on our own collaborative efforts, and we valued and encouraged opportunities for students to access one another's expertise. This collaboration extended to the field placements, and the students contributed to and benefited from the diversity among teaching staff as well. In a world in which we know we must prepare students to work effectively in teams both to define and to solve problems in ambiguous situations, teacher isolation is a terrible problem. The culture of schooling makes it very difficult for teachers to form strong work teams. As part of helping student teachers both experience and understand the power of collegial support, we required students to become interdependent. There was no way that any student could meet the demands of this seminar alone. They needed each other, they sought out one another, and they had to negotiate all the ordinary troubles of working together as part of their learning.

CONCLUSIONS

A deep commitment to the principles that pervade the entire teacher preparation program at the University of Calgary guided the creation of our special topics learning environment. We opened spaces in which student teachers used ICT fluently for personal productivity in the creation and maintenance of scholarly work. Student teachers developed an understanding of Alberta Learning's (2000) ICT Program of Studies, and discussed implications for learning and teaching in their discipline/grade level and for their own professional growth plans. Students were articulate in describing the ways that technology had influenced their own learning and in describing the ways they had seen technology play a role in others' teaching and learning. In groups, and as individuals, students wrote, communicated, made decisions, and conducted inquiry smoothly and effectively using technological aids if and when these digital tools contributed to those processes. Students intelligently questioned uses of ICT and were appropriately skeptical about naive enthusiasms and overly simple solutions. In the context of focused tasks and integrated units of study that they designed and created, students discussed the strengths and weaknesses of ICT in a wide range of applications.

In the course of this special topics seminar, students moved beyond being mere proponents of ICT usage, or already-hardened skeptics, and developed further as thoughtful professionals who choose and design tools appropriate for the tasks they needed to accomplish. Students developed an informed personal position on technology integration in education and articulated and defended that position with each other. In the school placements, student teachers encouraged children both to actively question the place of ICT in their learning and to make responsible use of ICT in their own work. In the context of their own creative work, student teachers understood and developed ethical dispositions and practices in relation to the uses of technology in the classroom. Finally, our student teachers developed a capacity for critical inquiry in the applications of technology in learning and teaching, an essential disposition given the rapid pace at which information technologies are transforming our world.

REFERENCES

Alberta Learning. (2000-2003). *Information and communication technology, kindergarten to grade 12: Program of studies*. Curriculum Standards Branch. [On-line]. Available: http://ednet.edc.gov.ab.ca/ict/

Alberta Learning. (1996). *Teacher Quality Standard: An Integrated Framework To Enhance The Quality Of Teaching In Alberta*. Policy Framework. [On-line]. Available: http://www.learning.gov.ab.ca/news/1996nr/june96/nr-qteaching.asp

Clifford, P., & Friesen, S. (2001a). "The Stewardship of the Intellect: Classroom Life, Educational Innovation and Technology". In Barrell, B. (Ed.). *Technology, Teaching and Learning: Issues in the Integration of Technology*, p. 29-42. Calgary, AB: Detselig Enterprises Ltd.

Clifford, P., & Friesen, S. (2001b). *Bringing Learning to Learners: The Galileo Educational Network*. Invited Presentation, and proceedings of ED-MEDIA 2001: World Conference on Educational Multimedia, Hypermedia and Telecommunications, Tampere, Finland.

Clifford, P., Friesen, S., and Jacobsen, D. M. (1998). *An expanded view of literacy: Hypermedia in the middle school*. Proceedings of the ED-MEDIA AND ED-TELECOM 98: World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications, Freiburg, Germany, June 20-25. [On-line]. Available: http://www.galileo.org/research/publications/literacy.html

Clifford, P., & Friesen, S. (1998). Hard fun: Teaching and learning for the 21st century. *Focus on Learning II*, 1: 8 – 32.

Clifford, P. & Friesen, S. (1993). A curious plan: Managing on the twelfth. *Harvard Educational Review 63*, 3: 339-358.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38* (4), pp. 813-834.

diSessa, A. A. (2000). *Changing minds: Computers, learning, and literacy*. Cambridge: MIT Press.

Goldman-Segall, R. (1998). *Points of Viewing Children's Thinking: A Digital Ethnographer's Journey*. New York: Lawrence Erlbaum Associates.

Jacobsen, D. M., & Goldman, R. (2001). "The Hand-Made's Tail: A Novel Approach to Educational Technology". In Barrell, B. (Ed.). *Technology, Teaching and Learning: Issues in the Integration of Technology*, p. 83-112. Calgary, AB: Detselig Enterprises Ltd.

Jacobsen, D. M. (2002). *Building Different Bridges Two: A Case Study of Transformative Professional Development for Student Learning With Technology*. Paper presented at AERA 2002: Validity and Value in Educational Research, the 83rd Annual Meeting of the American Educational Research Association, New Orleans, LA: April 1 - 5. [On-line] http://www.ucalgary.ca/~dmjacobs/aera/building_bridges_two.html

Jacobsen, D. M. (2001). *Building Different Bridges: Technology Integration, Engaged Student Learning, and New Approaches to Professional Development*. Paper presented at AERA 2001: the 82nd Annual Meeting of the American Educational Research Association, Seattle, WA: April 10-14. [On-line] http://www.ucalgary.ca/~dmjacobs/aera/building_bridges.html

McKenzie, J. (2000) Scoring Power Points. In *FNO: The Educational Technology Journal. Vol 10*, No 1, September 2000 [On-line]. Available: http://www.fno.org/sept00/powerpoints.html

North Central Regional Educational Laboratory. (2000). "New times demand new ways of learning." [On-line]. Available: http://www.ncrel.org/sdrs/edtalk/newtimes.htm

Papert, S. (2000). What's the big idea? Toward a pedagogy of idea power. *IBM Systems Journal, 39* (3&4). [On-line]. Available: http://www.research.ibm.com/journal/sj/393/part2/papert.html

Papert, S. (1980). *Mindstorms: Children, Computers, and Powerful Ideas*. New York: Basic Books.

Transformational Leadership & Professional Development for Digitally Rich Learning Environments: A Case Study of the Galileo Educational Network

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ABSTRACT: The Galileo Educational Network is an innovative educational reform initiative that brings learning to learners. Expert teachers work alongside teachers and students in schools to create new images of engaged learning, technology integration and professional development. This case study is based on the nine schools involved with Galileo in 2000/2001. Field visits and interviews (n=113) with Galileo staff, school administrators, teachers and students yielded rich information about the initiative. Indicators of success include: 1) demand for Galileo Network's services, 2) corporate investment in Intelligence Online (IO), 3) satisfaction among stakeholders at each level of the initiative, 4) evidence of engaged student learning, and 5) evidence of transformed teaching practice. Essential conditions for the sustainability and growth of the Galileo Network initiative are described. Factors that both contributed to and hindered the success of the initiative are discussed.

The Galileo Educational Network Association (GENA) is a continuous professional development and research organization in Alberta, Canada, that focuses on the fundamental changes to teaching and learning required by digital media and technology. GENA's expert teachers work in schools alongside teachers and students to create new images of engaged learning, technology integration and professional development. GENA works on-line to develop and share examples of innovative and high quality student work and sustains face-to-face initiatives via its website [http://www.galileo.org] and Intelligence Online (IO) professional development service. The professional development and leadership approaches of the Galileo Network are firmly grounded in current educational research, and Galileo Network members contribute to new knowledge by actively publishing and disseminating results of their efforts (Clifford & Friesen, 2001a, 2001b, 1998, 1993; Clifford, Friesen & Jacobsen, 1998; Jacobsen 2001). GENA has developed a number of strategic alliances with private, corporate, community and government organizations to generate innovative approaches and strategies for professional development. GENA is a charitable organization that began operations in 1999 in office space provided by the Faculty of Education at the University of Calgary. The Galileo Network operates autonomously from any one school district or division as it pursues a province-wide educational reform agenda. The majority of GENA's funding, both cash and in-kind, comes from a variety of government, private, corporate and institutional organizations. Each school division and/or individual school funds their participation with the Galileo Educational Network differently.

Classroom teachers need ongoing support and professional development for the effective implementation of technology for meaningful student learning. Conventional approaches to professional development for technology integration, usually short-term skill-based workshops and seminars about working the computer, do not transform pedagogy. What makes the Galileo Educational Network approach innovative is that teachers are provided with time during the school day to collaborate, to participate in professional conversations about practice, and to work with a trusted mentor who supports and extends their technology integration efforts. The professional development relationship is guided by essential principles of engaged student learning and high technology performance, and is responsive to the individual teacher's current practice and needs. Therefore, the professional development is more closely aligned with mentorship than with coaching from the side. Far from being a set model, the GENA approach is generative, flexible and responsive to the individual teacher's needs and ideas for his or her own learning. Galileo teachers start from where classroom teachers are in their development and beliefs. The individual starting point for each teacher is respected in much the same way that teachers respond to the diverse needs and capabilities of their students. Different questions and needs are honored, and projects that arise from the relationship come from the teacher's current practice, beliefs and ideas about teaching, technology and student learning.

Transformational Professional Development

It is important to pause here, and provide operational definitions of key terms. A decade ago, Leithwood (1992) described a move towards transformational leadership, which he defined as school leaders and classroom teachers seeking meaning together as a community, and supporting individuals as they seek meaning in their professional lives. The Galileo Network's approach to transformational professional development extends this tradition by building mutually beneficial relationships at all levels of a school system at once with the goal of empowering teachers to be innovative curriculum designers, and to free teachers to author rich learning experiences with their students. *Terms like empowerment and freedom are chosen deliberately to convey the vision of enfranchisement* and democracy that is at the foundation of GENA's work in schools. The Galileo approach is not just about enabling, or making possible, although this is an important and powerful part of their work with educators and educational leaders. Galileo's approach to transformational professional development aims to empower teachers and school leaders to be learners themselves again, and to form supportive communities that are committed to staff and individual growth. Galileo teachers work alongside teachers to help them develop as learners themselves so that they can translate this new freedom of inquiry into the design, implementation and evaluation of meaningful, authentic and challenging learning experiences for children.

Research Context

The present evaluation of the second year of the Galileo Network's professional development initiative builds and extends upon a study conducted at three elementary schools involved with the Galileo Educational Network in 1999/2000, its first year of operations (Jacobsen, 2001). A goal of the present investigation was to expand upon findings from three schools by investigating further the relationship between teacher and student perceptions about classroom events, the role of the Galileo Network in schools, and the duty of leadership in supporting and extending professional development initiatives during the second year of operations. The study was essentially guided by two overall research objectives: (1) Evaluate the impact of effective technology integration on engaged student learning, and (2) Evaluate the impact of the Galileo Educational Network on teaching practice and transformed learning environments by evaluating the sustainability of these professional development initiatives.

Case study research methods (Merriam, 1998; Stake, 1995) were employed to identify appropriate sources of data, and gather information. Field visits were made to eight schools to observe daily classroom events and instruction, and to conduct in-depth interviews. Over one hundred interviews (n=113) were conducted with Galileo Network staff, school administrators and technical personnel, classroom teachers and students. Observations of whole class dynamics, small group collaborative work and individual student engagement in learning were made, and observation notes recorded. The 26 indicators of *engaged learning* and 22 indicators of *high technology performance* developed by the North Central Regional Educational Laboratory (2000, 1995) provided a conceptual framework through which interview and observational data was understood, analyzed and discussed.

This case study research was rarely a linear, step-by-step process that proceeded logically from data collection to analysis. Instead, "data collection and analysis is a simultaneous activity" (Merriam, 1998, p. 151). Analysis began by framing the present study in the context of first-year findings, and continued as both an iterative and recursive process with each site visit and interview. The triangulation of data and information from site visits, interviews and observations enabled researchers to analyze and report on themes, trends and understandings of the group as well as honor individual experiences and observations in a rich, thick description of the case. Interview data was evaluated using: (1) content analysis (Merriam, 1998) of themes and recurring patterns of meaning, (2) constant comparative method (developed by Glaser & Strauss, 1967, described in Merriam, 1998) to identify emergent themes and categories, and (3) narrative analysis (Merriam, 1998) to study experience via the stories that people tell and remember. Field notes, observation and reflection on site visits, photographs of learning environments provided rich data for content analysis, and also categorical aggregation and direct interpretation (Stake, 1995). Aggregation of instances that suggested trends and shared understandings of the group, along with direct interpretation of an individual's stance, contributed to the development of themes.

DISCUSSION

Initial findings that have emerged from this case study of Galileo Network's second year of operations are summarized as follows: (1) sustainability of the initiative requires a long-term relationship be established and maintained between school teachers and Galileo teachers, (2) sustainability requires that teacher leaders who can champion the initiative be identified and cultivated; (3) the role of district and school-based leaders is vital to the effective establishment and cultivation of a inquiry-based learning environment in which teachers were prepared to take risks, and (4) indicators of success were focused on what the children could do differently, and how technology provided opportunities for learning that were previously unavailable. The context for these findings will be discussed in subsequent sections of the paper.

Transforming Pedagogy

Both philosophical and pedagogical barriers to innovation exist when teachers shift from information-transmission to designing technology-enabled, constructivist learning environments. When teaching roles change from content expert to designer of technology-rich, inquiry-based projects, some parents and educational leaders get nervous. A supportive and continuous relationship with Galileo Network teachers over an extended period of time is perceived by classroom teachers and school administrators to be an essential condition for achieving transformed teaching practices with technology. The Galileo Network recognized early on that in order to transform classroom teaching, they had to work at all levels of the educational system at once. To that end, the Galileo Network has formed strategic alliances with the provincial ministry of education, superintendents of schools, district technology and curriculum leaders, school-based administration, school teachers, parents and students to support the growth of innovative practices in schools. Educators can often be under intense pressure from the public, the ministry, the school board, their administrators, and even from themselves, to change practices and processes overnight. However, the pressure to change quickly is an unrealistic expectation, and Galileo teachers help classroom teachers to set realistic and achievable goals for inquiry-based learning and technology integration.

Creating Supportive Environments for Risk-Taking and Knowledge Creation

When asked to describe the nature of their on-site relationships with each teacher or group of teachers, co-founders Dr. Pat Clifford and Dr. Sharon Friesen explained that the work with teachers

> *...really showed us very clearly that there is no model for doing this...it's not models that make a difference, it's ideas that make a difference and it's relationships that make a difference. So it's in hearing what people want to do. It's just like teaching in a classroom where you work literally from where people are ... because people can't be in any other place than where they are. You can't wish them to be somewhere else. They are where they are from the start. And so you listen to that.. where's your opening? And then around the opening they provide you, the job of the expert then, we think, is to say what could we put in place for this person, given who they are, what they want to accomplish, and what they're working with? So it looks different, as it ought to, for each person. We called it being responsive and.. it's actually to say if you're going to have people work with kids in this way, you have to provide them, as teachers, a learning experience that's like that.*

The intent of the Galileo Network initiative is to model transformed approaches to leadership, teaching and learning that inspire and foster inquiry in learners of all ages. Pat and Sharon believe that...

> *...the work we do here, it's not without huge impact and it's not about individuals. It's far bigger than any individual. You are equal to get involved in it. You have to let it go. It's the gift you give to people. But they pick it up in ways that you don't anticipate. It's far bigger than any person. So we may work with the people, but what we put them in touch with is a part of themselves that, I think, they're often apt to give up when they enter the classroom. And once they get a hold of it, they don't want to let go because they see the impact. It's right in front of their face. You see what's happening to those kids.*

An ongoing and sustained relationship with a Galileo Network teacher provided some teachers with a safe and caring environment for exploring new approaches to teaching, and the motivation to continue when faced with questions and challenges from parents and other colleagues. For many teachers, the fact that Galileo teachers had been where they wanted to go was an important motivator for getting involved, and taking the necessary risks to change their teaching practice. Whether or not changes to practice are sustainable has a great deal to do with the ongoing nature of the relationship between teachers and the Galileo Network. Teaching practices are developed over years of experience with children, and years of observations in classrooms – hence, they are rarely transformed quickly. For a teacher to transform practices that have become comfortable, to abandon methods that have enabled her/him to achieve some form of results with children, the teacher needs ongoing support and professional dialogue with other teachers who understand her/his concerns, and can provide images of how it can work with children. The teacher has to trust that the changes being made offer some relative advantage over what is being done right now.

Inquiry Based Learning With Technology

What is the nature of change that occurs when meaningful partnerships are formed between learners and digital media? Teachers who designed and implemented inquiry projects emphasized the importance of student questions versus teacher questions. One of the desired learning goals for teachers was to promote student's meaningful and personal connections to the topic of study. Instead of designing integrated units or students' projects with pre-determined outcomes, inquiry projects were designed in such a way that students' ideas, questions and prior knowledge became an important contribution, and an assessment strategy was developed that accommodated multiple outcomes. Students made choices about questions that they would pursue in the context of the inquiry project, and formed collaborative groups based on shared interests rather than teacher-formed groups. Learning tasks were big and complex enough that students needed to rely on each other to gather the information needed to solve problems and generate solutions. Students shared their ideas and knowledge with their peers, not just with the teacher. Students were encouraged to use a variety of means to demonstrate their understanding of concepts and problems, from textual explanations, concept maps, and drawings to dramatizations, multimedia presentations, functional robots and web sites.

Teachers rarely used whole class instruction as a method of delivering the curriculum. In response to the student's emerging learning needs, the teacher's role became one of scholarly mentor and guide as she met with groups of students for discussion about specific problems, and with individual students who needed assistance. Within the context of a well-structured and challenging inquiry project, and with readily available guidance and instruction as they needed it from the teacher, students worked collaboratively with their peers to design creative, innovative and diverse projects. Instead of there being one best solution to a complex problem posed by the teacher, students were given the license to design alternate and unique interpretations and projects, and inquire into topics and questions that reflected their own interests, knowledge and understanding.

Different groups of students required different technology tools to create their designs and construct their projects. Technology skills were taught just-in-time in service of learning tasks and goals, rather than taught to the whole class at once. One group might need a spreadsheet program to model their data, while another group may choose to represent their understanding of relationships between concepts using a semantic mapping tool. To the extent possible, given the design and resources of the school, computers were at hand wherever and whenever the students needed them, rather than walking students down the hall to a computer lab for a booked amount of time each day. Novel solutions were created in schools where there were only 2 – 4 workstations available in the classroom. For example, at one elementary school, teachers negotiated arrangements whereby students could use computers distributed throughout the school and in other classrooms as needed for their projects. A culture of inquiry was created in this particular school such that students were trusted to work where they needed to be for their inquiry tasks and projects, and appropriate behavior was continuously demonstrated.

Among educators in Galileo schools, there was a monumental shift in the perception of the role of technology in teaching and learning. Through professional dialogue, mentoring and working alongside teachers with their students, the Galileo Network has facilitated a changed understanding of the intent and fundamental goals of Alberta Learning's ICT Program of Studies, from an initial perception of an emphasis on technology, to an understanding of the emphasis on higher order thinking, inquiry, communicating, problem solving, and decision making. Teachers clearly regarded Galileo's vision and methods as a focus on teaching and learning, which was a shift from their initial perception that GENA was all about technology.

Developing A Culture of Inquiry for Teachers

The Galileo Network worked with people at all levels of the educational organization in order to help build a culture that supports and expects reformed ways of teaching and learning with ICT. A social and political culture of reform and innovation, and the expectation that people would be charting new territory, helped to support teachers in making changes to their practice. An integral component of the culture of expectation in each of these schools was the support for change provided by regular access to onsite support and expertise, and the time to make optimal use of the onsite professional development. Teachers felt energized and excited about the changes to their practice, and were convinced by evidence of student ownership, joy and success in their learning. There were many reasons why schools and teachers first became involved, and then were highly motivated to continue, with the Galileo Network: (1) The Galileo Network teachers have worked with children on innovative and successful technology-enhanced projects, and share many examples of high-quality scholarship achieved by students; (2) The reputations of Galileo Network staff as experts and innovators, and the personal relationship networks that these experienced educators and managers have established in the Alberta education system, attract educators, and provide a basis on which to build trusting and productive relationships; (3) The push in Alberta to implement the ICT Program of Studies provides an important source of motivation; the Galileo Network bridges a professional development gap in the province with regard to achieving the expected ICT learning outcomes with students; (4) Teachers' desire for continuous professional development, and support while implementing a new program of studies, makes them highly value the opportunity to rediscover the learner and scholar within, and cherish the opportunity to work with dynamic, approachable and trusted Galileo colleagues; (5) The satisfaction of being involved with an innovative organization, and working side-by-side with energetic, enthusiastic and experienced Galileo Network teachers; (6) After participating in single or multiple projects with Galileo Network staff, the satisfaction of achieving higher results with students is a motivating factor for continued participation.

Indicators of Success

The ***first*** indicator of success is the continued demand for Galileo Educational Network's services. There is a great demand from schools all over the province to get involved in the Galileo Educational Network. In it's third year of operation, the Galileo Network initiative is growing from the current 9 schools in five school divisions to working in 18 schools in 7 different school districts in 2001/2002. A ***second*** indicator used to evaluate the success of the initiative is corporate investment in co-developing an online professional development service, Intelligence Online (IO), to extend and grow the Galileo Network's capacity to provide support to teachers. A ***third*** indicator used to assess whether the Galileo Network has been successful in achieving their objectives is stakeholder satisfaction. Overall, it can be reported with confidence that there were very high levels of satisfaction among stakeholders at every level of the Galileo Network initiative. Conversations with Galileo Network staff and school administrators yielded positive indications that key school board personnel are not only satisfied, but are actively developing strategies to spread the Galileo Network initiative to other schools in their division. A ***fourth*** indicator used to assess whether the Galileo Network has been successful in achieving their objectives is evidence of engaged student learning. Instead of designing integrated units or students tasks that had pre-determined outcomes, teachers designed projects in such a way that students ideas, questions and prior knowledge become an important contribution, and developed assessment strategies that responded to multiple ways of being right. Experienced teachers became convinced of the value of an inquiry-based approach to technology integration when they observed the enthusiasm, interest and independence of their students. Teachers and school administrators commented on how learning was enhanced for students of diverse abilities, and that the quality of work achieved by many students went well beyond their expectations. A ***fifth*** indicator used to assess whether the Galileo Network has been successful in achieving their objectives is evidence of transformed teaching practice. The professional development support provided by the Galileo Network is much less about technology integration, per se, and is instead focused more on inquiry into fundamental teaching and learning issues. Teachers appreciated having ongoing contact with a Galileo teaching colleague who has lived experience with integrating technology with children and can assist in pedagogical, project and technology skill development. Teachers critically examined their practice and determine next steps for pushing their practice forward with the onsite support of the Galileo Network.

CONCLUSIONS

Sustaining learning environments that enable technology-infused, inquiry-based approaches to teaching require that a number of essential conditions in the school be maintained, of which this is a non-exhaustive list: (1) Supportive Leadership; (2) A Learning, Risk-Taking Culture Among Staff; (3) A Colleague, From Within Or Without, To Walk This Road With You; (4) Ubiquitous Access To Reliable Technology; (5) Time For Professional Dialogue And Connections; And (6) School Board And Parent Support. A number of essential conditions for the sustainability of the Galileo Network initiative within a school emerged from conversations with school leaders, classroom teachers and Galileo staff. Among these were: (1) Securing Sustainable Sources of Funding, (2) Building On-Site Capacity And Leadership, (3) Diffusion Of The Mentorship Relationships, and (4) Designing Learning Communities to Resist the Urge To Turn Back.

Key Factors that contributed to the success of the Galileo Educational Network initiative during the 2000/2001 can be summarized as follows: (i) the vision, commitment and credibility (i.e., reputation) of the founding members of the Galileo Educational Network; (ii) the effective enculturation and professional development of new staff who join the Galileo Educational Network (i.e., cultivation of a learning organization); (iii) an organization-wide vision and mandate for transformational leadership and educational reform in the area of technology integration for teaching and learning; (iv) authentic examp les and images of best practice and engaged learning to share with school teachers; (v) active involvement of Galileo staff in teaching, coaching and mentoring within the classroom context; (vi) open and clear communication with, and support from, district and school administration; (vii) willingness and preparedness of school staff members to examine practice and to try new approaches to teaching and learning; (viii) maintenance and growth of a research agenda, and a mutually beneficial relationship with Alberta universities and research partners; (ix) the simultaneous development and cultivation of mutually beneficial relationships with key personnel at the school board/district level, the school level, and with corporate, public and private partners; (x) strategic leverage of existing district structures and personnel; (xi) widespread satisfaction of participant stakeholders at all levels of the initiative; (xii) a professional development model that is responsive to the needs and differences within and between school districts and schools; (xiii) ability to be innovative, flexible and responsive to stakeholders because the Galileo Network operates as an autonomous organization that is not subject to the political or bureaucratic constraints of any one educational, corporate, public or private partner; (xiv) building and extending upon innovative ideas, creative solutions and information on latest trends through strategic alliances with critical and political friends, corporations, public and private organizations within and beyond education; (xv) a focus on school-wide initiatives that permit buy-in as teachers feel able and willing to participate.

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References

Alberta Learning. (2000-2003). *Information and communication technology, kindergarten to grade 12: Program of studies*. Curriculum Standards Branch. [On-line]. Available: http://ednet.edc.gov.ab.ca/ict/

Clifford, P., & Friesen, S. (2001a). *Bringing Learning to Learners: The Galileo Educational Network*. Invited Presentation, and proceedings of ED-MEDIA 2001: World Conference on Educational Multimedia, Hypermedia and Telecommunications, Tampere, Finland.

Clifford, P., & Friesen, S. (2001b). "The Stewardship of the Intellect: Classroom Life, Educational Innovation and Technology". In Barrell, B. (Ed.). *Technology, Teaching and Learning: Issues in the Integration of Technology*, p. 29-42. Calgary, AB: Detselig Enterprises Ltd.

Clifford, P., & Friesen, S. (1998). Hard fun: Teaching and learning for the 21st century. *Focus on Learning II*, 1: 8 - 32.

Clifford, P. & Friesen, S. (1993). A curious plan: Managing on the twelfth. *Harvard Educational Review 63*, 3: 339-358.

Clifford, P., Friesen, S., and Jacobsen, D.M. (1998). *An expanded view of literacy: Hypermedia in the middle school*. Proceedings of ED-MEDIA and ED-TELECOM 98: World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications, Freiburg, Germany, June 20 - 25. [On-line]. Available: http://www.galileo.org/research/publications/literacy.html

Jacobsen, D. M., & Goldman, R. (2001). "The Hand-Made's Tail: A Novel Approach to Educational Technology". In Barrell, B. (Ed.). *Technology, Teaching and Learning: Issues in the Integration of Technology*, p. 83-112. Calgary, AB: Detselig Enterprises Ltd.

Jacobsen, D. M. (2001). *Building Different Bridges: Technology Integration, Engaged Student Learning, and New Approaches to Professional Development*. Paper presented at AERA 2001: The 82nd Annual Meeting of the American Educational Research Association, Seattle, WA: April 10 - 14.

Leithwood, K. A. (1992). The move toward transformational leadership. *Educational Leadership, 49* (5), 8-12.

Merriam, S. (1998). *Case study research in education: A qualitative approach*. San Francisco: Jossey-Bass Publishers.

North Central Regional Educational Laboratory. (1995). *New Times Demand New Ways Of Learning*. [Online]. Available: http://www.ncrel.org/sdrs/edtalk/newtimes.htm

North Central Regional Technology in Education Consortium's (2000) *Learning With Technology Profile Tool*. [Online]. Available: http://www.ncrtec.org/capacity/profile/profwww.htm

Stake, R. (1995). *The art of case study research*. Thousand Oaks, CA: SAGE.

Student Perspectives of Workload Pacing in International Online Graduate Education: A Case Study

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The Context: In 1997 the Distance Education and Technology unit of Continuing Studies at the University of British Columbia (UBC), Canada, in partnership with the Virtual University of the Monterrey Institute of Technology (ITESM), Mexico launched a five course post-graduate Certificate in Technology-based Distributed Learning (TBDL[1]). (For details on the partnership see Bates and Escamilla de los Santos, 1997). The first course in the certificate was offered in September of that year and by 2001 students participating came from over 27 countries with over 400 students taking the courses with UBC and more than 1500 students with our ITESM partners. The keystone to the design of each of the courses is collaborative online learning and constructivist interactivity.

This paper/presentation is a case study of one of these courses (Research and Evaluation Issues in TBDL). Using a quasi-Stake Responsive Model and participant-observation for data-gathering this paper will review the issues raised by the students, while the presentation will review the lessons learned and recommendations for future online collaboration and research.

Issues Raised by Students...Workload: In this course, one of the first issues raised by the students involved the concept of heavy workload. All of the learners were adult (ranging in age from early 20s to early 60s) with family, community and work responsibilities, in addition to their learning. Given the graduate-level nature of the course, a blend of reading, reflection, online posting/discussion and collaborative group work formed the basis for interaction and eventual assessment, if the learners were taking the course for credit (There were opportunities to take the course as an audit student).

As one student noted early on in the course: "…I've been wondering all weekend - as I write assignment 2 - how am I going to have the time to read all the postings that are going to arrive by Monday?…" [Student J, online posting, January 2001]

Another issue of concern surrounded the group assignments. Collaborative assignments required students to work together online through time zones, language barriers and different experiences. The group work culminated in a joint paper or project submission and students expressed concerns about: 1. the need to build trust within the group as each member was unknown to the other and 2. how to focus the group. As a student asked for help, she questioned "…Should I look for people with shared interests or who have different backgrounds to complement my lack of expertise in certain areas?" [Student C, online posting, January 2001]

The third issue of workload does appear, as well, to be more an issue of groups in general rather than specific to online group work. As one student noted, "[The] Last time I worked with a group, was on a project proposal. I ended up writing the whole thing because the other people let me down…." [Student M, online posting, January 2001]

Working with Different First Languages: While this course was taught in English and all course requirements were in English, the two partners, UBC and ITESM, found a great deal of interest on the part of the international community. As part of the strength of the course, many learners with English as their second or third language joined the international collaborative online group work. Students who were experienced in working online with ESL (English as a Second Language) colleagues, offered this advice: "When you have ESL issues you also need to allow time to sort out what the non-native speaker of English is trying to say, unless their English is very good (as was the case with one of the Mexican students). As the only native English speaker, I…volunteered to be the editor. However, I found that I often wasn't certain what they were trying to say due to the second language issues. When I edited, I needed time to check back…to make sure I hadn't changed…intended meaning, which turned out to be the case a few times…" [Student Q, online posting, January 2001]

"Getting your feet wet" vs. "lurking": One of the areas that instructional developers, online course designers, and instructors struggle with is how one might offer the learner the 'safest' way to enter the course and the learning. What we found over the five courses that make up the certificate, is that each student has his or her own way of coping and that often we cannot predict which, of the choices available to them, they might choose. The key is to offer options rather than one option. In this course, one student suggested, after finding the beginning introduction to the new concepts a bit overwhelming, that "…It might be worth creating a dynamic FAQ page in this course, which captures and presents these…[general and process] questions and responses…" [Student D, online posting, January 2001]

Another student acknowledged his suggestion but offered this rationale for letting these general and process questions and responses be encouraged early on in a course: "…I am just thinking out loud here so I could be way off base…Perhaps the confusion provided opportunities for people to "get their feet wet" by asking relatively safe information and clarification questions rather than jumping in with their own opinions. A way of hanging out in the "student union" developing the social context needed for dialogical teaching…" [Student N, online posting, January 2001]

This opinion, was followed up by another participant who noted that "…There's another point as well, though, which is that the learning styles of some (e.g. moi) contain less of the hanging out at the Student Union, discussing and arriving at a collective conclusion and more of the researching, cogitating and reflecting before we feel informed enough to venture an opinion. I think a rough parallel could be made between those who learn and retain knowledge through mainly oral means and those who need to see something written to absorb it." [Student Z, online posting, January 2001]

Conclusion: In many circumstances, pacing the workload is both physical and psychological for the instructor and the learner. It is important to address the reality of the online learning as well as its perception by the new online learner. It has been the experience of this online instructor that once comfortable many initial workload issues become more familiar and less stressful. The instructors and the learners shared a number of lessons. The accompanying presentation will review these lessons and identify areas that need to be addressed by those new and experienced in the field of online teaching and learning.

References

Bates, A.W. and Escamilla de los Santos, J.G. (1997). Crossing boundaries: Making global distance education a reality. Journal of Distance Education, (XII)1/2, p. 49-66.

Bullen, M. & Janes, D. (1998). Tutor and Student: Online Graduate Teaching and Learning in an International Context. In J. Baggaley, T., Anderson & M. Haughey (Eds.), Proceedings of the 14th Annual Conference of the Canadian Association for Distance Education (pp. 191-192). Athabasca, AB: Athabasca University.

Janes, D. (1999). Techniques and strategies for international group work: An online experience. Paper presented at 5th International NAWeb'99 Conference, Fredricton, N.B.

Janes, D. (2000). *International Collaborative Group Interaction: An Online Experience*. Chapter 20 in B. Mann (Ed.), Perspectives in Web Course Management. Canadian Scholars' Press.

Palloff, R. & Pratt, K. (1999). Building Learning Communities in Cyberspace. Jossey-Bass.

White, K. & Weight, B. (2000). The Online Teaching Guide. Allyn & Bacon.

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[1] Information can be found online at http://itesm.cstudies.ubc.ca/info

E-Games: Improvisation through Open Platform Design

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Abstract: A diverse range of instructional design and facilitation strategies are emerging as alternatives to content-focused courseware designed for self-paced independent learning. Improvisation through open platform design is one such emergence. My colleague, Dr Sivasailam Thiagarajan and I have been using improvisation as a fast, cheap and effective strategy to adapt, re-use and continually improve over 20 instructional templates we call email learning games. Improvisation allows us to play with the rules, not by the rules.

Introduction

Since 1998, my colleague Dr Sivasailam Thiagarajan and I have designed and facilitated email learning games with over 2,500 people worldwide (Jasinski, M & Thiagarajan, S, 2000a, Jasinski, M. & Thiagarajan, S, 2000b). An email learning game is a reusable text-based template. It provides a pre-structured process for guiding a group of participants through a series of tasks. These tasks are designed to progressively generate and process content around a salient issue. A game is played in several rounds and through a facilitated process, participants engage in activities like brainstorming, analyzing, evaluating, synthesizing, predicting and persuading each other. While individual games have a specific purpose and outcome, they all encourage the construction and sharing of new knowledge, understanding, perspectives, and insights.

Open platform design and the emergence of improvisation

Our work with email learning games has been accelerated by our practice of open platform design, where we provide a growing community of colleagues with access to our templates to use, improve, customize and return. We have found open platform design to be powerful in rapidly improving design and facilitation processes for these games and for confirming their usability in a range of contexts. Through this iterative and dynamic process, what has also emerged is the concept and practice of improvisation as an instructional design framework. Improvisation is a mix of ad-hockery and know-how.

> *Improvisation involves reworking precomposed material and designs in relation to unanticipated ideas conceived, shaped and transformed under the special conditions of performance, thereby adding unique features to every creation (Berliner, 1994 p.241).*

Like improvisation in jazz, instructional design using improvisation is a disciplined craft that works creatively within a planning framework, yet can take advantage of the unexpected. In short:

> *Improvisation does not involve the complete discarding of planning, but a change in how planning is done and in how the plan is viewed (Isenberg, 1987, p. 92).*

Improvisation as an instructional design concept exploits and works with contradictions and paradox: stable and unstable, structured and flexible, predictable and spontaneous, planned and random, content and process.

Improvisation: dimensions of complexity

Weick (1998) offers a particularly useful insight that is both conceptually and practically relevant to the context of improvisation as an instruction design framework. As well as an all-or-nothing process, Weick suggests improvisation can also be incremental with varying dimensions or levels of complexity. This staged approach requires*...increased demand on imagination and concentration* (p. 544).

These stages range from interpretation (taking minor liberties with the original), embellishment (reworking parts of the original without changing it drastically) variation (new aspects are inserted but align with the original) to improvisation (transforming the original to create a drastically different version).

This supports the experience we have had with coaching practitioners to adopt and adapt our email learning games. The emphasis on experiencing, experimenting and incremental development, lends itself to work-based methodologies that support 'designing-by-doing'.

Design jamming: playing with the rules not by the rules

The construction of email learning game templates and their subsequent facilitation, involves what we call 'design jamming', a concept adopted from jazz improvisation and applied to the instructional design context. Based on improvisation, design jamming is a dynamic and iterative co-design process of constructing, performing and adjusting instructional designs as a result of close contact with the learning audience and a community of colleagues. The essence of design jamming is to play with the rules, not by the rules.

Conclusion

Improvisation provides an alternative instructional design strategy for the fast changing environment of the online world for the following reasons:

- Small and incremental changes can be effected quickly, allowing fast responses to user requirements.
- Improvisation provides high levels of feedback and closer contact between teacher and learner.
- Design jamming involves co-designing with a learning audience and a community of colleagues allowing for rapid improvement of both design and facilitation processes.

Improvisation through open platform design is a complex game simply played. The key to improvisation is to play with the rules, not by the rules – or to create new ones.

References

Berliner, P. (1994). *Thinking in Jazz: The Infinite Art of Improvisation*. Chicago IL: University of Chicago.

Isenberg, D.J. (1987). The tactics of strategic opportunism. *Harvard Business Review*, 65 (March-April) 92-97.

Jasinski, M. & Thiagarajan, S. (2000a). Virtual Games for Real Learning: learning online with serious fun. *Educational Technology*, 40 (4), 61-63.

Jasinski, M & Thiagarajan, S. (2000b). Email Games. in R. Sims, M. O'Reilly & S. Sawkins (Eds.), *Learning to Choose: Choosing to Learn*. Proceedings of the 17th Annual ASCILITE Conference, Lismore. NSW: Southern Cross University Press.

Weick, K. (1998) Improvisation as a Mindset for Organizational Analysis. *Organization Science*, Vol 9, No 5, September-October.

Navigating the Information Space of a PC Computer-Based Aviation Flight Training Device: an Expert Evaluation of Information Search and Retrieval

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The Department of Transportation's Federal Aviation Administration (FAA) administers aviation flight training and pilot certification within the United States. Beginning in 1997, the FAA began permitting the use of PC-based Aviation Training Devices (called PCATD's) for flight training. Research has provided information evaluating PCATD interface design and usability, the transfer of learning associated with various PCATD related training procedures, and pilots' attitudes concerning the PCATD concept. Most of the current research that has been applied to the PCATD system has focused on assessing simulation fidelities and their influence upon training effectiveness.

However, recent concern has focused on problems associated with a "multidimensional information space," since a PCATD system is analogous to the computer based interface or "glass cockpit." PC-based flight displays have introduced a new concern regarding human factors identified as "navigating through an information space." These systems must balance the considerations of determining what information should be provided with properly designed features that enable successful operational control by the user.

The particular PCATD used in this study, a commercially available Jeppesen Model FS-200AC, operates in essentially two modes: (1) a full-screen "glass simulator" mode, showing a view from the pilot's seat of the full aircraft instrument panel, including a modest amount of ground features such as runways, and a "map-screen" mode, essentially showing representations of aviation charts. Thus, three-dimensional information is simulated within a two dimensional electronic environment.

The goal of this study was to identify factors affecting the user's ability to navigate and find information identified as necessary for the enhancement of situational awareness while using the PCATD's map-screen. Five expert flight and ground instructors evaluated PCATD system. These experts were given a basic orientation to the PCATD hardware and software; specifically, they were shown how to "toggle" back-and-forth between the two main modes of presentation. They were then asked to fly a series of "precision instrument approaches" to various runways contained in the database. Expert evaluators were not given specific information about either the precision instrument approaches (e.g., altitudes, headings, radio frequencies, etc.) or related data contained within various presentations in the map-screens. Thus, they needed to successfully formulate and execute searches using the map-screen for precise information needed to successfully complete each task.

Although the relatively small number of expert evaluators to this study precluded the usage of inferential or parametric statistical analysis, the experts were able to describe relevant issues of situational awareness, information searching, and knowledge are generally qualitative in nature by the use of open-ended questioning.

Overall, the experts reported that it was moderately difficult to locate and identify tools inherent to the map-screen that would help in formulating, searching, and retrieving information. Considerable exploration of icons, menus, and menu commands was needed to find pertinent information. The experts suggested the need for "finding aids," such as intermediary help menus or screens. The "zoom control" was particularly problematic, since it frequently contributed to the loss of situational awareness of the instrument approach being flown. The experts generally thought a "pop-up" quick-search function, ideally one that would allow for the use of a specific search term, would be the most helpful.

The Realization of Interaction in Cognitive Science Network Studies

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Abstract. This article deals with the research of the realization interaction in the Finnish Virtual University's network-based studies of cognitive science in the autumn 2001. In this research, we examine the independent study of cognitive science which occurs through a network and the face-to-face study that takes place in cooperation in a group and the study that occurs in WebCT groups. The research seeks answers to the kind of interaction that promotes network-based studies and what causes a lack of interaction. The data has been collected by questionnaires and observation. The results indicated that students considered interaction with the teacher and other students more binding than self-directed study. The expectations and biases of students did not always correspond to the objectives of studies and thus have prevented functional interaction in a network.

1. Introduction

The objective of the study is to examine the realization of interaction in cognitive science network studies in the Finnish Virtual University. Good interaction with both the teacher and other students motivates and binds students to a greater degree of study (Richardson 2001). Interaction occurring through a network with the teacher and with other students is important from the perspective of learning, even if it is seen as far more laborious than studying face-to-face (Heikkinen 2000).

Interaction in a network is created by the relationship of interaction between a student, a teacher, technology, and the others who are part of the process (Ruokamo & Pohjolainen 1999). In network studies, interaction between the teacher and the student is limited, neither does it always occur in real time, and thus it presents its own challenge to successful study (Paakkola 1992).

Cognitive science can be studied in a self-directed manner, under the direction of the teacher, or with other students using a WebCT as well as on the Internet through contact teaching by studying in groups [http://www.virtuaaliyliopisto.fi/osahankkeet/connet/webct.htm].

In studying cognitive science, we utilize problem-based learning and exercises are performed face-to-face as group work (Hakkarainen, Lonka & Lipponen 1999). In the study, we examine the realization of interaction in network studies, self-directed study, as well as the adaptability of group work face-to-face exercises as part of network-based studies, and the types of problems that arise in interactive study through a network, and what the lack of interaction causes.

2. Background

The Finnish Virtual University Project [http://www.virtuaaliyliopisto.fi/English/index.php] has been established based on the information strategy of the Ministry of Education (for the years 2000-2004). Its concept is a joint virtual university in Finland consisting of several institutions for advanced learning, businesses, and research institutions that provides internationally high quality competitive training services. (Ministry of Education 1999).

The study of cognitive science in a network, in other words the Connet Project, has been planned since 1999 [http://www.virtuaaliyliopisto.fi/osahankkeet/connet/]. The project includes students from eight different universities: Helsinki, Tampere, Turku, Joensuu, Oulu, Lapland, Jyväskylä, and the Helsinki University of

Technology. The Connet Project was coordinated by the University of Helsinki during the autumn semester 2001; with respect to the University of Lapland, it was coordinated by the Centre for Media Pedagogy (Ruokamo, Syrjäkari & Karppinen 2002). Basic studies in cognitive science began at all the universities participating in the project in the autumn 2001. Seventy-eight students had registered for the common e-mail list. Following their basic studies, the students will have the opportunity to conduct their cognitive science studies as network studies. Each university is responsible for a defined credit unit and studies will consist of modules chosen by the student.

Teaching consists of study periods in cognitive science, data processing, psychology, labour science, pedagogy, media education, cognitive technology, and the philosophy of technology. Teaching methods use the possibilities brought about by new technology that utilizes problem-based project-oriented method.

In network studies, learning is a process and a social event that needs for its support feedback and support from teachers as well as interactive study with the other students (Richardson 2001). Network students are generally highly motivated, even if the lack of social communication, interaction, and unclear expectations affect studying (Bonk 2001).

Interaction skills are important cooperative skills, but group-centred skills are broader in nature. The cooperative skills of an individual come into play only when in a community where the social activity that rewards them is organized. It is perceived that in learning, there are still too many individually centred learning models that prevent interaction and forms of communal activity. The individual needs an encouraging and socially respected operating environment. (Kuusinen 2001.)

3. The Objective and Research Questions of the Study

The study examines the realization of interaction in cognitive science network studies. Network interaction is created from different interactive contexts. The forms of interaction are the interaction between students, teacher and student, student and technology, and between the actors (Ruokamo & Pohjolainen 1999). The study examines the type of interaction that promotes network learning in the study of cognitive science and what causes the lack of interaction. A focus for examination is also self-directed study, inter-student interaction in WebCT, and the face-to-face study that takes place in groups with other course members. This study seeks answers to how self-directed study is located within the context of interaction. In multiform teaching, there is a reduction in teacher leadership; different forms of interaction, the purpose of which would be to support study, replace interaction between student and teacher (Paakkola 1992). Moreover, the study examines whether face-to-face group study best supports a student's motivation and learning in network studies, and whether it binds the student more firmly to his or her studies.

The culture of interaction in a network environment is a broad area and thus it places its own challenges on the work of research and its analysis. Research into network studies has increased in recent times, but most of the research has focused on analysing information produced for the network and the nature of student participation. The nature of a network-based social information structure and the characteristics of its interaction process have still to be studied whereas, in addition to the network environment, the entire interaction context with its discussions must receive attention. Learning is perceived as a communal process and interaction and, from the perspective of learning, it is created outside of the network environment. (Salo, Hurme & Järvelä 2001.)

4. Research Method

The study is limited to the study periods realized during basic studies in cognitive science in the autumn semester of 2001. The interaction in a network linked to study is a multi-actor phenomenon. The phenomenon consists of students, teachers, the network tools of the learning environment, and other essential actors (Ruokamo & Pohjolainen 1999). In order to gain relevant information and new perspectives, interaction should be examined both quantitatively and qualitatively.

The data was collected by questionnaires and observation. The first questionnaire was performed using an Internet form and through e-mail before the actual course began. The questionnaire was sent to the 78 students that had registered for the common cognitive science students' e-mail list. The questionnaire measured the students' biases, expectations, and thoughts on the realization of interaction in the study of cognitive science.

A second questionnaire was performed at the end of the autumn semester courses. It was sent to the 78 students and to 43 students that had performed their practice work. The second questionnaire focussed on the realization of interaction in the network-based study of cognitive science and the use of WebCT tools. In addition, the same questionnaire included questions directed at the students on the *Project Working and Creative Planning* and *Communication and Cognition* courses. The students on the *Project Working and Creative Planning* course studied in groups using the WebCT and the students on the *Communication and Cognition* course studied in face-to-face groups.

The perspective of teachers on interaction has been studied in a questionnaire directed at those teachers who gave their permission for the form to be sent. The aim has been to resolve how they think they have succeeded in creating interaction with the students, how group work has been articulated for network-based studies, and how they have experienced teaching through a network.

The project researcher has participated in cognitive science planning meetings as a participatory observer since the spring of 2001 and she has collected data using the teachers' and assistants' common e-mail list. Moreover, the researcher has participated as a student-observer for the video lectures on the *Communication and Cognition* course.

The Likert scale theorems of the questionnaires have been processed by quantitative methods using the SPSS statistics application. The participatory observations of the researcher as well as the data collected using open questionnaires has been analysed using qualitative methods.

5. Results and Conclusions of the Study

Eleven students (15.4 %) returned the first questionnaire and 16 students (13.2 %) returned the second questionnaire. The students encountered technical problems in returning both the Internet-based questionnaire and the one sent by e-mail in Word format. Twenty-seven forms were used in the study. There were more returned, but these were either empty or insufficiently completed or the student had not completed his or her network-based studies into cognitive science even though his or her name appeared on the e-mail list.

When examining self-directed study in a network in relation to other network interaction, students saw interaction with teachers and other students as more binding that self-directed study. Network interaction was seen as more binding in relation to time and place than self-directed study was. Part of the courses had to be completed as video lectures and study diaries. The defined times of video lectures and their related study diaries to a degree prevented graduate students and those students at work from completing the courses in question. Network-based study is generally seen as study independent of time and place and it is also marketed as such. In this relation, the pre-expectations of the students for study independent of time and place were not realized.

In the pre-expectations of the students before courses began, it was apparent that teachers did not have a clear picture of the possibilities provided by network-based teaching. The students in different localities considered important the help and guidance of a local guide and responsible person, the possibility to discuss courses, as well as the opportunity for technical support. Interaction with the teacher, especially in the initial phase of the courses, acts as a motivating factor for a course.

The interaction between the students in the study has been examined in the face-to-face group work on the *Communication and Cognition* course and in the WebCT group work on the *Project Working and Creative Planning* course. Face-to-face group work was conceived as being part of network-based studies. It was seen to make handling matters easier and students thus gained extra motivation for other network-based study. Typical problems related to the performance of group work, such as the heterogeneity of the group and the uneven distribution of responsibility, were seen in the face-to-face group work. The groups included students from different localities, so dstances and timetables prevented and slowed study. The students did not consider slowing or preventing studies as the intention of network-based studies.

Based on the open questions in the qualitative examination of face-to-face practice, contact teaching arose as the best form of guidance, next was video-conferencing and in addition to these, e-mail. The students thought all forms of teaching supported one another, when they were well organized.

In the students' (N=11) pre-expectations, it was apparent that almost half the students (45.5 %) to a degree believed that WebCT supported interaction between a student and other students. Almost one-third of the students (27.3 %) did not have the same or a different opinion; less than one-fifth (18.2 %) was somewhat of a different opinion and only one student was of a different opinion. Over one-third of the students had pre-expectations that WebCT would to a degree support the interaction between the student and teacher. Only one student has the same opinion. Less than one-fifth (18.2 %) of the students did not have the same or a different opinion, similarly were to a degree of a different opinion and the same number were of a different opinion (18.2 %).

The group on the *Project Working and Creative Planning* course was formed though WebCT *discussions* field. More real-time discussion would have been needed at the beginning of studies and there would have been a need for functional group working. There was limited experimenting with WebCT in group work, and it was not found to support the group's joint writing process.

The students (N=16) evaluated the best interactive situations on a scale of 4–10. The best interactive situations among the students were created: 1. in practice work (mean = 9), 2. with e-mail (mean = 83), 3. in contact teaching (mean = 8.2) and 4. in WebCT *discussions* (mean = 7.6). Other interactive situations were realized using WebCT communication and group tools, the mean of which varied between 5.8–6.5.

The students (N=16) chose the best interactive tools on a scale of 4–10. The best interactive tools were: 1. some e-mail other than WebCT (mean = 8.5), 2. video-conferencing (mean = 7.8), 3. contact teaching (mean = 7.6), 4. in WebCT *discussions* (mean = 7), 5. WebCT e-mail (mean = 6.6), 6. the WebCT notice board (mean = 6.3), 7. telephone discussions (mean = 6), and 8. WebCT real-time discussion (mean = 5.7).

The fluent and versatile use of a learning environment appears to increase the entire interaction with the student, teacher, and other students. Those coming on a network-based course for the first time need guidance and instructions on the use of the learning environment and its tools. The use of WebCT in the study of cognitive science could include credits during the orientation phase to studies. In other respects, the biases of the students to computers, the use of e-mail and information searches were good in relation to their own skills.

The interaction between actors was observed using the common e-mail list. E-mail functions as a common information channel between teachers, designers, and assistants. A common e-mail list provides support for the actors to agree on plans, timetable, and meetings.

The objectives of teaching and the expectations of students do not always correspond to each other. A factor affecting interaction is the cultural background to the organization arranging teaching. The results of the research support the importance of guiding teachers and other students in network-based studies. Face-to-face study should be a part of network-based studies. However, self-directed study in a network should be respected and various opportunities should be provided on courses for interactive contexts.

The research has examined interaction from various interaction contexts as well as noted self-directed study and how it is located within the context of interaction. The research has become extensive and it has provided a lot of information and additional material for those organizations arranging teaching and for all those interested in interaction in network-based study and teaching. The information and additional material from the research can benefit educational purposes, the development of learning environments, and follow-up research both in Finland and internationally.

This study examined different face-to-face group work and the group work that takes place in a learning environment. The researcher's personal interest has grown in studying face-to-face group work and the integration of group work into a network-based learning environment and thus into the appearance of the observed problems as well as into the development of the fluent and versatile opportunities for network-based group work.

References

Bonk, C. 2001. Teaching on the Web II: With a Little More Help from my Pedagogical Friends. Indiana University. http://php.indiana.edu/~cjbonk. Tutorials & Workshops, ED-MEDIA 2001 Conference, June 25-30, Tampere, Finland.

The Connet Project, the Finnish Virtual University. Also available on the Internet at <URL: http://www.virtuaaliyliopisto.fi/osahankkeet/connet/> (accessed 12.4.2002).

Hakkarainen, K., Lonka, K. & Lipponen, L. 1999. Tutkiva oppiminen. Älykkään toiminnan rajat ja niiden ylittäminen. Porvoo: Wsoy.

Heikkinen, N. 2000. Kasvokkain ja etänä – vuorovaikutus monimuotolukion oppimisympäristössä. Oulun yliopisto. Kasvatustieteiden tiedekunta. Pro gradu –tutkielma.

Kuusinen, R. 2001 Ongelmana yhteistyökyvyttömyys? Teoreettisen ymmärryksen etsintää web-avusteiselle tiedontuottamisyhteisölle. Helsingin yliopiston kasvatuspsykologian tutkimusyksikkö. Tutkimuksia2/2001. Yliopistopaino. Electronic thesis. Also available on the Internet at <URL: http:www.ethesis.helsinki.fi> (accessed 12.4. 2002).

Ministry of Education 1999. Information Strategy for Education and Research 2000-2004. Implementation Plan. <URL: http://www.minedu.fi/minedu/education/inform_strategy_implementation_plan.pdf> (accessed 12.4. 2002).

Paakkola, E. 1992. Johdatus monimuoto-opetukseen. Helsinki: Valtion painatuskeskus.

Richardson, J. 2001. The Role of Social Presence in Online Courses: How does it relate to students' perceived learning and satisfaction? In C. Montgomerie & J. Viteli (eds.) Proceedings of ED-MEDIA 2001 Conference, June 25–30, Tampere, Finland, 94.

Ruokamo, H. & Pohjolainen, S. (eds.) 1999. Etäopetus multimediaverkoissa – Kansallisen multimediaohjelman ETÄKAMU-hanke, Digitaalisen median raportti 1/1999. Teknologian kehittämiskeskus TEKES, Helsinki. Also available on the Internet at <URL: http://matwww.ee.tut.fi/kamu/loppuraportti> (accessed 12.4. 2002).

Ruokamo, H., Syrjäkari, M. & Karppinen, P. (to appear) The University of Lapland Faces the Challenges of the Virtual University. Paper to be presented and published in ED-MEDIA2002 Conference, June 24–29, 2002 Denver, Colorado USA.

Salo, P., Hurme, T., & Järvelä, S. 2001. Sosiaalinen tiedonrakentaminen verkko-oppimisessa – miten tutkia ja analysoida sitä? Kasvatus 4/2001, 334–344.

The Finnish Virtual University Project available on the Internet at <URL: http://www.virtuaaliyliopisto.fi/english/index.php> (accessed 12.4.2002).

WebCT <URL: http://www.virtuaaliyliopisto.fi/osahankkeet/connet/webct.htm> (accessed 23.4.2002)

Sequence Learning with Intelligent 3-D Practice Environments

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Abstract: This paper describes our experiences with sequence learning activities for intelligent 3-D practice environments. An intelligent practice environment offers learning by doing and learning by discovery in a realistic practice situation. A Knowledge-Based-System (KBS) improves learning opportunities with dynamic advice and feedback. An expert system monitors user interactions to provide dynamic advice for the expected sequence of user activities and updates objects in the 3-D world for the current state in the sequence. A prototype implementation is described for intelligent 3-dimensional (3-D) practice environments developed using a web browser, the Virtual Reality Modeling Language (VRML), JAVA, and an expert system. The VRML enabled web browser provides an interactive 3-D world where the user can learn and practice sequential tasks.

Overview

This paper focuses on our experiences integrating 3-D practice environments with a sequence learning strategy managed by an expert system. Sequences are a foundation for learning complex skills and high-level problem solving. An example sequence learning approach was developed to illustrate the capabilities of intelligent 3-D practice environments for mechanical skills training. This is an on-going research activity whose long-term success is largely determined by the maturity of the technology needed to implement the intelligent 3-D practice environments. The ability to implement a few working prototypes has been proven by integrating the technologies described in this paper. Our goals are:

- Understand the capabilities required to ensure users can learn by doing and discovery
- Identify and investigate useful learning strategies, such as sequence learning, that take advantage of the exploratory learning process offered by practice environments
- Develop a basic framework or architecture that supports re-using basic components
- Devise ways to separate practice session content from the basic re-usable framework.

Cost is always an issue and affordability is a major objective. Finding ways to make practice environments an affordable solution is a critical success factor for adoption of the technology. There are two major cost considerations for this web technology, first we must be able to afford to develop the practice environments and second we must be able to afford to deploy the content to the users. One way of reducing development cost is to develop modular components that can be reused. There is a high reuse potential for the components we have developed. The expert system with its JAVA applet and VRML interface applet are reusable. The rule base for processing sequence learning procedural steps and goals is reusable. The sequence learning fact structure is reusable. The specific facts for the procedures and the VRML worlds are content specific and have to be developed as lesson content. Techniques for deploying content to the user will evolve as the technologies mature.

Sequence Learning Strategies

The objective of intelligent 3-D practice environments is to provide a highly interactive, realistic learning experience where the user learns by doing and by discovery. Sequence learning is an important component of learning complex skills and advanced problem-solving skills. Sequence learning strategies can provide practice and discovery activities for the user. To develop advanced skills, the user needs to practice solving a wide range of problems and handling different situations. A highly interactive practice environment encourages the user to explore complex relationships and increases the development of advanced skills through self-motivated discovery and problem solving activities. Sequence learning features of a practice environment are:

1. Monitoring and controlling the situation in the 3-D world
2. Recognizing goals accomplished by the user
3. Using facts and rules to recognize correct sequences of actions by the user
4. Offering advice and feedback for correct and incorrect sequences of user actions
5. Generating actions for the objects in the 3-D world based on the current sequence location
6. Dynamically controlling the behavior of objects in the 3-D world based on user actions.

Practice Environment Development Process

There are two main phases in our current prototype development process. First, the technology must be developed and integrated to create the desired capabilities of the practice environment. Our research activities have shown that it is critical for the technology to be sufficiently mature and robust to support the implementation of the desired practice environment capabilities and learning strategies. Second, after a practice environment has been developed and tested, learning content must be developed for the practice sessions.

Developing an intelligent 3-D practice environment requires software developers, instructional designers, 3-D graphics experts, subject matter experts, and rule base programmers. The initial development of an intelligent practice environment requires a technical team that can implement the practice environment with the desired learning strategies. A robust practice environment can be developed with re-usable software components, expert system rule bases, and expert system fact bases. Once a re-usable practice environment has been developed, the focus shifts to learning content development.

Learning content development for an intelligent 3-D practice environment involves three critical activities in addition to the traditional subject matter expertise required for creating a good learning session. For a sequence learning practice session, the subject matter expert first decomposes the tasks into interactive actions and sequences of actions that can be performed by the user. The behavior of objects in the practice environment is identified for each user action and accumulated sequence of user actions. Second, 3-D worlds must be created and populated with 3-D objects that support the required user interactions, controls, and object behaviors. Based on the desired practice and exploratory activities, sensors must be added to the 3-D objects to control their behavior and trigger actions, to manage user-controlled movement and placement of objects, to monitor user interactions with the objects, to monitor the user's position, and to control the state of objects. Third, knowledge engineering is required to define the facts and develop the rules necessary to support the learning and practice activities performed by the user in the 3-D world.

Example Prototype Architecture

Technology and especially the maturity of current technologies are critical to the development of intelligent 3-D practice environments. For the intelligent 3-D practice environment illustrated in this paper, we used the VRML External Authoring Interface (EAI) to integrate the Jess expert system with VRML practice environments. Jess (Copyright 1998 E. J. Friedman-Hill and the Sandia Corporation) [Friedman-Hill 1998] is an expert system shell written in JAVA. The source code for Jess is available for integration with a practice environment. Jess is also distributed with sample applets and console applications. We modified the Jess expert system interface to include buttons for feedback and advice. Figure 1 shows the configuration of existing products and developed software integrated to create an intelligent 3-D practice environment.

A simple knowledge base manages the sequence of practice activities, feedback, and advice for the practice environment. A set of facts defines the practice activities, the sequence of activities, advice for each activity the user can accomplish at the current time, and feedback when an activity is successfully accomplished. The knowledge base contains a set of rules that manage the user's practice activities and the behavior of objects in the practice environment by determining which activities are valid at the current point in time and updating the 3-D world based on the current situation. Table 1 provides information about each of the interfaces in the implementation.

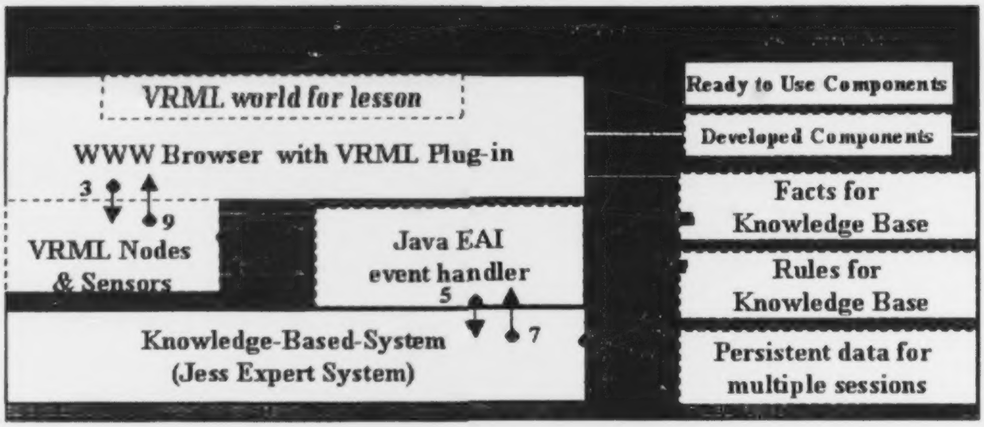
VRML world for lesson
WWW Browser with VRML Plug-in
3
9
VRML Nodes & Sensors
Java EAI event handler
5
7
Knowledge-Based-System (Jess Expert System)
Ready to Use Components
Developed Components
Facts for Knowledge Base
Rules for Knowledge Base
Persistent data for multiple sessions

Figure 1: Prototype Implementation of an Intelligent 3-D Practice Environment

Interface Number	Interface Origin	Interface Destination	Purpose of Interface
1	Rule Base Fact Base	Expert System	Load learning strategy rules and initial set of facts into the expert system knowledge base.
2	Persistent Data Store	Expert System	Load current data for facts and other state information stored from last session
3	3-D scene User interactions	3-D Nodes and Sensors	Access information about user interactions in the practice environment
4	3-D Nodes and Sensors	Java EAI event handler	Pass user interaction information and other state information to the Java EAI event handler for analysis
5	Java EAI event handler	Expert System	Update knowledge base and assert new facts based on user interactions and state of the 3-D objects
6	Expert System	Persistent Data Store	Store facts and state information to be available in another session.
7	Expert System	Java EAI event handler	Update state data, feedback, and advice in the practice environment
8	Java EAI event handler	3-D Nodes and Sensors	Pass updated data from the expert system and Java EAI event handler to the practice environment
9	3-D Nodes and Sensors	3-D Scene	Update the scene with expert system and Java EAI event handler data.

Table 1: Interfaces in the Intelligent Practice Environment

Mechanical Skills Example

An example is the best way to illustrate the intelligent 3-D practice environment concepts. This example was developed to teach maintenance technicians how perform shaft alignment tasks. Figure 2 shows a horizontal parallel misalignment correction practice environment. The expert system advice and feedback is displayed at the top of the screen. The user receives feedback from his actions in the expert system display. The expert system determines which activities the user can perform at the current time in the 3-D scene. State information from the expert system is used to activate sensors, animations, and user selections in the 3-D scene. The expert system display has two buttons that give the user access to advice and feedback at any time. The user requests advice with the advice button. The user automatically receives feedback when he accomplishes one of the active tasks. The effectiveness of the advice and feedback is dependent on the quality of the knowledge captured in the knowledge base.

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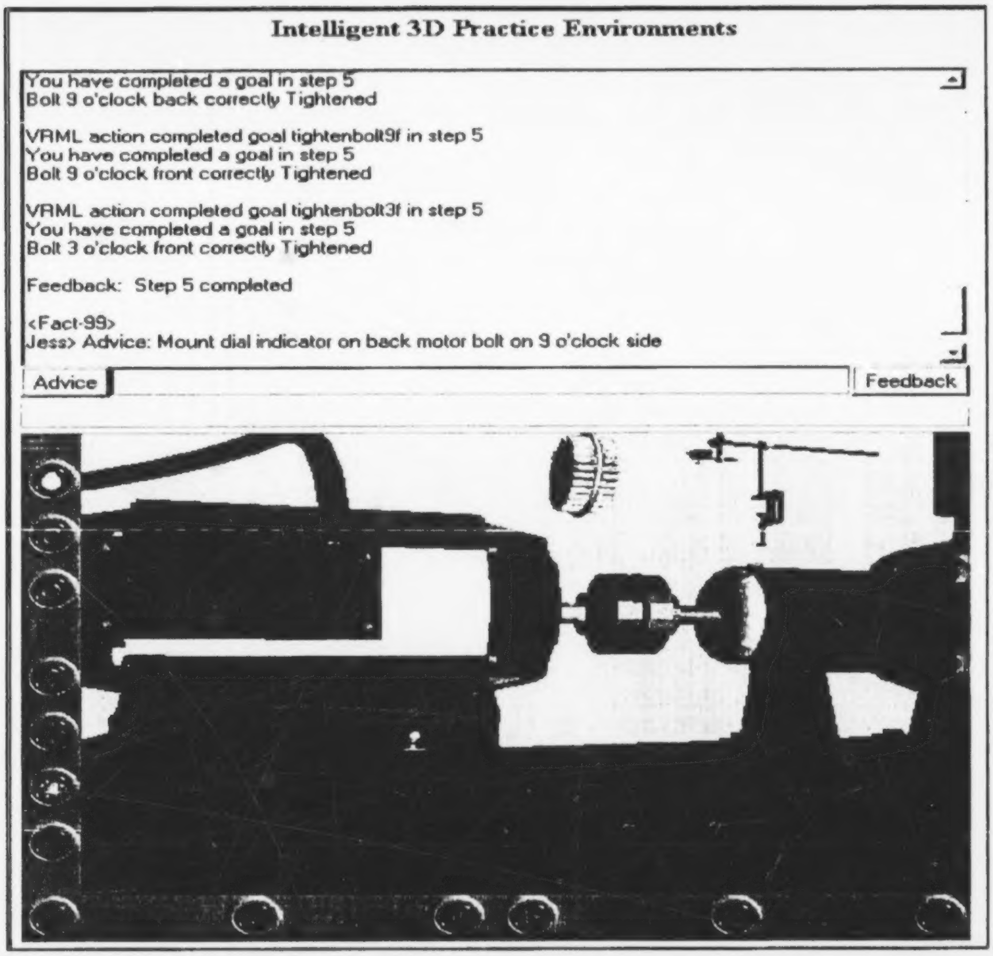

```
You have completed a goal in step 5
Bolt 9 o'clock back correctly Tightened

VRML action completed goal tightenbolt9f in step 5
You have completed a goal in step 5
Bolt 9 o'clock front correctly Tightened

VRML action completed goal tightenbolt3f in step 5
You have completed a goal in step 5
Bolt 3 o'clock front correctly Tightened

Feedback: Step 5 completed

<Fact-99>
Jess> Advice: Mount dial indicator on back motor bolt on 9 o'clock side
```

Figure 2: Horizontal Parallel Correction Practice Session

The practice session in Figure 2 illustrates problem solving for a set of sequential activities that the user will accomplish in the 3-D practice environment. An example of the fact data for this sequence learning problem is shown in Table 2. The initial fact data is loaded into the knowledge base when the practice environment is started and the facts are updated as the user works in the practice environment. The data in Table 2 reflects the current fact set for the situation shown in Figure 2 where the user has completed steps 1 through 5 and is ready to perform step 6 in the sequence.

The rules in the rule base interact with the 3-D practice environment to activate objects that the user must work with to accomplish goals in the procedure. These objects include the dial indicator, the reset or zero knob on the dial indicator, the motor, and the motor mounting bolts. For step 6, the only active component in the 3-D practice environment is the dial indicator that needs to be mounted on the 9:00 side of the motor near the back mounting bolt. There were 3 active components in step 5 where the user was required to tighten 3 bolts in an undefined order.

The current rules implemented in the sequence learning rule base have the following behavior:

1. All goals for the current step are activated and can be accomplished by the user.

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2. All goals in a step must be accomplished before activating the goals in the next step.
3. The user can accomplish the active goals in the current step in any order.
4. When requesting advice, advice for any of the active goals can be given to the user.
5. Feedback is automatically given to the user whenever the user accomplishes a goal or a step
6. The user can request feedback identifying their current situation at any time.

Step	Goal	Next Step	Advice for next action in sequence	Feedback for correct action in sequence	Active	Completed
1	Mount dial indicator	2	Mount dial indicator near front motor bolt on 9 o'clock side	Dial indicator correctly mounted on front motor bolt on 9 o'clock side	No	Yes
2	Zero dial indicator	3	Zero the dial indicator on front motor bolt on 9 o'clock side	Dial indicator correctly zeroed on front motor bolt on 9 o'clock side	No	Yes
3	Loosen bolt 3f	4	Loosen 3 o'clock front mounting bolt	Bolt 3 o'clock front correctly loosened	No	Yes
3	Loosen bolt 9f	4	Loosen 9 o'clock front mounting bolt	Bolt 9 o'clock front correctly loosened	No	Yes
3	Loosen bolt 9b	4	Loosen 9 o'clock back mounting bolt	Bolt 9 o'clock back correctly loosened	No	Yes
4	Move Motor	5	Push front of motor on 9 o'clock side	Motor 9 o'clock front correctly pushed	No	Yes
5	Tighten bolt 3f	6	Tighten 3 o'clock front mounting bolt	Bolt 3 o'clock front correctly Tightened	No	Yes
5	Tighten bolt 9f	6	Tighten 9 o'clock front mounting bolt	Bolt 9 o'clock front correctly Tightened	No	Yes
5	Tighten bolt 9b	6	Tighten 9 o'clock back mounting bolt	Bolt 9 o'clock back correctly Tightened	No	Yes
6	Mount dial indicator	7	Mount dial indicator on front motor bolt on 9 o'clock side	Dial indicator correctly mounted on front motor bolt on 9 o'clock side	Yes	No
7	Zero dal indicator	8	Zero the dial indicator on front motor bolt on 9 o'clock side	Dial indicator correctly zeroed on front motor bolt on 9 o'clock side	No	No

Table 2: Facts for a Sequential Activity

Related Research

There are several research areas that should continue to have a positive impact on our ability to add intelligence to 3D practice environments to make them more effective training tools. 3D worlds offer a rich environment for visualization and expression of ideas. Researchers have already begun to populate and inhabit 3D worlds so they can gain knowledge about the unique challenges and potential of 3D learning environments. The interaction between man and machine is often viewed as a dialog. An effective practice environment needs to be able to participate in a meaningful dialog with the user(s) in a problem solving session. Two important areas of research aimed at improving the ability for man and machine to communicate are mixed-initiative interactions [Hearst 1999] and intelligent dialog systems [McRoy, Ali, Restificar, and Songsak 1999]. Researchers in these areas are developing new techniques to improve communications between man and machine through more meaningful and flexible interaction strategies. Collaboration among real and simulated users in multi-user worlds is another hot research area. Pedagogical agents [Lester, Towns, and FitzGerald 1999] are being created to act as teachers and tutors in future 3-D learning environments. Other researchers are simulating the actions of peers for team problem solving activities. Dynamic, real-time explanations [Callaway, Daniel, and Lester 1999] should increase learning effectiveness for future generations of practice environments.

Summary

This project is an on-going research activity. We have not conducted any large-scale user evaluations or trials. However, we are able to provide the following assessment of the current state of the technologies used for our experiments. The mechanical skills training example demonstrates the integration of existing technologies with a minimum amount of software development. With the objective of making 3-D practice environments an affordable training solution, reuse was a prime consideration in the design of the implementation.

1. The Java applet encapsulating the Jess expert system is reusable and is not training content dependent.
2. The Java EAI event handler applet is reusable. A table linking the Jess fact base with the VRML nodes and sensors in the practice environment is content specific and must be created for each practice session.
3. The rules developed for the sequential activity knowledge base are totally reusable. These rules provide the logic for managing the user activities and VRML objects for a sequential procedure practice environment. The rules also provide the logic needed to determine the advice and feedback requested by the user with the Jess applet interface buttons.
4. The fact structure for the knowledge base is reusable for other sequential procedure practice environments. The facts are content specific and must be created for each practice session.
5. Reusing 3-D Computer Aided Design (CAD) objects adds realism to the practice environments. Reuse is never easy. The original CAD model designer's objectives are very different than those of a training practice environment designer. Inevitably, the objects must be edited. A good approach is to create a hierarchical scene with each object of interest in a separate VRML file. The 3-D scene is created as a composite of all of the individual VRML objects. The user's interactions are easier to monitor and analyze with a hierarchical scene composition

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References

[Anderson 1995] Anderson, J. (1995). *Learning and Memory*, John Wiley & Sons, New York.

[Callaway, Daniel, and Lester 1999] Callaway, C., Daniel, B., and Lester, J. (1999). *Multilingual Natural Language Generation for 3D Learning Environments*, Proceedings of the 1999 Argentine Symposium on Artificial Intelligence, pages 177-190, Buenos Aires, Argentina, September 1999.

[Curran 1995] Curran, T. (1995). *On the Neural Mechanisms of Sequence Learning*, Psyche An interdisciplinary journal of research and consciousness, August 1995, Volume 2, http://psyche.cs.monash.edu.au/psyche-index-v2.html.

[Friedman-Hill 1998] Friedman-Hill, E. 1998. *Jess, The Java Expert System Shell*, SAND98-8206 Unlimited Release, http://herzberg.ca.sandia.gov.jess.

[Hearst 1999] Hearst, M. A. (1999). *Trends and Controversies: Mixed-initiative Interaction*, IEEE Intelligent Systems and their Applications, September/October 1999, pages 14 - 23.

[Lester, Towns, and FitzGerald 1999] Lester, J., Towns, G., and FitzGerald, P. (1999). *Lifelike Pedagogical Agents for Mixed-Initiative Problem Solving in Constructivist Learning Environments*, Computational Models of Mixed-Initiative Interaction, pages 185-228, Kluwer Academic Publishers, 1999.

[Johns 1999] Johns, J. (1999). *Web Based Practice Environments to Teach Mechanical Skills*, The Interactive Multimedia Electronic Journal (IMEJ) of Computer Enhanced Learning, AACE, http://imej.wfu.edu, April 1999.

[Johns 1998b] Johns, J., (1998). *Teaching Mechanical Skills with 3-D VRML Practice Environments*, ASTD's Interactive Multimedia Summer Conference, Proceedings, Society for Applied Learning Technology and American Society for Training Development, pages 425-436, August 1998.

[Johns 1998a] Johns, J. (1998). *Improving Perceptual Skills with Interactive 3-Dimensional VRML Scenes*, Journal of Interactive Instruction Development, pages 3 - 11, Volume 10, Number 4, Spring 1998.

[Johns and Brander, 1998] Johns, J., Brander, J. (1998). *Improving Perceptual Skills with 3-Dimensional Animations*, Journal of Instruction Delivery Systems, Volume 12, Number 1, pages 8 - 19, Winter 1998.

[McRoy, Ali, Restificar, and Songsak 1999] McRoy, S., Ali, S., Restificar, A., and Channarukul, S. (1999). *Building Intelligent Dialog Systems*, ACM Intelligence, Spring 1999, ACM ISSN 99/0300.

[Roberts and Schneck, 2000] Roberts, C., Schneck, W. (2000). A Rule Engine integration architecture for the enterprise, JAVA Report, Volume 5, Number 7, pages 104 – 114, July 2000.

[Sun and Giles 2001] Sun, R., Giles, C. L. (2001). Sequence Learning: From Recognition and Prediction to Sequential Decision Making, IEEE Intelligent Systems, Volume 16, Number 4, pages 67-70, July/August 2001.

[VRML 1997] International Standards Organization (ISO) standard reference for the Virtual Reality Modeling Language (VRML), ISO/IEC 14772-2:1997, http://www.vrml.org/Specifications/VRML97.

A Historical Virtual Environment for Archeology and Creative Writing Students

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Abstract. This project is an extension of ongoing efforts to develop Immersive Virtual Environments (IVEs) for education at North Dakota State University. This IVE recreates a Native American village and the adjacent fur trading post as they existed when they were inhabited in 1854 and also as the area appeared while being excavated by archeologists in 1954. One version will be used by archeology students who will learn the methods and reasoning used by archeologists; another version will be used by creative writing students at NDSU and at Fort Berthold Community College as they write historical fiction about the area. This presentation will focus mostly on the version being developed for use by creative writing students.

For the past several years, the NDSU World Wide Web Committee has been engaged in the development of Immersive Virtual Environments (IVEs) for education. These virtual environments, which focus on science education, especially understanding scientific method and reasoning, include The Geology Explorer and The Virtual Cell (Slator et al., 1999). A new development of these efforts is an IVE that will be used by archeology students and creative writing students; information about this project is available at http://vcell.ndsu.nodak.edu/fish-hook/. One version will have a 3-D fly-through, graphically rich interface and a teaching system for archeology. Much like the other IVEs created at NDSU, archeology students will use this version to learn scientific methods and reasoning by doing what an archeologist would do in the simulated environment. The other version, which shares the same basic content, is a largely text-based MOO; this version will be used by creative writing students at both NDSU and at the Fort Berthold Community College in New Town, North Dakota, who will write historical fiction based on their interactions with it. In both cases, the place is an actual Native American village, Like-a-Fishhook, and the adjacent fur trading post, Fort Berthold, an area in western North Dakota that was inhabited during the 1800s. Located on the Fort Berthold Reservation, home of the Three Affiliate Tribes *(MHA Nation)*, this area will be represented as it existed in 1954, during the excavation process, and in 1854, when it was inhabited it was inhabited by Mandans, Hidatasas, and various European Americans associated with the fur trade. Visitors will be able to "time travel" between the two time periods.

Like-a-Fishhook village was established by Mandans and Hidatsas around 1844. These two tribes had previously lived in separate villages, but decimated by a smallpox epidemic in 1837, the survivors banded together to build a new village of earth lodges on the Missouri River upstream from their old villages. In addition to hunting and gathering, the Mandans and Hidatsas cultivated corn, beans, squash, and tobacco along the river bottoms, and they continued their traditional trading with other tribes and with Europeans in the area. A fur trading company soon established Fort Berthhold, and fur trade was important to the economy of the area for the length of its existence. The Arikaras joined the Mandans and Hidatsas in 1862. In the mid-1880s, the United States government pressured the residents of Like-a-Fishhook village to relocate to individual allotments on the reservation, and the village was abandoned. In 1947, despite protests by the Three Affiliated Tribes, construction of Garrison Dam began. Between 1950 and 1954, salvage archeological excavations were conducted by the North Dakota State Historical Society under contracts with the National Park Service and by the River Basin Surveys of the Smithsonian Institution. By late summer of 1954, the rising waters of Lake Sakakawea flooded the site of Life-a-Fishhook village as well as the best farmland on the reservation (Smith, 1972). The Like-a-Fishhook village and Fort Berthold area was chosen for this project for several reasons. In the 1800s, this village, the last earth-lodge settlement on the northern plains, was occupied by three separate and distinct tribes that maintained their cultural identities. In addition, European Americans and people of mixed blood were associated with the village since shortly after it was first established. In the 1900s, the building of Garrison Dam, the struggle by archeologists to excavate the area and save the cultural record before the area was flooded, and the inundation of this site and other tribal lands were important events for the Three Affiliated Tribes and for the state as a whole. The history of the area will provide a rich source of material for writers.

Although historical fiction should accurately depict other times and places, it frequently does not. The Like-a-Fishhook/Fort Berthold MOO will serve as a text that provides accurate, detailed information about this place. Visiting the MOO will simulate a field trip to a location and to times that would not otherwise be possible. The MOO interface, which presents authentic details through textual descriptions, interactions, and a limited number of carefully chosen images, is designed to stimulate the imagination of the students. As Ann Bertoff points out, "...looking, seeing, turns on the mind....students of composition and creative writing who do a lot of looking will learn that perspective and context are essential to interpretation. In short, they will learn habits of mind essential to critical and creative thinking" (Bertoff, 1981, p. 37).

The connection between print fiction and recreational MOOs and MUDs is interesting. Some role-playing, recreational MUDs have been inspired by works of fiction, especially by those of J.R.R. Tolkien, Anne McCaffrey, and Frank Herbert; on the other hand, participation in MUDs inspires some mudders to write conventional albeit not particularly meritorious fiction based on the authors' experiences in MUDs. Just as many students are motivated to learn science by environments that incorporate game-like strategies, we believe that students will be creatively inspired by immersion in a MOO environment. Because a MOO is a social environment and because this MOO will be visited by students from varied ethnic backgrounds, including descendants of the inhabitants of the village, this experience will introduce them to the challenges and concerns of depicting a multicultural society. Further, visitors who interact with each other as well as with various bots in the MOO will experience a sort of virtual improvisation that will help them to develop characters and to write dialogue. Creative writing students will have opportunities to write short narratives or poems about objects in the MOO; after a review process, excellent examples of these short writings will be attached to the respective objects in the MOO via an object called a "story point." These story points can be read by other visitors to the MOO. In this way, writing created as a result of interaction with the MOO, some of which will be displayed in the MOO and some of which will exist as conventional print media, will not only be creatively enhanced by the precision of the setting, it will also flow from the students' immersion in virtual time and space and their struggles with the cultural issues they find there.

The creation of this MOO, which represents a real space in two historical time periods, presents several challenges. Extensive historical, ethnographic, and archeological records were used to create the virtual depiction. However, how much prior knowledge of the subject potential users might have as well as cultural perspectives of language, time, and space must be considered. The number and type of visual representations to include in a largely text-based MOO is also a consideration. The engagement of the students who visit the MOO and then write about it will be determined by the use of surveys and interviews. The narratives they write as a result of participation in the MOO will be assessed for accuracy and creativity. Students' understanding of the concerns related to writing historical fiction and their ability to explain the decisions they made when writing historical narratives will be judged by reflective essays they will write after completing the process.

References

Berthoff, A.E. (1981), The Teacher as Researcher. In *The Making of Meaning: Metaphors, Models, and Maxims for Writing Teachers (p. 37).* Montclair, N.J: Boynton/Cook.

MHA Nation: http://www.mhanation.com/.

Slator, B.M.; Juell, P., McClean, P.E.; Saini-Eiduct, B.; D.P.; White, A.R.; and Hill, C. (1999). Virtual Environments for Education at NDSU. World Conference on Educational Media, Hypermedia, and Telecommunications (ED-MEDIA 99), June 19-24, 1999, Seattle, WA, pp. 875-880.

Smith, G.H. (1972). *Like-A-Fishhook Village and Fort Berthold, Garrison Reservoir North Dakota.* Anthropological Papers 2. Washington, DC. National Park Service, U.S. Department of the Interior.

Design of a Distance Learning Environment
DIACOM : An Interactive Forum based on Collaborative Learning for Continuing Medical Eduaction

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Abstract: This communication presents an educational and collaborative forum : DIACOM (Interactive Case Based Discussions for Medical Training). DIACOM offers a distance, continuous training activity, dedicated to physicians. Its principle is based on the sharing, confrontation and discussion about clinical cases. It can be considered as a more structured and collaborative approach of the discussion forums already in existence on the Internet. Its first function is to allow physicians to describe cases. It permit also to put them in touch with other practitioners, whose cases share common subject and important point of view differences. This operation is performed by a pairing process between described cases. This paper aims to introduce a description of the DIACOM interface module that makes collaboration and interactions between peers, effective and formative.

Introduction

Internet discussion forums constitute a means of communication used to enable the sharing of experiences, in distance education. In medicine, they are particularly interesting. But the themes discussed on these forums are of a general, theoretical or technical nature and rarely focused on the practical content of courses (Peraya 99). Moreover, many users prefer to add their own contribution rather than to try to make contact with someone who has previously related a similar experience.

DIACOM forum (Interactive Case Based Discussions for Medical Training) offers a distance, continuous training activity, dedicated to physicians. Its principle is based on the sharing, confrontation and discussion about clinical cases. In fact, its main function is to allow physicians to describe cases. It permit also to put them in touch with other practitioners, whose cases share common subject and important point of view differences. Thus, the DIACOM forum can be considered as a more structured and collaborative approach to the discussion forums. This operation is performed by a pairing process between described cases.

The DIACOM forum structure is composed of three modules. These modules are described in th second section. Before, in the first part of this paper, we present the medical context of this research work. Then we conclude throuch the interface module, by describing the collaborative sight of the forum.

A Medical Context

In medicine, learners have frequently to study practical experiences, called *clinical cases*. These cases studied individually, or by groups, stem from real practices and described by physicians concerning patients. This kinf of learning is also called Problem Based Learning (PBL) (Barrows, Tamblyn, 80). In the framework of the Continuing Medical Education (CME), the case based learning approach is also performed. Internet has an abundance of websites that offer interactive clinical cases intended for physicians to train themselves (Interact – http). However, the more experienced a physician is, the less he seems to be content with a simple study of clinical cases. In fact, he would prefer to discuss about these cases with his peers. This is why, aware of this need of collaboration between practitioners on training tasks, continuing education associations still organise regular meetings. During theses meetings, real cases are raised and discussed by participants. Firstly, these meetings allow practitioners to improve their own knowledge on a subject. Secondly, these discussions enable also to test physicians skills and to discuss about diagnosis or therapeutic management protocols that occur in their daily practice. Nevertheless, practitioners have less time at their disposal to actively and regularly participate to these meetings. Therefore, it could be interesting to allow physicians share and discuss their views, through the development of a distance learning system based on individual experiences.

Some kind of existing systems have a similar objective. These are Computer Supported Collaborative Learning systems (CSCL) (Dillenbourg and al., 96). In fact, their general functioning principle consist in making the learners learning in small groups, solving common problems and interacting each others. In the medical domain, constructing CSCL environments is very interesting for PBL (Koschman and al., 95) (Mendelez and al., 99). Some CSCL works aims at perpetuate the training, mainly by the way of discussions without considering any problem-solving angle for the system. For example, CONNECT (Baker and al., 99) concerns epistemic interactions between learners in a CSCL environment, dedicated to sciences learning. In CONNECT, the system analyse learners contributions and, thus, evaluate their similarities, in a textual analysis. The DIACOM principle is similar from the CONNECT paradigm. In fact, the learning method of DIACOM is also based on interactions between peers. Nevertheless, DIACOM is dedicated to medical training and doesn't focalise on textual contribution but on structured clinical cases. Moreover, CONNECT is designed for children education organized by a teacher. DIACOM is then designed for CME. Physicians have to learn from each other, by confronting their knowledge and their approaches of a problem. So, they train themselves, and above all autonomously, without any tutor or moderator.

The DIACOM approach is especially relevant when it comes to training practitioners in new medical practices or in domains, for which there is no established guidelines. So, as to raise discussions of clinical cases it is necessary to attribute to the forum, a specific medical topic. It is preferable for the forum to belong to the domains of medical research, and of technical, diagnosis or therapeutic innovations. In fact, in this kind of domain, physicians have their individual methods of practice. Consequently they could express their opinions and demonstrate a willingness to engage in discussions and to participate in training about the subject. So, the pairings and debates resulting from these topics become all the more interesting, efficient and valuable for the learners. The pediatric pain management domain corresponds to these criteria. As patients in this field are very young, consultations or clinical examinations may result in difficulties and complications that are uncommon in other medical fields. Moreover, the consensual guidelines for pain management are still quite rare in the pediatrics domain. Some reference books composed by scientific papers, show how much the pediatrician community is interested in the subject (Ecoffey and Murat, 99). Thus, the cases described in the forum can illustrate different solutions and strategies in solving problems. These are mainly based on a pediatrician's individual experiences of child pain management.
The following section deals with the three modules that make up DIACOM forum architecture.

DIACOM Architecture

DIACOM forum structure is composed of three modules : the *data module* that aims at making a list of various data's models used by the system ; the *pairing module* which is charged of the processing realized by the system to manage pairing between cases ; and, the *interface module* that manages interactions between users and the system.

The data module

DIACOM forum uses a lot of domain dependant knowledge and data, in order to help authors during their case description. These data aims also at peforming the pairing comparison of cases. These data are managed by the data module of the DIACOM forum. This module is composed of a *generic model*, a *specific model* and a *generated model*.

Firstly, the generic model allows to generate a modelization of the case structure. In DIACOM forum, a clinical case is considered as a sequence of steps named *scenes*. Each of theses scenes represent a collection of elementary concepts called *entities* and describing the patient features. In order to get through to the following scene, a scene must contain a conclusive *action*. This action represents the decision he has taken or he would take, in front of this situation. It contains also a modeling of the solving problem strategies described by physicians in cases. Consequently, the generic model is composed of a modeling of cases, of entites and action, and of entities and action types. It is independent from the pediatric pain management domaine.

Secondly, the specific model contains all the domain dependant data and makes up the generic model instanciation in the pediatric pain management domain. With this specific model, we collect all the entities and action types, defined for the pediatric pain management. This model contains also the complete corpus of cases described by physicians on the domain, and the solving problem strategies associated to each case.

The generated model aims at storing information issued from the pairing. In this way, this model maintains a case categorization, and the whole information about paired cases. It is charged of and also the storage of discussions resulting from the pairing and processed by physicians.

The Pairing Module

The pairing module aims at managing the processing realized on cases in sort to constitute relevant couples of cases for following discusions. These couples of cases are those which present similarities in accordance with sure criteria but mostly important differences in accordance with other ones.

Once a physician enters a new case, the underlying system performs a pairing process based on three domain dependent criteria. The first criterion named the *theme* represents the pathology illustrated in the case. The second criterion is called the *object* of the case and identify the case objective next to the pain (evaluating pain or treating pain). At last, the third criterion is the solving problem *strategy* proposed in the case by the physician. The aim here is to introduce people who deal with the same problems but who have different approaches in solving them. So, as well as being paired through their similarities, the cases are also identified by the differences in opinions expressed by the physicians. The importance in identifying these differences lies in the fact that, if people are in accordance with each other they will not benefit from the forum and as a consequence the discussion becomes useless. The principle of favoring different opinions is presented in (Dillenbourg and Schneider, 95). It is cobnsidered as a fundamental element in generating beneficial discussions in a collaborative learning group. Consequently, a socio-cognitive conflict (Doise and Mugny, 84) could arise and provide discussions and debates that are richer and more beneficial in their content.

This pairing module is composed by a general algorithm that manages progress of the processing chain. This algorithm executes mainly two sub-algorithms. The first one is named *criteria extracting algorithm*. It allows to extract the pairing criteria from cases (the theme, the object and the strategy). These criteria permit to put the cases together by categories in the generated model category level. Next, the second sub-algorithm is the *pairing algorithm*. This algorithm makes use of the last extracted criteria in order to compare them with those of other cases already stored in the category level. Thus, the collection of cases that deal with the same object is then extracted. The pairing module select cases with a similar theme but a distant strategy, then those with a distant theme but a similar strategy, and finally those with distant theme and strategy. This retrieval of relevant cases generate three types of paired couples. The pairing can be considered as an uprising of an identified problem by analyzing the two cases. Once relevant case have been extracted, the information concerning the pairing and the reasons of these pairing is stored in the generated model pairing level. This information is then transmitted to cases' authors through the interface module. Discussions can now take place. In a pedagogic point of view, the discussion is benefic, because physicians learn from the cases of each of them, but also from their own explanation's tentative (self-explanation effect of Chi (Chi and al. 98)).

The Interface Module

The interface module proposes two user interface. The author interface, DIACOM-IA (DIACOM Interface for Authors) allows a physician to simply describe his experience. This interface can be considered as an author interface because it aims at « allowing authors, non programmers, to describe and to make visible their knowledge » (Murray, 99). By the way, an author, must be able to apprehend the description of a new case in the base, in accordance with a specific process. The current author interface version, is developed in Java. Moreover, because a case contains several composition levels, we have chosen to present it to the user, in form of an « arborescence ». At each level of this arborescence, the user has got the possibility to develop the lower level with a mouse click. At the top of the tree, we can see the name of the case accompanied with a small description. At the lower level, we can see the ordered scene list making up the case. Under each scene appear entities names, and this of the action that allow to go through the next scene. In another way, to manage the user acts we have chosen to offer contextual menus that appear with a right mouse click. On each hierarchy level, the presented menu is then different. For example, at the case level, the contextual menu proposes to modify information about the case, to add a new scene to this case, or to delete the last scene of the case. Nevertheless, at the scene level, it enable to add a new entity or a new action in the clicked scene.

The discussion interface, DIACOM-ID (DIACOM Interface for Discussion), constitutes the part of the interface module that enables the management of discussions between learners. Obviously, discussions proposed on the forum are asynchronous. In fact, the aim of the DIACOM forum is to propose to physicians a tool, easy to use and without any time and place constraint. Moreover, discussions have to be serious and authorized only to regular physicians. Consequently, the access to the DACOM-ID web site content begins with an identification phase in order to authorize discussions and case base consultation only to previous registered physicians. In the first step, an authorized physician access to a *customized page* in which he can inquire pairing about his own cases. Then he can link to the paired case description or directly to the related discussion page, corresponding to a pairing. When the physician click on one of these discussions, the totality of the discussion is displayed. On another way, the customized page give him an access to the *case page* that present the whole cases stored in the system, and to the *discussion page*, that allows to link to the whole current discussions of the DIACOM forum.

These two interfaces are at the center of the collaboration and interaction management of the DIACOM system.

Collaborative Learning Through the Interface Module

The DIACOM forum interface module is a part of the system through which collaborative pedagogical interactions can be effectives.
With the DIACOM-IA interface, a physician begins to formulate, formalize and structure his expertise. He take the first plunge in order to integrate a real group discussion, efficient for his continuing education and knowledge improvement. In fact, each collaborative learning could only be efficient if each participant has performed a preliminary individual reflection about the subject that must be discussed and debated. It is the only way to obtain interactions and an exchanges of each individual thought (D'Halluin, 01).

Moreover, DICAOM-ID aims at stimulate these interactions between peers by presenting paired cases to physicians authors of clinical cases. For the moment, it is for example the matter of saying to the practitioner: "Your case has been paired wit Dr X's case. His case deals with similar subject as yours, but it doesn't present the same problem solving approach. You have a real interest to interact with him through a discussion. We encourage you to begin the discussion with him, starting with a presentation of your opinion about his own case". Couples of paired cases generates, on their own, a discussion subject on which two learners doesn't agree. So make these persons interacting, through asynchronous point of views debates on the subject, is beneficial to the pedagogy in the system. Two persons is the minimal group number required in order to obtain beneficial interaction in terms of knowledge transfer and enriching. This principle of creating couple of cooperative learners is near from the dyads constitution of Quignard and Baker in (Quignard and Baker 99).

Obviously, we have seen in the DIACOM-ID description that the discussion access is not saved for paired case authors. In fact, it's turned out that the discussions activated by pairing have interest for each physician became aware of the question raised. Thus, the discussion interface allows each participant to participate to the whole discussions currently developed in the forum. By the way, a physician have not to submit a case to interact with other physicians about interesting subjects. It could be noticed that, for a people who has not submitted any case, the access to discussions is not easier than in a traditional discussion forum. Even if group discussions are possible, the choice of these extern participants is not funded on a point of view difference as it is done when people are connected according to the pairing process. Moreover, these participants, didn't previously have the possibility to describe a clinical case based on the current discussion subject. So, they didn't make the thought process to structure and formalize their expertise on this specific subject. But, interactions generated by these external people can be a plus for the whole collaborative learning group then constituted. In fact, they can re-incite and re-motivate interactions by introducing new questions about the discussion subject.

The following paragraph conclude on the actual state and on the evolution perspectives of this research work.

Conclusion

A first experimentation phase has been carried out on the pediatric pain management. These experiences have allowed to collect an experimental corpus in order to constitute the specific model of the forum. Our current works are firstly centered on the strategies modelization and abstractions, from the experimental corpus. Once the author interface would have been validated by experts, a second experimental corpus will be able to be collected. This corpus will support our conclusions on the strategies modelization and by extension the pairing module. A complete prototype of the DIACOM forum will then be finalized. This prototype will allow us to test and validate the complementarity of the two DIACOM interface in the process of collaborative learning, based on interactions between peers.

References

Baker M., De Vries E., Lund K., (1999). Designing Computer Mediated Epistemic Interactions, *Artificial Intelligence in Education*, S.P. Lajoie and M. Vivet (Eds), IOS Press, pp. 139-146.

Barrows, H.S. and Tamblyn, R., (1980). *Problem-Based Learning: An approach to medical education*, New York: Springer.

Chi M.T.H., Bassok M., Lewis M.W., Reimann P., Glaser R.. (1989), Self-Explanations : How Stuents Study and Use Examples in Learning to Solve Problems , *Cognitive Science*, 13, 145-182.

Clancey, W.J., (1983). Guidon. *In journal Computer-Based Instruction*- Vol 10- n°1 et n°2.

D'Halluin C., (2001). Use of a mediated environment for cooperative learning (In French : Usages d'un environnement médiatisé pour l'apprentissage coopératif), *Les Cahiers d'études du CUEPP*, N°43, janvier 2001 – USTL CUEPP.

Dillenbourg P., Baker M., Blaye A., O'Malley, (1996). The evolution of research on collaborative learning. *Learning in Humans and Machines*, Scapada & Reimans (Eds).

Dillenbourg P. et Schneider D., (1995). Mediating the mechanisms which make collaborative learning sometimes effective. *International Journal of Educational Telecommunication*, 1(2-3), 131-146.

Doise W, Mugny G., (1984). *The social development of the intellect*. Oxford : Pergamon.

Ecoffey C., Murat I., (1999). *Pain in childhood*. (in French), Flammarion (Eds).

Interact – http, The interactive patient Web Site (*http://nt.media.hku.hk/InteractivePatient/medicus.htm*)

Koschman T.D., Feltovich P.J., Meyers A.C., Barrows H.S., (1995). Implications of CSCL in Problem Based Learning, *CSCL'95*.

Mendelez E., Burgin A., Le Duff F., Le Beux P.. Design of a CSCL Environmen for Clinical Reasoning Learning and Problem-Based Learning in Medicine. *MEDINFO 2001*, V.Patel et al. (Eds), Amsterdam IOS Press – IMIA p 1056-1060.

Murray T., (1999). Authoring Intelligent Tutoring Systems, an Analysis of the Stat of Art. *International J. of Artificial Intelligence in Education*, Vol 10, pp. 98-129.

Peraya D., (1999). The Cyberspace: a system of communication and mediated training. (In french) , *Cyberespace et auto formation*, De Boeck, Alva S (Ed.).

Quignard M., Baker M. (1999). Favouring modellable computer-mediated argumentative dialogue in collaborative problem-solving situations, *Artificial Intelligence in Education*, S.P. Lajoie and M. Vivet (Eds), IOS Press, pp. 129-136.

A Constructivist-based Tool for Operating Systems Education

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Abstract: RCOS.java is a simulated, web-based operating system that provides a platform on which to build constructivist-based approaches to teaching operating systems. This paper briefly describes the design, capabilities and availability of RCOS.java

Introduction

A course covering the algorithms, concepts and theories behind the design, construction and operation of operating systems is a recommended core component for courses in computer science (Denning, 1989). For a number of reasons students find operating systems related topics, like many computer science topics, difficult to learn. In an attempt to address these problems and based on previous experience RCOS.java has been developed. RCOS.java aims to provide a platform on which students can actively experiment with the algorithms, data structures and services of an operating system. RCOS.java combines the capabilities of Java and the World-Wide Web to implement a single system that includes features of previous operating systems courseware including animation, concurrency simulation and toy operating systems.

RCOS.java Components

RCOS.java acts as a simulated operating system within a Web browser. Students can drill down and peer underneath the user interface and interact with graphical animations of the data structures and algorithms used to implement RCOS.java's simulated operating system and hardware. RCOS.java is implemented as a Java application consisting of 250 classes and over 100,000 lines of source code broken up into the following five major categories: hardware, operating system, animators, message passing and compiler.

The lowest levels of RCOS.java are a collection simulated computer hardware including a CPU, disk drives, RAM and terminals. The operating system is based on a message passing micro-kernel architecture. The micro-kernel handles interrupts, context switching and generates messages that are passed onto other operating system components that perform higher-level tasks such as memory management, inter-process communication, process and disk scheduling.

The Animators provide the visual representations of RCOS.java's internal operations. The Animators can also provide interface elements that allow students to modify the operation of RCOS.java by choosing between different parameters and algorithms. The animator system also includes a recorder that can store a RCOS.java session for subsequent playback.

The entire RCOS.java system is based on a message based architecture. This architecture allows the replacement of individual components including hardware, operating system and animator with little or no influence on other components. The message passing architecture also enables the implementation of the recorder.

RCOS.java will execute programs written by students. Students write these programs using a programming language similar to C/C++. The RCOS.java compiler will compile these programs into RCOS.java executables. The RCOS.java C/C++ dialect includes simple support for inter-process communication primitives including semaphores and shared memory.

Use of RCOS.java

RCOS.java is designed to enable and encourage active manipulation and experimentation by students. There are four main methods, which can be used including: visual investigation and experimentation, creating presentations, writing user programs, and modifying the internal operations of RCOS.java.

The animators provide visual representation of what is going on under the RCOS.java hood. Students can use these to observe RCOS.java's operation under different scenarios to gain a better understanding of how the algorithms and data structures work. A number of the animators also allow the student to modify the operation of the underlying operating system and hardware further enabling investigation of performance under alternate scenarios.

Using the RCOS.java compiler students can create and execute their own RCOS.java programs. The C/C++ dialect includes support for services, such as semaphores, which students are generally not familiar. By combining their programs with the visual representation provided by the animators students can further investigate and experiment.

The recorder allows students (and teachers) to create stand-alone RCOS.java sessions for future playback. This allows the creation of animations designed to demonstrate important concepts.

Students can also modify the internal operation of RCOS.java by modifying its source code. This allows students to implement alternate algorithms, data structures, animators and simulated hardware. Due to RCOS.java being implemented with a message passing architecture it is possible for students to concentrate solely on the component they are modifying.

Current Status and Future Work

RCOS.java has been under development since 1996. Developing a computer-aided learning package as complex as RCOS.java has been a time consuming process fraught with many difficulties. The long development cycle has itself created a number of problems including project students graduating, changing teaching responsibilities, and changes in the Java platform.

If the potential advantages of RCOS.java are to be realized integration into the curriculum is necessary. RCOS.java is currently a usable tool and yet there is still a significant development effort required to develop the appropriate learning activities and associated support material to enable its use in a course. Current work on RCOS.java is concentrating on this process.

RCOS.java has been released under an open source license and the system itself and the associated resources are available on the web from http://www.rcosjava.org /. Any interest in the use or development of RCOS.java is more than welcome.

Conclusions

RCOS.java is a simulated operating system that aims to enable the use of constructivist based learning activities in operating systems education by providing a concrete platform to enable visualization and experimentation.

References

Peter Denning, Douglas Comer, David Gries, Michael Mulder, Allen Tucker, Joe Turner, Paul Young (1989), Computing as a Discipline, Communications of the ACM, 32(1), pp9-32

Student feedback, anonymity, observable change and course barometers

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Abstract: A Course Barometer is a method for addressing the loss of informal feedback in a distance education setting. Originally proposed and used at the University of Trollhattan Uddevella this paper describes how the idea of a course barometer has been adopted by Central Queensland University. The paper suggests connections between anonymity, observable change and the level of student contributions. Usage statistics, staff and student feedback, and stories are used to identify trends, draw conclusions and make suggestions for further improvement.

Introduction

Collis and Oliver (1999) report in their analysis of the papers submitted to EdMedia'99 that the majority of papers report on prototype development and evaluation with few ideas going beyond this stage. One of those papers (Svennsson, Andersson, Gadd, Johansson, 1999) described the initial development and evaluation of the course barometer. A course barometer is a web-based application designed to provide students a simple, anonymous method for providing informal feedback about their feelings toward a course while it is being taught. This paper reflects on the use of the course barometer idea within the Faculty of Informatics and Communication (Infocom) at Central Queensland University (CQU).

The absence of informal, in-term feedback is a major problem within Infocom since most courses are taught with a large number of staff via both print-based distance education and in a face-to-face mode at 13 sites spread through out Australia, Fiji and South-East Asia. The course barometer concept within Infocom was initially intended for a course taught by the author in the second half of 1999. Since then the potential and obvious need for in-term feedback from students has led to the course barometers contributions being received in 67 different course offerings.

The paper starts by offering a brief overview of the course barometer concept followed by a description of the data sources used to examine Infocom's barometer experience. Two stories are then provided which show how a course barometer has made a positive difference for both staff and students. The paper then examines the connection between implementation choices, anonymity, observable change, and the level of student contributions to the course barometers.

Barometer Design and Implementation

There have been three versions of the course barometer concept. Two versions, alpha and beta, have been implemented at the University of Trollhattan (Svensson and Sorenson, 2001) and the Infocom version described here. All three barometers provide a mechanism by which a student can indicate their current mood and provide a small textual comment about a course. All three provide a statistics page where staff and students can view the atmosphere of the course. Minor differences between the barometers include changes in the interface design, moods that can be expressed, administrative mechanisms, and the implementation environment.

A more significant difference between the Trollhattan barometers and the Infocom barometer is the number of times per week students could make contributions. At Trollhattan students could make as many contributions as they wanted, whenever they wanted. In an attempt to increase the value placed on barometer contributions the Infocom barometer restricted students to one contribution per week per course. The intent was to encourage students to be more thoughtful in their contributions. This limitation also prevents the possibility of the barometer taking on an unbalanced view due to large numbers of repeat contributions from a small number of students. Lowder and Hagan (1999), writing about another web-based anonymous feedback system, report on a student using the ability to make multiple postings as a nuisance technique.

To implement this restriction it was necessary to be able to identify which student was making a contribution. This violates the aim of providing an anonymous environment where students need not fear repercussions for making negative comments. Recognizing the negative impact this may have upon student participation the implementation of the password protection system aimed to make it as difficult as possible to identify which student made a specific contribution. Additionally, teaching staff are never provided with any access to information connecting students to contributions and an effort was made to communicate this information to students. A positive side effect of the password requirement was to address another problem. Infocom course websites generally are not password protected. In the past this has led to non-CQU students misusing facilities that allow for visitor contributions.

The alpha and beta barometers at Trollhattan were used over a four-week period in a single course during two different terms. There were a total of 213 submissions for the alpha and 308 for the beta barometer (Svennson and Sorenson, 2002). The Infocom barometers have been used for the entire 12 weeks of 5 different terms and contributions received for 67 different course offerings. For all but the last term the Infocom course barometers were only included at the request of the course coordinator. In the last term of 2001 the course barometer was made a standard part of the default web site for all Infocom courses. In this term there was a total of around 100 courses with default web sites. Barometer contributions were only received in 46 of these courses.

Data Sources

Information about student contributions to the Infocom course barometer is stored in two database tables. One table stores the course, week, feeling (good, bad or indifferent) and any comments. The other table stores the student number, course, and week. It is this second table that is used to prevent students making more than one comment per course, per week. The data in these tables has been used to generate statistics about students and their contributions. The student comments on the Trolhattan alpha-barometer underwent content analysis. Due to time and resource limitations such analysis has not yet been performed on the Infocom data.

Logs from the Infocom website have been archived since early 1997. These logs record the date, time and web page of every visit to the Infocom website. The web server logs have been used to compare the number of visitors to course barometers with the number of people making contributions.

To gather more information about student feeling toward the course barometers a 15-question survey was placed on the Web toward the end of 2001. The survey contained 8 likert style questions and 7 short answer questions. An email message announcing the survey was sent to all students enrolled in Infocom courses during the second half of the year. CQU's student record system contained email addresses for 948 of these students. 350 of those email addresses suffered from a number of problems that prevented delivery. A week after the first email initial results were released on the web and another email sent informing students and reminding them about the survey.

61 responses to the survey were received giving a response rate of 10.2%. 70% of the students who responded to the survey knew about the course barometer. 58% of respondents agreed or strongly agreed with the statement "The course barometer is a useful feature". While responses to the survey are a useful guide to student feeling there is some bias in the sample. The type of students who had correctly entered an email address into CQU's student records system and completed an online survey during the final stages of a term are more likely to make use of an online resource like the course barometers.

An email message about the course barometers was distributed on the Infocom staff mailing list early in the second half of 2001. Of the 60+ course coordinators within Infocom, many of whom had previously never used or known of the course barometer facility, there were 6 replies. In some cases there was on-going discussion between the author and individual staff.

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Statistics, Trends and Potential Reasons

Over three years of use 1188 student contributions were made via the Infocom course barometers. The average length of a comment on the Infocom barometers was 120 characters. Over the 5 terms of year the average number of contributions per course offering was less than 18. However, three of these terms had significantly higher levels of contributions. The three busy terms had an average of 40 contributions per course offering. While the two slow terms had an average of 7 contributions per course offering. The defining difference between these two groups of terms appears to have been the motivation and involvement of the course coordinators in encouraging and responding to barometer contributions.

In the last main term for 2001 the course barometers were, for the first time, a compulsory part of every Infocom course website. However, staff were not required to encourage students to contribute to the course barometers. In this term 448 contributions in 46 different course offerings were made for an average of 9.7 per course. Only 16 of the 100+ courses in this term had greater 10 contributions.

29.5% of the Trollhattan alpha-barometer submissions included comments (Svennson, et al, 1999) while 71.7% of the Infocom submissions included comments. Trollhattan contributions showed overall student feelings of 57% bad, 10% indifferent, and 33% good. The Infocom breakdown was 29% bad, 20% indifferent and 51% good with the 1188 student contributions being made by 538 different students. The most prolific student made 50 contributions over 6 courses during two terms in 2001.

If you accept that the one comment, per week, per course increased the effort placed into the Infocom barometer contributions this may help explain why the number of contributions with comments at Infocom is almost the inverse of that at Trollhattan, 29.5% to 71.7%. It may also explain the switch in reported feelings from 33% good at Trollhattan to 51% good within Infocom. Especially given the observation that both the Trolhattan and Infocom barometers have been used primarily in courses with staff interested in improving the students' experience.

The number of contributions per week for almost all courses follow a common trend. There is an initial spike early in the term when the course barometer is first discovered. Followed by a gradual drop off until some minimum level is found and maintained until the last week or so of term. At this stage there is usually a small increase in contributions due to the end of term. Any exceptions to this trend were caused by events specific to the individual course that encouraged students to contribute.

Two Stories

While the overall level of contributions to the Infocom course barometers has been limited there have been a number of specific incidents where they have played an important role in improving the experience of both students and staff. The first story takes place during the first term in which the Infocom course barometers were used. In the second week of the term a serious student complaint was made about a relatively new staff member. The complaint was very critical of the staff member's lecture style. The week after the complaint was raised the number of comments on the course's barometer was over four times the average. Almost all contributions directly addressed the topic of the initial complaint and all were very positive. For example,

> After hearing XXXX talk about the student who pretty much is jeopardizing his job, I feel really bad for him. He is a GREAT lecturer and the way he has summed up Programming A in just a matter of weeks I understand the concepts a lot better.

The second story comes from the last main term in 2001 and demonstrates how the course barometer was able to contribute toward an improvement in the student's experience. Many of Infocom's courses are delivered via video-conferencing between four regional campuses. Such presentations are usually made as traditional lectures originating from CQU's Rockhampton campus where most course coordinators are located. In 2001 a new lecturer located on the Bundaberg campus was given responsibility for a course that had to be delivered by video-conferencing. During the first three weeks the course barometer shows an increasingly negative feeling from students about the course. Most of the comments related to the quality of the lecture delivery. It should be noted that contributions in these early weeks involved less than 10% of the students attending these lectures.

> Lecturers voice fades, notably at the end of sentences. There were technology problems as well, but lecturing techniques need to be improved....

72% of the comments in those first three weeks came from students at the Rockhampton campus (11% Bundaberg, 16% Mackay). Many of the Rockhampton students would have been on the receiving end of a videoconference delivered lecture for the first time. The difference in viewpoints between campuses became more obvious during the following weeks.

> You people in Rockhampton are pathetic. You complain that the lecturer was late. I know for a fact that he was not........
>
> Well I think the students in bundy should think before they speak or in this case write.....

Often problems such as this would have continued throughout the term with little or no change. However, in this case the problems raised were addressed in a variety of ways and from week 4 onwards the overall student feeling on the barometer was positive.

> The lecture was far different than last week, the voice of the lecturer was much better.....

Why don't students contribute?

In the period July 1999 to November 2001 there were an average of just less than 18 barometer contributions per course offering. This raises concern about why more students are not making contributions to course barometers. This section draws on data from web logs, student barometer comments and responses to the student survey to examine this issue further.

Of the students surveyed who knew about the course barometer 7% never read the contributions, 21% read them once, 36% every now and then, 17% once every couple of weeks, and 19% once a week. Of the students surveyed who read contributions 57% never made a contribution, 34% made a comment every now and then. Only 9% of students surveyed made a contribution every week. Using web logs it is possible to determine that during the three busy terms 6% of the people looking at a course barometer made a comment. During the last term of 2001, where all Infocom courses had barometers, only 1.5% of visitors made a contribution.

When asked why they didn't make a contribution the most popular student responses included: having no complaints or strong opinions to contribute, having a preference for using another medium, and the belief that there would be no change if a contribution was made. Other reasons given included a lack of other comments, didn't want to repeat an existing comment and having no time.

When asked why they made contributions the most common reasons included: the importance of giving feedback in order for change to happen, having strong feelings about an issue and supporting a lecturer against negative comments. Other reasons included agreeing with a comment, disagreeing with a comment and because the lecturer asked.

69% of survey respondents agreed or strongly agreed with the statement, "If visible changes were made because of comments to the course barometer I would be more likely to add comments to the course barometer". Student comments to various survey questions include

> Because the lecturer *really * wanted feedback – asked every week. I though it was worth the trouble to help improve the course for the future......
>
> Does it get back to the Dean or Head of school? It's no use going to the lecturer. If the barometer will serve to fix slackness then yes it will be useful
>
> It is just another mouthpiece for the University not to take into consideration. It is the same as the evaluations. None of them are ever taken into consideration.
>
> Any changes that were made came to late for the majority of the class. In fact, when the changes were made they advantaged the few and disadvantaged the majority of the class.
>
> I don't think I saw any changes. I did however notice in one nameless subject that I did this semester, that at the start there were some very negative comments about it (that I totally agreed with) but when nothing changed the use of the barometer just died.....

The lack of anonymity was not given by any student as a reason for not contributing. However, a barometer contribution did show that at least one student had a problem with the apparent lack of anonymity.

> I suppose you think that if no-one submits a comment, then everyone must be going ok. Not! Just maybe, its the fact that the submission doesn't appear to be anonymous when your asked for your student details to submit your comments. I have lots of concerns and would like to pass comments to the course barometer, but am concerned that its the messenger that will be shot and not the message addressed.

Other students expressed concern about anonymity when answering the survey question "What didn't you like about the course barometer?".

> While realising the need to prevent malicious access, it was disconcerting to need username and password to access an anonymous site.
>
> When you submit you need to logon. This gives the feeling that who is responding is being recorded instead of it being anonymous.

Some students appear to have believed that the course barometer was anonymous. Responses to the survey question "What did you like about the course barometer?" included

> students can feel safe in that it is anonymous, so they won't be attacked for their opinion.
>
> Allows student who do not wish to be named to provide any kind of feedback without fear of it being held against them come marking time.

Some students, usually when supporting a lecturer against negative contributions, defeated the supposed anonymity of the barometer contribution by including their name, for example.

> I do not feel the need to make my comments anonymously, so here goes. ....Linda.

Though this practice was given other interpretations by other students

> ....It is amazing how some students say they don't need to be anonymous about their comments and then piss in the lecturers pocket and attach their name

Some students perceived that the anonymity provided by the course barometer was actually a negative attribute.

> .....I would approach the lecturer/Co-ordinator directly. I believe that the barometer restricts/reduces open communication with the source of the problem
>
> Often I noticed other students use anonymity to feel OK about not bothering to construct appropriate arguments and blurt out unconstructive criticism.

Other students suggested that knowledge of the contributors identity should be used

> Force student ID, student number would suffice, so that course organisers can follow up true complaints
>
> Very good thing, maybe every time somebody votes, they get an entry into a prizepool to win something, maybe a textbook refund or something simple like that.

While the apparent lack of anonymity was a problem for some students it appears it is not as important a factor as the lack of observable change. Students do not wish to give feedback if there is no visible response.

Staff Impact and Views

Only a small number of motivated staff have made significant use of the course barometers. As a result all of these staff see the potential benefits that the barometer can provide.

> ..the Course Barometer is an excellent tool, and staying "in the green" all term is a good challenge for teaching staff. At a glance, you can see how some students are going. And because there is no way for teaching staff to see who made which comment, students can say how they are going without fear of recriminations.

However, they have also experienced a number of problems including: unconstructive feedback, inability to help students with problems directly, and frustration caused by negative feedback when trying their best.

> Because the tool keeps students anonymous, the feedback tends to attract occasional students who want to have a little rant or hissy fit without any chance of people finding out who they were. So, instead of these students seeking help or doing something really useful, they vent their frustrations. We need to reach these students and help them, but instead they hide behind anonymous feedback
>
> ....So, maybe this student is looking at the slides for the wrong subject, or simply cannot put two and two together, or else has some severe fundamental misunderstandings, or is on another planet, or something. In any case, I cannot find out who they are or contact them or help them, and this is a real shame.
>
> Comments made on the feedback barometer can be incredibly frustrating because the students who make them can sometimes need urgent help or assistance, but they have chosen the barometer to make their comments, and this keeps them anonymous, so we have no chance to find out who they are or help them. This is incredibly frustrating. I want to help these students, but my hands are completely tied - unless they also decide to email me or contact me in some other way - which sadly, does not seem to happen. These students seem to replace email with the feedback barometer, so they seem to use one instead of the other.

Conclusions

A course barometer is a method for addressing the loss of informal feedback in a distance education setting. While the use of course barometers within Infocom has been done in an ad hoc manner with limited contributions by students there have been a number of situations where its presence has helped students, staff and the organization.

The small number of contributions on the Infocom barometers can be explained by a number of factors. It appears that a combination of staff promotion of the barometers and observable change in response to student feedback are amongst the most important factors for promoting student contributions. It appears that the lack of anonymity provided by the Infocom implementation of course barometers, while an issue for some, is not of prime concern and some students and staff actually see it as a negative influence over the quality of contributions.

In the future tools such as the course barometer will be of increasing importance to Infocom. Recent moves to increase the importance of quality assurance within the Australian University environment is one factor. Infocom's increasingly complex mix of distributed campuses and distance education also increase the importance of having a simple, heavily used student feedback mechanism.

As a result the Infocom barometer concept is likely to have an expanded role with a number of planned changes to improve the level of student contributions. In particular, it is likely that responsibility for promoting student contributions and ensuring changes are seen to happen will be given to a position seen as being independent and separate from teaching staff. Another likely change is the combination of the course barometer idea with the anonymous threaded discussion functionality described in Lowder and Hagan (1999). This would allow discussions and responses to develop around a particular student contribution. This would provide a place where change can be seen and also encourage further learning (Lowder and Hagan, 1999) and facilitate informal student interaction.

The work described here is still in the stage of early investigation. More research is required to further test and clarify some the observations and conclusions that have been made. As the use of the course barometer concept expands it will become increasingly important to investigate how the course barometer fits in with and relates to other mediums used to support teaching and learning. However, course barometers can be a positive and useful tool.

References

Collis, B., Oliver, R., (1999), Preface, In B. Collis, R. Oliver (Eds), *Proceedings of EdMedia'99*, Seattle, Washington.

Svensson, L., Andersson, R., Gadd, M., Johansson, A., (1999), Course-Barometer: Compensating for the loss of informal feedback in Distance Education, In B. Collis, R. Oliver (Eds), *Proceedings of EdMedia'99* (pp 1612-1613). Seattle, Washington.

Svensson, L., Sorensen, C., (2001), Designing Community Atmosphere Barometers, to appear in the *Proceedings of the Xth European Conference on Information Systems*, Gdansk, Poland, June, 2002.

Lowder, J., Hagan, D., (1999), Web-based Student Feedback to Improve Learning, *ACM SIGCSE Bulletin, Proceedings of ITiCSE'99 Conference*, pp 151-154.

E-Learning Development in Higher Education: Maximising Efficiency – Maintaining Quality

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Abstract

Many tertiary institutions in Australia provide support to develop online teaching and learning resources, an environment characterised by demands from students for quality face-to-face and distance education, staff concern over workloads, institutional budgeting constraints and an imperative to use management systems. There also remains a legitimate focus on using online learning to facilitate new learning strategies within a complex social setting. This paper presents an extended instructional design model in which the development cycle for online teaching and learning materials uses a scaffolding strategy in order to cater for learner-centred activities and to maximise scarce developer and academic resources. The model also integrates accepted phases of the instructional development process to provide guidelines for the disposition of staff and to more accurately reflect the creation of resources as learning design rather than instructional design.

Introduction

Teaching and learning in tertiary education has shifted over the past two decades to an environment where technology is a significant component of the overall infrastructure and the skills and credentials of both teachers and learners are crucial to enable them to work effectively with collaborative, online activities. While many teachers have embraced these new environments and take responsibility for the development and delivery of resources, many other academic staff rely on central support units to provide expertise in both curriculum design and strategies for online teaching and learning. It is this latter group of people to whom this paper is specifically directed, although the concepts will also have ramifications for all online development.

As leaders of support units in two Australian universities, one Faculty-based the other University-wide, we find that academic staff often have too little time or too few skills to maximise the benefits of online learning. At the same time our institutions, like many others, are emphasising the role of enterprise-based Learning Management Systems. Within this environment, our roles involve the design and development of online teaching and learning resources within tight timeframes and institutional constraints, which often force the units to be in a 'responsive or reactionary mode' without proper and significant long term planning. This can result in *just-in-time* delivery packages rather than more preferable long-term *rollouts*.

This short paper speculates on extending the way in which instructional design strategies are applied to educational resource development such that that production efficiency can be increased and the ongoing maintenance of online environments enabled. While instructional design and development processes integrate current good practice, the proposed variations from existing models are based on an extended approach to the development process conceptualised in three discrete phases and the integration of professional development scaffolding to effectively align online teaching resources with learner needs and expectations. In essence, the model articulated provides a means to enhance the production environment for online materials while maintaining or even increasing quality by conceptualising the design and delivery environment within the iterative and rapid prototyping methods available through contemporary development systems.

Three Phase Design and Scaffolding

The general instructional design model (for example, Morrison, Ross & Kemp, 2001) typically prescribes the creation of resources, their implementation and delivery that is then followed by evaluation and improvement. Our enhancement proposes the initial creation of a fully functional prototype, which is then used for delivery, with the evaluation and improvement activities being integrated with scaffolding (support) for the teacher and learners to provide a dynamic teaching and learning environment in which resources or strategies can be developed or modified during the actual delivery stage. The need for scaffolding has largely arisen because of the rapid implementation of learning management systems, the increased used of online teaching and learning and the evolution of learner-centred educational paradigms (Herrington & Oliver, 2001).

Integral to this process is the notion of iterative development or successive approximations, with initial prototypes being built to *test the water* before completion of the entire course. In the first iteration learning environments are generally created to provide functional delivery with the necessary componentry for effective online teaching and learning. This can include the outputs of a preliminary needs analysis of the learning environment and resources that are *scaled to fit* the proposed teaching and learning context. However with the second and subsequent iterations, development can be enhanced with each generational change. In addition, the model is based on a team approach, bringing together the three main elements of course development in a more lateral manner. No longer is process driving the development, but the project itself (i.e. the course) is dictating the make up of the teams (a cross section of skills from educational design and production) in a much more targeted and effective manner. These teams ideally stay formed for the duration of the project, potentially over a number of semesters, with communication and collaboration between academic staff and developers a key focus.

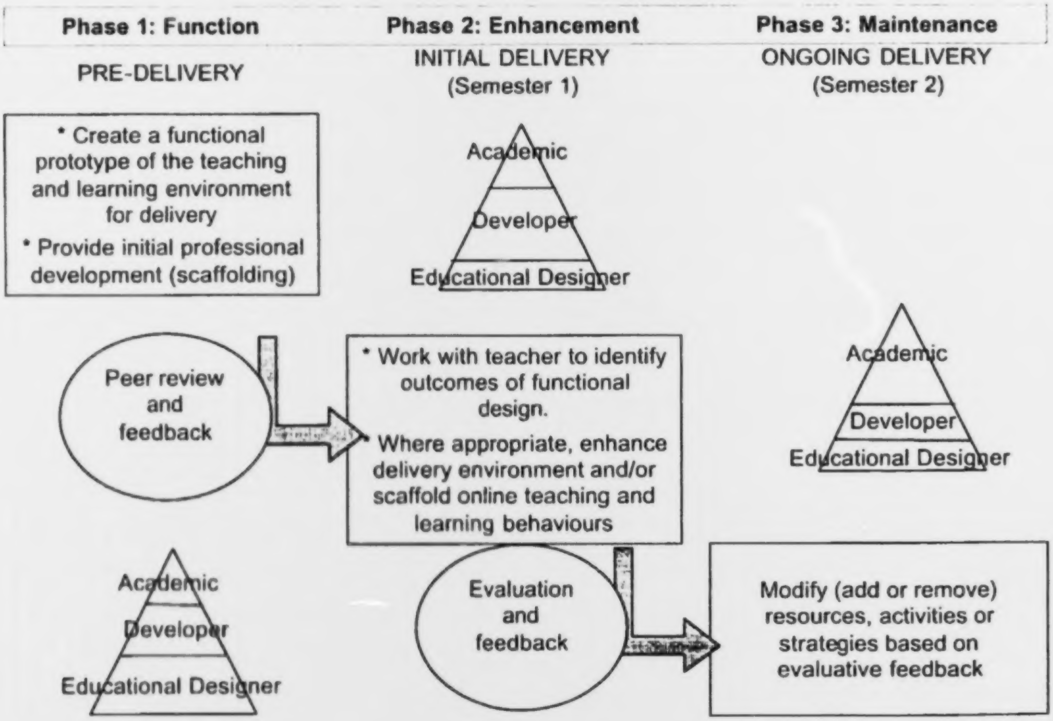
Phase 1: Function
Phase 2: Enhancement
Phase 3: Maintenance
PRE-DELIVERY
INITIAL DELIVERY (Semester 1)
ONGOING DELIVERY (Semester 2)
• Create a functional prototype of the teaching and learning environment for delivery
• Provide initial professional development (scaffolding)
Academic
Developer
Educational Designer
Peer review and feedback
• Work with teacher to identify outcomes of functional design.
• Where appropriate, enhance delivery environment and/or scaffold online teaching and learning behaviours
Academic
Developer
Educational Designer
Academic
Developer
Educational Designer
Evaluation and feedback
Modify (add or remove) resources, activities or strategies based on evaluative feedback

Figure 1: Three-Phase Design & Scaffolding

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The model therefore reinforces both the team-based approach to the design and provision of resources as well as an *iterative* development process. One of the essential aspects of the model is the specification of *baselines* in levels that correspond to these iterations – the first relating to course functional and essential elements, the second to multimedia enhancement or interactivity and the third to ongoing maintenance. These iterations are identified within the strategy as three scheduled phases of development that integrate both a methodological approach to unit development, scaffolding and quality controls and assurance, as illustrated in Figure 1.

The triangles indicate the relative efforts of the critical members of the project team at each phase of the process, based on the influence model (Sims, 1997), which articulated the period at which factors had specific influence over the project. The allocation of resources to enable this process involves establishing "unit teams" whose commitment will vary according to the position of the unit in the development cycle, with expertise based on the varying requirements of the course. More importantly, within the context of our work environment, it is the allocation of resources for the duration of the project life that differentiates the model, as detailed in the following description of the phases.

Phase 1: Prototype Development

The aim of this phase is to design and create a functional teaching and learning online environment that will meet all learning outcomes as well as faculty teaching and learning strategies. The first phase therefore becomes easier or simpler than more traditional models of instructional design, as it is functional, and production does not try to complete a final package at the first attempt - the process can therefore be likened to enabling a "dress rehearsal" for both teacher and leaner. The process also involves specifying the *core items* for this phase, such as specific teaching resources (e.g. unit guides, study guides, readings), their mode of access (e.g. print, online) and the essential educational strategies (e.g. experiential, situated, learner-centred). In this way the academic who has minimal experience with online teaching and learning environments has an relatively easy introduction to the environment while knowing that ongoing support will enable the generational development of that environment.

An equally important aspect of this phase is the allocation of team members and their specific role within the project, which can be articulated in terms of:

- *The Support Team*: Providing the Educational Designer (responsible for educational advice and curriculum design), the Interactive Architect (responsible for ensuring the online interactions and communications are consistent with the design) and Information Analyst (responsible for ensuring all required learning resources and objects are available). In addition, Project Management support will be required
- *The Faculty Team*: Allocating the Content Specialist(s), who are responsible for ensuring all necessary content is defined and that all learning outcomes, learning activities and assessment tasks are defined. In addition, a commitment to the schedule and baselines/guidelines is critical.

In addition, an Online Developer, Network Specialist and Technical Specialist will both advise and be advised on required and/or appropriate learning environments. As an extension to the triangular concept indicated in Figure 1, the detailed representation of *influence* (see Sims, 1997) is elaborated in Figure 2 for each of the perceived roles, where the apex of the triangle or polygon represents the phase in the development cycle at which that team member will have most influence. In this illustration, the different skills are also aligned with a particular unit - Support representing the central unit within the institution that provides educational advice and development services, Faculty representing the knowledge based to be provided from the teaching unit and IT representing the potential need for highly specialised network and programming expertise. In addition, these teams will also link across the various phases as the *courseware assembly* process progresses.

Another aspect of the concept of *influence* is that members of the development team are understood to have potential levels of influence at any stage of the development and delivery process, although that influence will be affected by the current status of the project. For example the Interactive Architect, who has the main responsibility (influence) for creating the design specifications, may also be active in the quality review of the project as it nears completion. An important concept underpinning this model is that, like actors in a play, the team members all have roles to play and particular *scenes* or *acts* within that process will require their leadership. But they can also have smaller, but by no means unimportant, roles throughout the whole development, delivery and maintenance cycle.

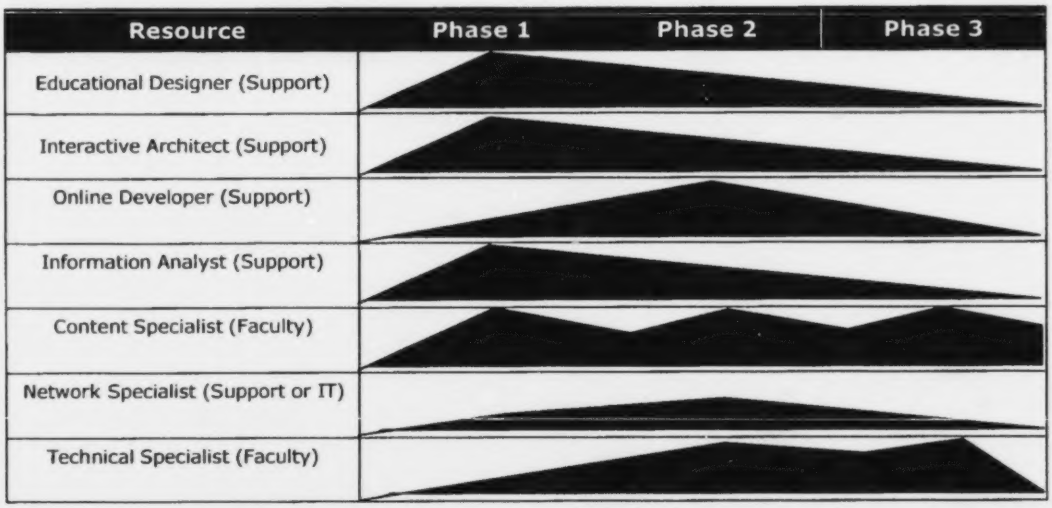

Figure 2: Influence of Team Members During Project Life-Cycle

Phase 2: Evaluating and Enhancing Delivery

The second phase is conceptualised to take place during the delivery of the unit, with feedback from both teachers and learners used to modify and enhance the delivery environment. This may include the introduction of content items and enhancement of teacher:learner, learner:content or learner:learner interaction conditions (cf Sims, Dobbs & Hand, 2001). It is also an opportunity for teachers to work in a scaffolded environment to maximise the effectiveness of online environments, where the efforts of both teacher and learner can be evaluated and the delivery environment enhanced on the basis of that evaluation. This process also allows for clearer scheduling of resources and consequently planning, production and workflow processes.

This phase will require a *team-based* approach to delivery combining, where appropriate, both academic and technical staff in two discrete components. The first requires more technically-oriented teams to "shadow" the delivery of the unit materials defined and created in Phase 1 to both assess their efficacy as well as integrate additional content, interactive learning objects and collaborative activities. The second includes the provision of targeted professional development or scaffolding on an "as required" basis for all participants in the learning process. Overall, this phase emphasises generational changes with an increased emphasis on the production (completion) of resources, with the students or learners having the role of research or evaluation assistants. There is less emphasis on handover, and more emphasis on *duty of care* through the availability of sustainable course materials and teaching resources.

Phase 3: Maintenance

Following completion of the course of study, additional modifications and enhancements are prescribed and implemented for subsequent delivery. The unit would then continue in "maintenance mode", involving ongoing support and training, until it undergoes a more formal review. Again, the important concept underpinning this model is that the original functional system developed will always be subject to change and that any development environment must cater for resources to be available for the duration of the life-time of a course (or unit) of study. Within tertiary institutions this can be as long as five years, the time between a unit's conception and its formal review for reaccreditation. However, the sustainability of the course is catered for by the continual process of gathering and incorporating evaluation data.

The success factors will depend not only on the concept being accepted but also for academic staff, students and the development team to reconceptualise their roles in the design and delivery of online educational resources. For teachers there is the option to collaborate with an online development expert while delivering the course to implement modifications based on student feedback; for learners there is the opportunity to contribute to both the content base and the educational strategies

In Figure 3 following, a sample model is provided to demonstrate how the model may be implemented over a three-year cycle, with the assumption that units of study are delivered on a semester basis.

2002		**2003**		**2004**	
S1	S2	S1	S2	S1	S2
prepare materials for S2/02 units	deliver S2 units	deliver S1 units	deliver S2 units	deliver S1 units	deliver S2 units
	shadow and enhance S2 units	shadow and enhance S1 units	shadow and enhance S2 units	shadow and enhance S1 units	shadow and enhance S2 units
	prepare materials for S1/03 units	prepare materials for S2/03 units	prepare materials for S1/04 units	prepare materials for S2/04 units	
		evaluate s2/02 units	evaluate s1/03 units	evaluate s2/03 units	evaluate s1/04 units

Figure 3: Implementing the Plan

Conclusion

Higher education in Australia is changing and to meet these changes and challenges innovative models for academic support are required. The model proposed in this paper articulates an enhancement to traditional instructional design processes where specific aspects of development and delivery are viewed in parallel rather than in sequence. Instead of a development team watching delivery of resources remotely, it is proposed that, where feasible, members of the development team actively participate with both teachers and learners in the delivery process. In this way support or scaffolding in the form of professional development can be provided on an *as required* basis while technical specialists can implement modifications to both content and pedagogy.

The value of this model can therefore be realised through the innovative ways in which it conceives the development process as *develop baseline – implement/evaluate/develop – maintain/evaluate* rather than the more traditional process of *design – develop – implement – evaluate*. The model provides an holistic framework consisting of long-term development teams, course templates, design and delivery standards and specified delivery platforms. The development of course materials is therefore not a short-term production process but a long-term collaborative process by all.

Based on this analysis we believe the benefits to teaching and learning in higher education will include the following:

- it can be a *try it and see* approach, where the first phase enables strategies to 'test the water' so initial budgets aren't blown out in expensive experiments, as has been evidenced in many multimedia projects;

- funds can be allocated across more projects for a longer period of time, such as towards second iteration enhancements that really target the learners and are appropriate to the learning environment; and
- course design in this development model includes both teacher and learner feedback and is enhanced incrementally to match learner needs.

References

Herrington, J. & Oliver, R. (2001). Online Learning: Professional Development for the Changing Role of the Lecturer. Moving Online Conference [Online] http://www.scu.edu.au/schools/sawd/moconf/MOC2_papers.html [Available 14th May 2002].

Morrison, G.R., Ross, S.M. & Kemp, J.E. (2001). *Designing Effective Instruction*. 3rd Edition. New York: John Wiley & Sons.

Sims, R., Dobbs, G. & Hand, T. (2001). Proactive Evaluation: New Perspectives for Ensuring Quality in Online Learning Applications, in G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds). *Meeting at the Crossroads*. Proceedings of the 18th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education. Melbourne: Biomedical Multimedia Unit, The University of Melbourne.

Sims, R. (1997). Interactive learning as an "emerging" technology: A reassessment of interactive and instructional design strategies. *Australian Journal of Educational Technology*, *13*(1), 68-84.

HyWeb: A Holistic Approach to Technology-based Tertiary Education

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Abstract: For the last few years, we have been developing an online/in-house teaching environment in Web-design and multimedia animation. At this stage, the outcome is a hybrid system, known as HyWeb (Hybrid-Web). It is the result of combining online delivery with traditional teaching. The experience has led to the belief that a holistic approach to course design and delivery is not only practical but also essential. As certain features are required they are added to enhance the quality and efficiency of the system, making it a dynamic and evolving entity. This paper discusses the approach used for course development within the Multimedia degree, School of Information Technology at Griffith University, Gold Coast campus.

1. Introduction

At Griffith University Gold Coast, several faculty members of the School of IT are working together to create a holistic and evolving teaching environment aimed at meeting the needs of their students. Two important components of good online instruction are: methods to cope with the limited bandwidth of today, and the inclusion of the human element. The problem of limited bandwidth is diminishing with time, but the "human element" still needs to be considered. Communication, involvement and connectivity can be addressed by a more flexible approach to online education.

2. Online Delivery System

HyWeb was developed at Griffith University, Gold Coast and implementation has been ongoing since 1999. The system focuses on delivery and can be applied to any field of study. There are two major limitations:

- Bandwidth and Data Transfer Rates – with the increasing amount of Internet traffic, it is difficult to guarantee adequate data transfer speeds, site availability and consistency. One of the major problems reported by students using the system has been the slow data transfer rate (Jones, *et al.*, 2000). High bandwidth options, such as broadband, are still expensive and not practical for many students.
- Communication and the "human element" - another limitation reported by students is the reduced face-to-face contact (Jones, *et al.*, 2000). Student feedback has shown that they prefer some face-to-face contact during an online-delivered course. At Griffith University Gold Coast, we have endeavoured to maintain a face-to-face component within the online system, using a combination of traditional-style lectures, tutorials, lecturer/tutor consultation and online delivery. The one-hour consultations, available weekdays, provide the opportunity for students to seek assistance and have contact with the lecturer/tutors. The students have used this resource extensively, especially before assignments and examinations are due.

3. HyWeb – The Evolving System

HyWeb is still evolving. As needs arise, these needs are met by system growth. Communication is an essential component and has been maintained in the HyWeb model via several media: email, online forum, online notice board and face-to-face (Jones, *et al.*, 2001). By introducing a *wireless* component, additional communication via WAP-based email, Internet-based forwarded email and SMS (short message service) can be achieved.

3.1 Wireless System Component

To provide more options for students, wireless technology is being incorporated within the system. It will be available through either a Web-enabled mobile phone and/or a handheld device such as a PDA. Students can also have limited access to the wireless system using a non-WAP mobile phone, by receiving SMS notifications and email through various Internet-based free, email forwarding services.

Along with its versatility and adaptability, wireless technology has certain limitations, which include: mainly text-based information; small screen size; high running costs; no keyboard or mouse (although a plug-in keyboard is now available for some models); and lack of storage space. Wireless communication bandwidth is low (transfer rates are currently around 9600 bps), but WAP was designed to cope with low bandwidth and intermittent coverage. There are many positive aspects and promising features of wireless technology, such as: portability and mobility; flexibility; convenience; remote access; and user-friendly devices (Jo, *et al.*, 2001).

The idea of mobile innovations and a wireless university campus is not new. Minnesota State University, Mankato (MSU) introduced a wireless system in mid-2000. Mobile handsets were provided and the students were expected to perform many of their daily tasks using wireless services (Virtanen, *et al.*, 2000). Mobile innovations were also introduced at Twente University in Holland, where the mobile phone is now considered to become an important tool for learning (Dorsey, 2001). Wireless technology in education is also referred to as wireless e-learning, and can offer many benefits. Grimes (2000) states that, "If wireless communication is still in its infancy, wireless e-learning is in an embryonic stage". Convenience is a key element of this technology, allowing anytime/anyplace access. Using wireless technology within the established delivery system, students will be able to: check assignment due dates and exam timetables; send email to the lecturer; access a web-lecture using a PDA; check the online notice-board; and join an online forum or chat session.

4. Conclusion

The HyWeb system has undergone many changes over the last few years, the most recent being the introduction of wireless technology. This is expected to have a positive effect on the students and their perception of the course. Handheld and wireless devices are used extensively in today's society and the concept of using such technology is both exciting and inspiring. HyWeb is constantly evolving with new technology being integrated into the system as it emerges. HyWeb enables easy modification of the system and allows for growth and flexibility. By constant reviews and modifications, ideas, inspiration and motivation are maintained and those involved strive to develop the system into the more fully expanded and improved structure. This is an ongoing project aiming at an effective and efficient dynamic learning environment, which can demonstrate increased flexibility, portability and convenience.

5. References

Dorsey, J. M. (2001) Going Mobile: A Dutch university aims to teach students on the run, *Wall Street Journal*; New York, N.Y.; Mar 12, 2001. Available online [http://www.wsj.com/public/current/articles/SB984072265634007065.htm]

Grimes, B. (2000) *Wireless E-Learning*, November 15, 2000, [http://www.cisco.com/warp/public/750/iq/ele/new/cut/ele_new_cut_0002/ele_new_cut_0002_1.shtml] (March, 2001)

Jo, J.H., Moon, K., Jones, V. and Cranitch, G. (2001) Innovations in e-Learning with Wireless Technology and Personal Digital Assistant, *Conference Proceedings ICCE2001*, Seoul.

Jones, V., Jo, J.H., and Cranitch, G. (2000) The Evolution of a Multimedia Delivery System and its Effects on Student Perception and Performance, *Conference Proceedings ASCILITE 2000*, Coffs Harbour, Australia.

Jones, V., Cranitch, G. and Jo, J.H (2001) HyWeb: A Hybrid-Web System for Delivery and Enhancement of Web-Based and Traditional Teaching, *Conference Proceedings AusWeb01*, Coffs Harbour, Australia.

Virtanen, V., John, S. and Wright, K. (2000) *Nokia and Midwest Wireless Establish Model Wireless Campus at Minnesota State University*, Press release (September 15, 2000) [http://press.nokia.com/PR/200009/790728_5.html]

Introducing ICT into Irish Schools. A Case Study report – Interim Findings

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Abstract: In terms of education technology the Irish education system is a late developer. In 1997 a government led initative, "Schools IT 2000" was launched to computerize the nation's schools. This qualitative research study documents the experience of five schools involved in piloting a communications and collaborative project called "Wired for Learning" that was sponsored by IBM and the Department of Education and Science. The data and the findings discussed pertain to the first year of the project's introduction in the participating schools. A follow-up study will be completed on the project's overall progress and development when the three-year project period comes to an end in 2002.

Introduction

In 1997 the Irish Government launched a major drive to computerize Ireland's schools when it established the National Center for Technology in Education (NCTE) to implement its "Schools IT 2000" policy initiative. The Schools Integration Project (SIP), administered by the NCTE, was a key strand of this initiative. Its remit was to explore creative ways in which ICT could be successfully integrated into the existing education system at primary and post primary levels. To achieve this, SIP invited schools to establish best practice models across a wide variety of school settings including, special needs, curricular and technical support. One of the SIP projects, known as "Wired for Learning" is the focus of this research.

Wired for Learning (WFL) is a secure communications and collaboration tool designed to develop the use of ICT for communications and collaboration purposes for the entire school community i.e. teachers, pupils, parents and mentors. It was developed by IBM as part of its global 'Reinventing Education' programme that began in 1994 in the U.S. In 1998 IBM Ireland and the Department of Education and Science announced a special education partnership and a $1 million investment in Ireland's school system to bring the WFL platform to a number of Irish schools under the SIP umbrella. Its core stated objectives were (a) To empower teachers with the capability to share resources and knowledge within and across primary and post-primary schools and (b) To facilitate communication and collaboration between schools, parents and the wider community.

There were five schools in total in the WFL project, 3 primary schools and 2 post-primary schools at two sites. Site one comprised three schools located in a disadvantaged suburban community in Dublin. Site two, was located in a more affluent semi-urban area in the far south of the country. As part of the project all schools were equipped with a state of the art networked computer lab.

Access to the WFL environment is facilitated via a standard web browser, a registered user ID and password. The environment is made up of a suite of tools or applications that support communication, collaboration and learning. Communication tools include secure email for all pupils, teachers, parents and mentors and a bulletin board interface which supports conferencing between parents, teachers and students. Collaboration tools facilitate student team projects, a private area where teachers can work together and the involvement of both local and global mentors. A suite of related databases known as the Instructional Planner support the learning process. A demo version of WFL is available for downloading at www.wiredforlearning.net/.

The Research Context and Research Questions

The research was carried out by a full time PhD Research Fellow located at Dublin City University using a case study methodology. Research tools included; (a) Classroom observations of how ICT was being used to support teaching and learning; (b) Attendance at project strategy meetings and staff training courses and (c) In-depth interviews with key personnel i.e. I.T. coordinators, school principals and teachers (n=37). The key three research questions focused on (1) teachers' perceptions of the innovation; (2) its usefulness as a communications and collaboration tool and (3) the sustainability and scalability of the innovation.

Teachers' views on the innovation were mixed. Many however questioned its usefulness and relevance to their classroom teaching and practice. The Instructional Planner section of WFL was particularly criticised in this regard. The main reason being that (a) it forced them to plan out lessons in a very structured way which was not how they traditionally planned their lessons; (b) the system was too cumbersome; (c) the process was too time consuming and (d) there was a deep suspicion that it was an attempt to bring in greater teacher accountability through the back door. In fact opposition to the Instructional Planner was so strong that most schools had effectively abandoned its use as a lesson-planning tool by the time the interviews were conducted. Instead the IT coordinators and principals were concentrating their efforts on encouraging staff to use other aspects of the innovation.

In general most teachers reported that WFL had given them the opportunity to collaborate more with each other. Teachers reported how training opportunities to learn the software as a group, in addition to the use of teacher release time which gave them the opportunity to plan how to use the system and to input lessons and resources into WFL, all helped this process. As one teacher phrased it – "the project has given us a chance to work together as adults". The facility afforded by the system to create a repository of resources for each year group was cited as a particularly welcome feature of the system and evidence of greater transparency, co-operation and collaboration among staff members. One school reported how its use of the system for encouraging staff members to electronically communicate agenda items for staff meetings had increased teacher involvement and contributions.

Opinions on its usefulness as a communications tool were less positive. Many could not see the point of sending another member of staff an email when they could talk to them in the staff room during break time or in the corridor. E-mail communications with parents was viewed in an even more problematic light. Teachers expressed a fear that emailing parents could potentially lead to a situation where too much teacher time would be required to service parent emails, particularly those of a demanding parent. The schools in the disadvantaged area also felt that emailing was impractical because very few of their students had PC's at home anyhow. Consequently none of the schools in this cluster group had yet put procedures in place to involve the parents in the project.

A number of reservations were expressed at both sites in relation to the sustainability and scalability of the innovation. Some of the main reasons given were (a) the expense involved in purchasing the WFL system which the pilot project sites did not have to incur; (b) a feeling that there were other systems available on the open market which could do the same thing in a more efficient and less cumbersome manner and (c) a belief that the WFL was culturally more suited to the American education system than to the Irish system. There was also a strong feeling among participating teachers that teaching colleagues in other schools would not be prepared to invest the same level of time and effort as they had. In addition many were of the view that any attempt to roll out the project nationwide would be opposed by the teachers unions. It was also difficult to see how other schools would be prepared to run with such a system if they were not going to receive out side technical assistance and support, on a par with that provided to the two start-up sites.

Conclusion

All in all the early evidence seemed to indicate that schools were struggling to integrate WFL successfully into the school environment and that it was unlikely to be a success if rolled out to other schools. However, as the project still had another year to run, the researcher is of the view that it is probably too early to make any substantive claims about the innovation's long-term sustainability and scalability.

Development and Application of CyberPedia: a New Platform for Internet-based Collaborative Encyclopedias for K-12 Education

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1. Introduction

Integrating encyclopedias with the Internet is changing the way K-12 students study with encyclopedias from looking at an encyclopedia to making one with all students and teachers participating and contributing. From this point of view, we have developed an Internet-based collaborative encyclopedia platform called CyberPedia for K-12 education.

It has three main features. (1)Easy uploading: Anyone can contribute to the encyclopedia by uploading his/her knowledge or learning results with multimedia contents via the Internet. (2)Easy Searching: Anyone can easily search for them. (3)Easy Authoring: Anyone can make a custom encyclopedia on a browser without having a database of technical knowledge.

2. Basic Design

CyberPedia supposes three types of users: a student, a teacher, and a site manager who is an expert or educator supervising designs and contents of CyberPedia as well as being a database manager.

(1) Student

First, a student explores and studies existing data in CyberPedia, which mean initial contents that site managers prepared beforehand. Then, he/she chooses an attractive topic and goes out in the field with a digital camera or a video camera to further investigate it independently. After returning to the school, the student completes observations in a template and submits them to CyberPedia. Finally, the student broadens his/her knowledge by comparing it to other's reports. CyberPedia offers students the opportunity to explain what they gathered so that it has some meaning for others.

(2) Teacher

The teacher's main tasks are to register user information beforehand and to manage data uploaded by students. CyberPedia enables the teacher to return comments or advice on each student's work and to make it public or private on the Internet. The default is private.

(3) Site manager

The site manager designs CyberPedia itself according to a learning theme. The design of an encyclopedia necessarily differs according to its contents or the author's expertise. Therefore, CyberPedia offers the site manager authoring functions to decide what search conditions are, what object data categories are, and so on. Moreover, the site manager can change the web site visually and insert the initial data into it. In short, CyberPedia is a platform for making custom encyclopedias. It can also provide students with multiple different encyclopedias at the same time.

3. Implementation

We used Linux as the operating system, Apache as the Web server, and PostgreSQL as the database because this software is all free and stable. The programming language is Java servlet and JSP.

Figure 1 shows a screen-shot of the search window of the microorganism guide housed in Sendai Science Museum and used by junior high school students in Sendai. The left frame is for specifying characteristics of the search conditions. Each entry in the encyclopedia (which we call an object) is linked with relevant characteristics. The middle one lists object names of the search results. Objects have the same data categories to classify data according to the contents. When one selects an object and a data category, its contents are shown in the right frame.

Needless to say, fixing the format reduces the flexibility of the encyclopedia's design to some degree. However, we considered simplicity and productivity to be more important than flexibility. This enables site managers to make a custom encyclopedia by editing characteristics, objects, and data categories and to design it by inserting icons and changing colors

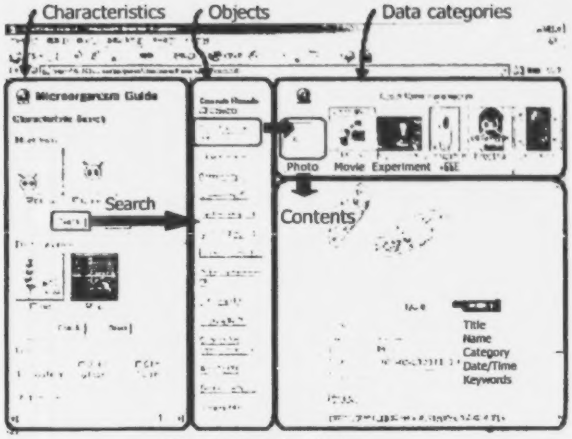

Fig. 1 Search window.

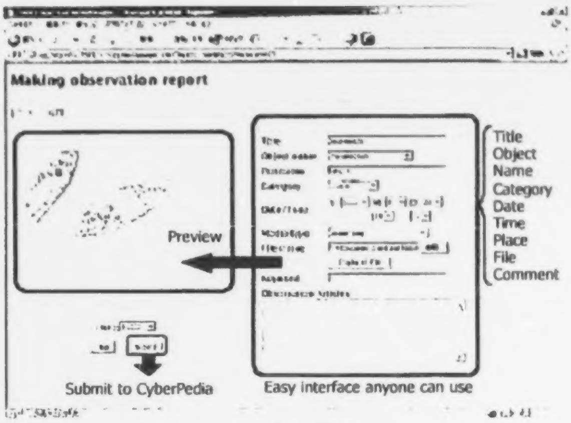

Fig. 2 Upload window.

on a browser. They can do almost all of the operations to make an encyclopedia just by selecting from menus.

Figure 2 shows a screen-shot of the upload window. This one page is a template for students to submit observations. They have only to input or select some items such as a title, object, data category, and comments. When the submit button is pressed, all information is automatically accumulated in CyberPedia. Contents can be uploaded in various formats, such as JPEG, MPEG1, and Quicktime movies.

4. Discussion about the applications using CyberPedia

The strengths of CyberPedia are to teach science as a process, to provide a good opportunity for students to express their thoughts, and to facilitate collaboration among distant students and experts. In some applications using CyberPedia (Kura 2001), the students tackled the learning theme independently. From the results of questionnaires, we found that all students were interested in uploading their findings and in debating with peers using CyberPedia. Not only exploring the initial contents but also observing the neighboring natural environment and uploading observations to CyberPedia were good opportunities for students to think deeply about science as a real natural phenomenon. Simply working in the CyberPedia environment challenged both teachers and students to change their teaching and learning methods.

However, the experiments revealed a lack of functions. For example, teachers said that the page uploading format did not challenge students to develop their own means of organizing information. Of course, it depends on students' skills, but we should offer alternative functions supporting drawing tools on the Web to develop the students' creativity (Sugiyama 2001). Besides that, we will also think about team-building activities and reflective writing tools in future.

CyberPedia is really a simple structure and has a great potential to various applications such as digital museums and community platforms. We think the most promising area is student portfolios. CyberPedia offers the potential for individual students to develop portfolios that they might develop over a lifetime of learning.

5. Conclusions

We described the concept and development of a new encyclopedia platform called CyberPedia. It is a web-based application; therefore it can provide an opportunity for distant students and teachers to make an encyclopedia in collaboration. This is very effective pedagogically, because uploaded contents include the position, date, and time of the observation, and students all over the country can study and investigate a specific theme, for example, the movement of the cherry-blossom front in spring or the distribution of growing trees, collaboratively.

References

Kura, T., Takahashi, T., Fujimoto, T., Kakehi, N., Tsuchiya, H. (2001). CyberPedia: an Internet-based Content-growing Encyclopedia and Evaluation of a Pilot Project, World Conference on the WWW and Internet, Association for the Advancement of Computing in Education.

Sugiyama, T., Takahashi, T. (2001). CollaBoard: Web-based Collaborative Learning System Using SVG, World Conference on the WWW and Internet, Association for the Advancement of Computing in Education.

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Integrating Simulators and Real-Life Experimentsinto an XML-based Teaching and Learning Platform

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Abstract: This paper deals with a specific aspect of the joint project "Wissenswerkstatt Rechensysteme" (WWR, Knowledge Factory for Computing Systems) of twelve German universities. It describes how to integrate external simulators and experiments into courseware based on an XML teaching and learning environment. The approach is based on wrapping experiments as Web Services. It provides an indirect access to the experiments through the central university learning system. We are convinced that learning by experiencing the phenomena of computer systems in simulation or/and in real working systems (is very helpful for) helps a computer science student to comprehend and to get acquainted with the more complicated topics in this field.

Introduction

In the ongoing joint project "Wissenswerkstatt Rechensysteme" [1] (WWR, Knowledge Factory for Computer Systems) (Lucke, 2002), a broad set of multimedia teaching and learning modules are being developed in the field of computer engineering. Each module can be offered at three levels, such as basic, advanced, and expert as per the target group (teachers, learners) in following output formats (HTML for Internet-based learning material, PDF for printed manuscripts, PPT for slide presentations). In order to achieve such a flexibility, modules are prepared in the Extensible Markup Language (XML) (Bradley, 2000), maintained in a repository and organized using metadata based on the IEEE Learning Objects Metadata (LOM) standard (IEEE,2000), (Monthienvichienchai, 2001). Based on learning objectives, teachers select the modules as per the needs of their students and offer these as a course. As a result, the materials required for a course are generated as per the request in the desired formats from/by the content repository using XSL (Extensible Style sheet Language) (W3C, 2001) processing techniques.

The WWW-based online course material so generated is described below in greater detail. For students, such courses mainly consist of pieces of HTML text, diagrams, pictures and other embedded multimedia documents. But computing systems and especially operating systems are not directly perceivable by human beings! A student cannot see, listen, touch and smell the running processes, the events happening etc. The most complicated are the practical exercises. In order to really comprehend and understand, how the system works, probably the best way is to experience a running system with all its effects and side effects, its dynamics, the occurring events and exceptional situations, the relations "if ... then ..." etc. (Gershon,2001). As a consequence, a much higher degree of interactivity is required compared to traditional course materials. This means incorporating simulators and interacting in real-time with external real-life systems and experiments. This type of environment was set up and used with great success for practical exercises about operating systems based on a more traditional technical platform and hand-coded experiment interfaces (Kalfa, 1997).

This paper deals with the higher degree of interactivity required and proposes a method for solving the technical problems arising from the external applications put on the Internet as if they were locally available to the student. The university has to keep the control on the interaction of a large number of students during such prearranged experiments. Chapter 2 discusses the problem of interactivity in more detail. Chapter 3 provides

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[1] This work is supported by the German Ministry of Education and Research (BMBF).

insight into the architecture developed, while chapter 4 discusses the initial examples of the application of this architecture.

The Problem of Interactivity

Web-based interactive course materials are written in HTML. Such courses run locally on the student's computer and use a standard browser as the user's interface. HTML links are used for referring to the local and external Web documents. Interactivity is typically based on buttons, animated GIFs, image maps and animations. Here, animation is defined as a time-based manipulation of some target elements visualizing some (e.g. technical) process. Animations are considered to be running locally as a part of the interactive course. They are well-suited for illustrating specific aspects of the behavior of the complex processes. In this sense, an animation is typically based on an abstract model of the real-world, and it is completely specified at design time concerning its time behavior. Thus, an animation can not be considered as a substitute for a real-life experiment. Today, for example, Macromedia Flash (Macromedia, 2001) is a well accepted commercial solution for defining animations in the Web environment. It allows link-based navigation to other elements of the course and requires a browser plug-in for playing the so-called Flash movies. In future, open W3C standards for animation like SMIL (W3C, 2001a, 2002b) may become important as well, when they are directly supported by browsers.

Compared to animations running locally, interfacing of external simulators and real-life experiments is more complicated. The principal architectural requirements are illustrated in figure 1. The protocol "user-experiment" demonstrates the dynamic interaction. The user can change the parameter of the simulation as well as the kind of measurements and the monitoring time interval, on the fly. The minimum requirements are a control window, a visualization window, and a measurements window.

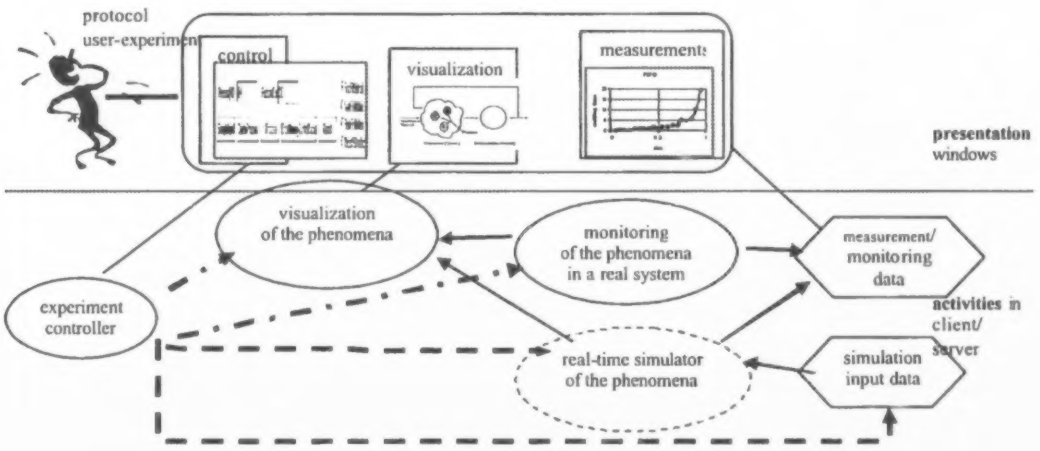
protocol
user-experimen
control
visualization
measurements
presentation windows
visualization of the phenomena
monitoring of the phenomena in a real system
measurement/ monitoring data
activities in client/ server
experiment controller
real-time simulator of the phenomena
simulation input data

Figure 1: Requirements of /for the architecture (full lines designate the data flow, and the dashed lines the control flow)

A simulation program or a running experiment typically requires some control input and will produce measurement data and other output information. Measurements are feasible in a simulation model or can be implemented by monitoring a real-life experiment. In the second case, an instrumentation of the system under measurement is necessary. Operating systems, such as UNIX/LINUX as well as Microsoft Windows offer services for information about the parameters specific to the running system. Other may be added to operating systems, if the source code of the operating system is given, i.e. LINUX and now Windows, as well.

The integration problem is even harder, when a "tight" integration is required, i.e. when the experiment or the simulator output affects the course materials presented. In this case, a different paragraph of the text may be presented, some alternative link in the presentation may be followed etc. Such cases require a dynamic

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rearrangement of the course material presented. Besides, the teacher may be interested in providing all his students access to the supplied experiments and in monitoring the students' progress.

Architectural Approach

This chapter describes the current approach to solve the problem of interactivity as outlined in the last chapter. The architecture developed is illustrated in figure 2. It distinguishes between the interactive course and the external simulators or experiments. The interactive course may be running on the learner's computer, perhaps at home, and on the learning system server running at the university site. The external simulators or experiments may be running somewhere, usually also at the university site. In some cases, it may be desirable to access these.on the learner's computer. In other cases, a complex and expensive experiment setup may need to be provided centrally for several universities over the Internet. Principally, interaction between the learner and the experiment takes place indirectly through the learning system at the university. This ensures full supervision, control and feedback. It also keeps account of the learner's actions and controls his access to the experiments offered as well as synchronizes these.

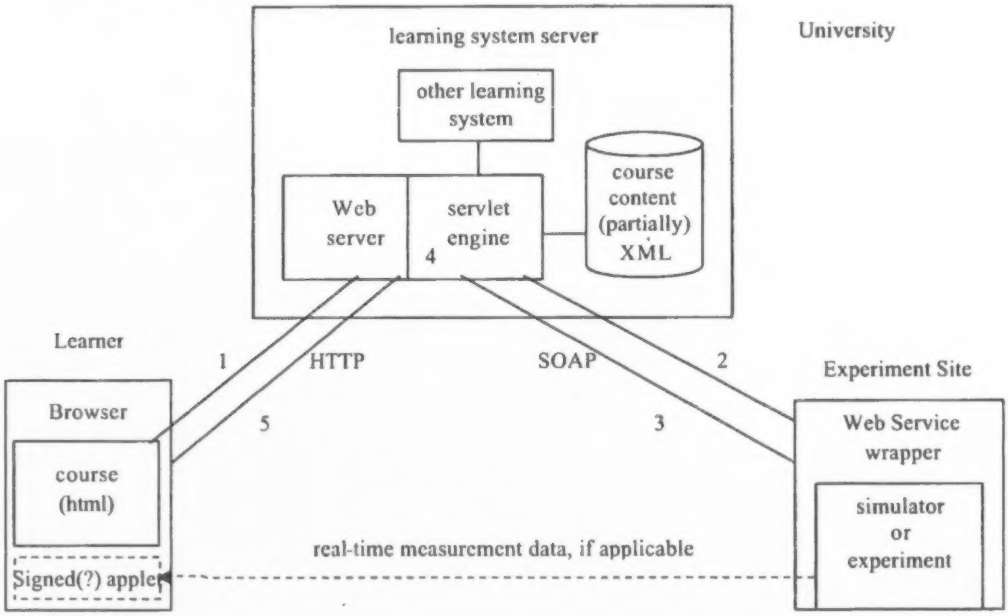

Figure 2: System Architecture

A general approach for interacting with a remote program component is called the Remote Procedure Call (RPC) paradigm, considering the request/response type of interaction between a client and a server . Classical RPC systems, like SunRPC or DCE/Microsoft RPC are based on a binary encoding scheme for parameters and results. This binary communication scheme is quite inadequate for the WWR learning modules, programmed as XML documents. Thus, a new approach is needed, which allows /provides for a seamless integration of the simulator/experiment results into the final HTML pages visible to the learner. Especially, this approach should be as generic as possible to cover all types of external components for all the different WWR modules under development as Boolean logic, circuit synthesis, processors, caches andsomething like this.
Our approach is based on XML documents. We currently envisage to use the so-called Web Service paradigm based on the Simple Object Access Protocol (SOAP) with attachments (W3C 2001c) for interaction between the learning system and an external experiment. SOAP uses XML documents for encoding input and output parameters and forwards requests using the HTTP protocol. The Web Services Description Language (WSDL) (W3Cd) is another XML-based notation. This describes services as a set of endpoints operating on messages.

These may contain either document- or procedure-oriented information. As a result, existing simulators or real experiments can be wrapped in order to transform them into a Web service. A big advantage is that SOAP wrappers can be often generated automatically, if an appropriate interface description is available.

Thus, the following interaction pattern results therefrom: The student is able to work most of the time locally on the course . Only when dynamic information is required for the external experiment or simulator, the browser will contact the learning system at the university site (1). Beside other components, which are not important for the discussion here, the learning system consists of a Web server with an associated servlet engine, an XML parser and a style sheet processor. Based on the student's input, a servlet will generate a SOAP request for the simulator/experiment Web service (2). When the response comes back as an XML document (3), it will be parsed and merged with the stored XML fragments. These are generated at course creation time by the included modules and processed by a stored style sheet. Its output is the final HTML page (4). This goes back to the student's browser (5). If a real-time measurement data stream from the experiment to the learner has to be supported as well, the approach described here can open a private communication channel between the experiment and a signed applet running on the student's browser, after this applet has been loaded from the university learning server (dashed lines).

This approach fulfils all requirements related to the dynamic generation of HTML pages and also has some other advantages: it keeps the student's environment simple. It just consists of his browser displaying standard HTML pages. The burden is put on the central learning system server at the university site which generates the more complicated dynamic HTML pages. This central server is able to uniformly interact with all simulators or real-life experiments used in all active courses. Furthermore, the learning system server is able to collect information about the students'.access to the external simulators/experiments. This information may be useful for other components of the learning environment.

Examples

Currently two modules are being prepared for evaluating the approach described in the previous chapter. The "source code" of the modules are stored in an XML-based repository. From this repository, different kinds of modules of the same subject can be generated:

- pictures and interactive animation of phenomena supporting real lectures
- textbooks with pictures and interactive animation for self-study and for complementing real lectures (s. Figure 3)
- local and/or in a client/server architecture usable experiments (simulation or on a real system).

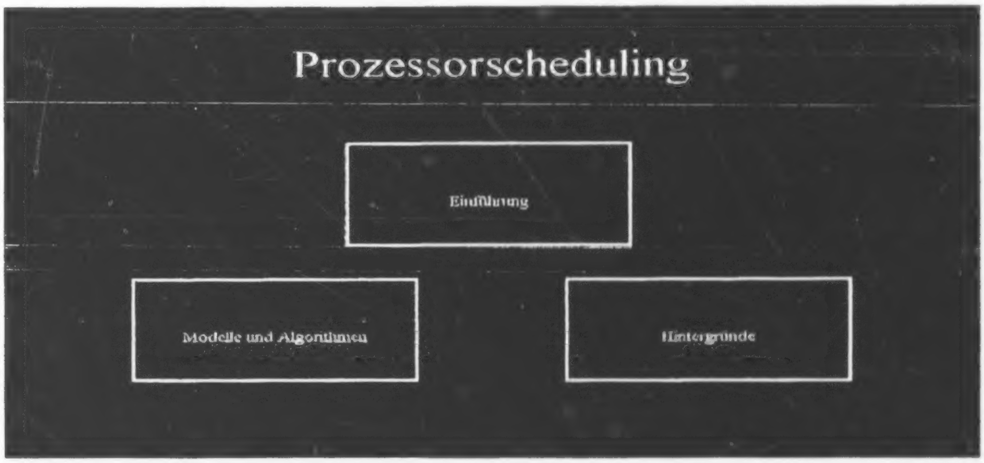

Figure 3: Snapshot of a "textbook-like" module

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By means of the first module "Processor Scheduling" the student can measure the arrival rate, the service rate as well as the waiting time, the actual queue length and utilization in a simulation experiment for processor scheduling. Thereafter, he is able to compare the simulation results with the theoretical ones according to the model.

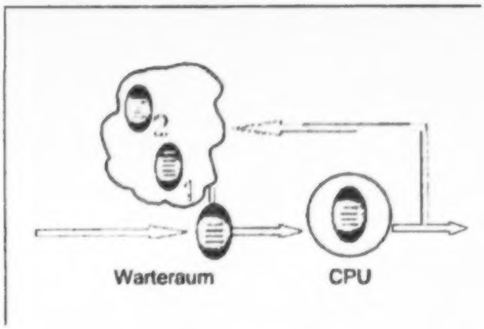

Figure 4: Snapshot of the visualization in an "experiment" module

The second module presents "Inter-Process Communication (IPC)", another topic of a classical lecture on operating systems. Here, the learning module interacts with real inter process communication examples being carried out on a remote Linux machine or a remote Windows NT system. In this way, the student experiences the classical UNIX IPC primitives like pipes and message queues and recognizes differences to similar NT abstractions.

Conclusions

We are convinced that learning by experiencing the phenomena of computer systems in simulation or/and in real working systems is very helpful for a computer science student to comprehend and to get acquainted with the more complicated topics in this field. Based on this assumption, we presented an architecture for integrating the external simulators and real-life experiments seamlessly into the course materials. These are being currently developed for the XML teaching and learning environment in the joint project "Wissenswerkstatt Rechensysteme" (WWR, Knowledge Factory for Computing Systems).

References

Gershon, N., & Page,W. (2001). *What Story telling Can Do for Information Visualization?*- CACM 44 (2001), No. 8, pp. 31-37.

Lucke, U., & Tavangarian,D. (2002). *Turning a Current Trend into a Valuable Instrument: Multidimensional Educational Multimedia based on XML.* To be published in ED-Media 2002.

IEEE (2000). Learning Technology Standards Committee. *Draft Standard for Learning Object Metadata*, New York, 2000. (http://ltsc.ieee.org/wg12/)

Monthienvichienchai, R., & Sasse, M.A., & Wheeldon,R. (2000). *There's trouble in paradise. Problems with educational metadata encountered during the MALTED project.* Proceedings of ED-MEDIA, Tampere (Finland), June 2001.

Bradley, N. (2000). *The XML Companion*, Addison-Wesley, London, 2000.

W3C (2001). *Extensible Style sheet Language (XSL), Version 1.0*, W3C Recommendation, 15 Oct. 2001 (http://www.w3.org/TR/2001/REC-xsl-20011015).

W3C (2001a). *Synchronized Multimedia Integration Language (SMIL 2.0)* Specification, W3C Proposed Recommendation, 09 Aug. 2001 (http://www.w3.org/TR/smil20/).

W3C (2001b). *SMIL Animation*, W3C Recommendation, 04-Sept.-2001 (http://www.w3.org/TR/smil-animation).

W3C (2001c). *SOAP Messages with Attachments*, W3C Note, 11 Dec 2000 (http://www.w3.org/TR/SOAP-attachments).

W3C (2001d). *Web Services Description Language (WSDL) 1.1*, W3C Note, 15 March 2001 (http://www.w3.org/TR/wsdl).

Macromedia (2001). *Flash* (http://www.macromedia.com/).

Kalfa et al.(1997). *Practical Exercises and Experiments in Operating Systems (German).* TR 3/1997, TU Chemnitz, Operating Systems.

WWR (2002). *Wissenswerkstatt Rechensysteme.* http://www.wwr-project.de

Video Clips User Interface Designs

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Abstract: The purpose of this research is to evaluate the new interface designs of the digital video clips for K-6 from the data, questionnaires, and interviews. The interface was changed on the following two points by the result of the previous research (Kamei et al, 2001)[1]: 1) Add up a function to stop a key scene of a clip for teaching, 2) Add up a function to connect the related clips. These two changes clearly meet teachers' needs and help their utilization in the classroom.

Introduction

The Japanese government promises that every classroom will have accessed to the Internet and have two PCs and a projector by 2005. From the promise, digital video clips, one of the digital materials, will have been much more developed near future [2].
On our previous research, we grasped the tendency of the teachers' utilization and problems when teachers use the clips. In this time, we fixed the interface for viewing the clip by the above findings.

Research and Development

Clips Background

The clips and the interface were customized for elementary schools (K-6) in Japan. It was assumed that teachers would show the clips for their students. The subject is Japanese History. The image on the clips, 30-90 seconds, were selected from NHK (Japanese public broadcaster) archives, and re-edited.

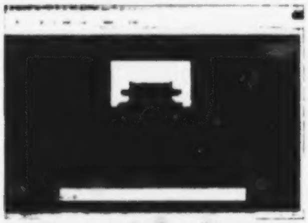
Figure 1: Before Change

1st Change: Add up a function to stop a key scene of a clip for teaching

It was clear that teachers often try to make a stop in the middle of clips, but they struggled. Therefore, we put small pictures which shows the position where the key scene is (Fig. 2).

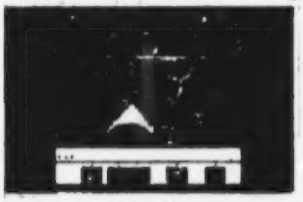
Figure 2: 1st Change

2nd Change: Add up a function to connect the related clips

It was clear that teachers combined the clips in the different units. Although they wanted to use such way, it was very hard because each clip was isolated by the era categories. From that, our solution to this problem is to put and link a small picture which is related (Fig. 3).

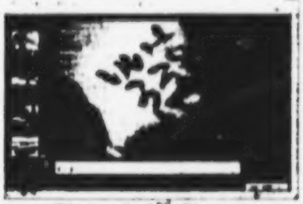
Figure 3: 2nd Change

Methodology

25 teachers were chosen and 72 clips were prepared for this research, April-July, 2001. Questionnaires and interviews were made in order to evaluate the changes. 22 of the 25 teachers were replied our questionnaire after using the clips. The interviews were made to 12 of the 22 teachers.

Results and Implements

1st change

In the first investigation, we compared with two groups, a group of key scenes with small pictures and without small pictures by the number of the teachers who stop and use the clips. As a result, the clips with small pictures are more stopped by teachers, comparing with the clips without small pictures (t=4.75, p<0.01)(Tab. 1).

From the interviews, there are two types of reactions: one is positive and the other is average. The reason of the positive reaction is that it is easy to show clips quickly. In addition, the teachers who are novice for teaching could easily recognize the key scene where many teachers think it is important for teaching.

The reason of the average reaction is mostly from the teachers who have much experienced for teaching because they did not care the key scene.

From these results, we concluded that the first change was efficient for the teachers because there is no negative opinion.

	Mean	SD
With small pictures(43 scenes)	6.95	3.92
Without small pictures(293 scenes)	4.03	2.50

Welch's t-test (N=22, t=4.75, p<0.01)

Table 1. Scene stopped

2nd change

Table 2 shows the ratio of the pair of clips (A and B) with the new interface. The utilization of the clip A in 2002, which is put and linked the small pictures, is higher than Clip A in 2001.

From the interviews, all teachers evaluated that the second change were efficient. The main reason is that it is easy to show clips quickly because they did not need to go back to the top page of the unit one after another.

From these results, the second change, put and link the small pictures on the same page, was efficient for the teachers.

	Clip A	Clip B
2002 (N=22)	95.5%	100.0%
2001 (N=27)	77.8%	-

Table 2. Utilization of a pair of clips

Conclusion

It is concluded that the new interfaces, which put small pictures under control bar, would be helpful for a teacher to select a key scene. Teachers immediately could show the scene that they want the students to watch. The second change, put and link the small pictures on the same page, are also efficient for the teachers.

Further research would be needed especially on the following three points:1) Needs to conduct experimental study. 2) Needs to collect more data about the teacher's utilization of the clips.3) Needs to develop the system to reflect the data from the teachers' past usage.

References

[1] Kamei M., Yokota M, Mizukoshi T. (2001). Teaching with Digital Video Clips - Video Clips about Japanese history in elementary school -. *Proceedings of ICCE/Schoolnet 2001*, Soul, Korea, 1:447-450

[2] Ministry of Education Culture, Sports, Science and Technology, Supporting Documentation for the "Millennium Project" (Accessed on April 2002) http://www.manabinet.jp/it_ed.pdf

Bringing Computer-Supported Reading One Step Further

Individual Assistance through Screen Typography and Speech Synthesis

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Abstract: The research focus of this study is how to use computers to support and improve dyslexic students' reading and writing performance. More than 10% of the population is estimated to experience substantial difficulties. We propose to offer *personalised text formatting according to individual profiles* when reading screen texts, and preliminary studies indicate improved reading performance among poor readers. We also propose to use *speech synthesis* in order to give auditive support to the reading process. Improved reading is of importance both to the students' motivation and the overall learning outcome. It is important that the increasing use of computers in primary schools does not result in just another arena for shortcoming for dyslectic students.

Introduction

Reading consists of two components; decoding and comprehension. *Decoding* refers to the technical skill that enables the reader to transform printed letters into recognised words as the basis for activation of meaning. *Comprehension* is a cognitive process that allows the reader to interpret the text, which includes thinking processes on higher levels. This basic concept of reading must be completed with an additional component; *motivation*. Motivation is crucial in all learning tasks.
Some research shows that as many as 15--20 % of the students in primary and secondary schools have problems in meeting the required level of literacy in today's society (Catts and Kahmi 1999, Solheim and Tønnesen 1999). Other studies, however, show a substantially lower prevalence of reading problems.
At the onset of the 21th century the computer is increasingly being adopted as a relevant tool (and medium) for reading and writing. Both in Norway and internationally, the number of computers per student has increased over the last few years as well as the time spent working with them. It is of great importance, however, to realise that the introduction of computer technology in schools implies both a risk and a possibility. If the special needs of students with literacy problems are not recognised and taken into account, the use of computers in classroom based project groups may well represent an additional hurdle instead of a compensatory asset.

In our work we have developed a prototype to support reading on screen for persons with reading disabilities. The basic functionalities offered in the first version are:
- personalised text formatting;
- auditive support using speech synthesis (single words, sentences and paragraphs).

The target group is students (primary and secondary school), but the software may be useful to adults with reading difficulties as well. In a future version functionality supporting writing and project work will be added. Our study has a twofold focus: a) utilisation of the computer to help students with reading and writing difficulties to decode and comprehend, and b) application of technology in such a way that these children are integrated in the computer-based activities in the classroom.

Reading: support for decoding, comprehension and motivation

Decoding support: From research conducted over the past 20 years, we know that many factors influence legibility of texts on computer screens, see (Kamstrup et al., 2002 and Harrell 1999). Computer texts may be formatted according to individual reading levels and personal preferences, a possibility the printed book does not offer. Our prototype supports adaptation of font type, font size, line length, line spacing, word spacing, type colour and background colour (see Kamstrup et al., 2002). Each student can create her own individual profile, and subsequently all texts that the student chooses to read will be formatted according to her established profile.

Comprehension support: Several researchers have recommended the use of speech synthesis to support decoding and comprehension in children with reading difficulties (Wise 1997, Lewin 2000). Wise et al. (1997) found that speech synthesis substantially improved the disabled reader's reading performance, and this has recently been confirmed by Lewin (2000). The prototype offers a "read-it-loud-to-me" functionality through speech synthesis. The student can choose to listen to words, sentences or paragraphs according to the individual needs. The words are highlighted while being read.

Motivation: Speech synthesis supports comprehension, and provides for the poor reader a necessary distance to the laborious task of technical decoding and as such strengthens the communicative aspect of literacy. This may make the reading task more enjoyable, stimulate further reading, enhance a sense of mastery, and trigger more motivation.

Results and future research

We have conducted preliminary studies that indicate both improved reading performance (Haugen 2001) for poor readers and increased motivation for reading when using our prototype. Further and more in depth studies are necessary to show the real effect of reading individually adapted texts on the computer screen as compared to traditional paper-based reading, and experimental designs that can show this effect must be developed. Such studies will be carried out in the context of this research project over the next two years.

Conclusion

Knowing that children with reading and writing difficulties are motivated by certain uses of computer technology, this must be exploited for the best of struggling readers. Computers are an integral part of the daily life of many children, and we must ensure that the process of introducing computers in the classrooms will be an asset for all students. Several researchers have shown improved reading either by the means of screen design and typography or by speechsynthesis. In our prototype we have integrated these two options to make an even better support for dyslexic children.

References

Catts, H. and A. Kahmi (1999) *Language and Reading Disabilities*. Boston: Allyn and Bacon.

Harrell, W. (1999). Effective Monitor Display Design. *International Journal of Instructional Media. Vol 26, no 4*, pp 447-458

Haugen, A. (2001). *Fra bok til skjerm - Fortidens læremiddel inn i nåtiden? En studie av lesesvake elevers lesing i bok og på dataskjerm*. Master Thesis, Department of Special Needs Education, University of Oslo.

Kamstrup, G., Mjøvik, E., A-L. Rygvold, B.G. Saltnes (2002). *Multifunk: Bringing computer-supported reading one step further*. NR Technical Report no. 983, April 2002, ISBN: 82-539-0491-6.

Lewin, C. (2000). Exploring the effects of talking book software in UK primary classrooms. *Journal of Research in Reading. Vol 23, no. 2*, pp 149-157.

Solheim, R.G. and F.E. Tønnesen (1999) *Kartlegging av leseferdighet og lesevaner på 9. klassetrinn*. Høgskolen i Stavanger, Senter for leseforsking.

Wise, B., R. Olson and J. Ring. (1997) Teaching phonological awareness with and without the computer. In: Hulme, C. and M. Snowling (eds.), *Dyslexia: Biology, Cognition, and Intervention*. London: Whurr.

Virtual Design Studio for Collaboration

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Abstract: The purpose of this research is to develop a collaborative architectural design system. Design collaboration requires an extensive use of communication methods as well as the participation of various experts from different domains. Such facts address several issues when the Internet and digital media are able to create a completely new work environment. The building design process was studied, and possible modes of design collaboration were defined. A prototype system is being developed in accordance with the defined collaboration model. The system integrates a set of communication tools and web-based design media. Such media include a synchronous multi-user Web CAD tool, a schematic 3D design tool, and a graphic whiteboard. A project database was designed in order to coordinate the project-wide communication which elaborates technologies such as web-based data access. In order to find out the effectiveness of the system, a usability test was performed both in quantitative and qualitative manner. The research will contribute to the development of world-wide design and construction collaboration through the Internet, which is becoming a mainstream building process model.

Introduction

In architectural design team works are often required, and thus collaboration from a number of participants of various specializations is needed to complete a project. For collaboration the design process should be formalized, and communication methods should be established. Since Internet and multimedia play an important role in current computer applications, it is desirable to develop a collaboration system which manages and integrates design data and project data by various communication tools and digital media [11]. Collaboration based on multimedia communication though World Wide Web enables designers to share both synchronous and asynchronous information on database, and thus to manage design project effectively. This is due to enhancement of operating system tool libraries and programming API's which make Web-based programs efficiently share 3 dimensional design data and work space among multi-users. These kinds of technological opportunities and communication needs in design process naturally lead to the development of real time design information sharing system, virtual design studio for collaboration.

Recently efforts on the development of collaborative systems have been made, but they focused on asynchronous text-based document management instead of synchronous information sharing. For a collaborative system to share design work space, it is required not only to overcome technical barriers but also to understand the design process. The purpose of this study is to develop a collaborative design system which let designers generate design objects and discuss them synchronously through the Internet. For the system a number of different types of graphic tools are introduced according to design development stages; graphical whiteboard, Space Builder, Space Planner and WebCAD. The system also supports asynchronous communication means like web-mail, project bulletin board, chatting board and video conferencing.

For effective collaboration in architectural design following aspects should be considered. First, visual communication by graphics is more prevalent than by text or dialogue. Second, design data should be stored in a database along with media objects as their container and project management schedules [7]. Third, collaborative working environment should be differentiated and be supported accordingly. Fourth, such design related information as building regulations should be linked to generated design data for design evaluation.

Conceptual model and system components

In order to develop the system the communication model of the design process was investigated, and then tools are defined for model components. The system environment is designed to integrate these tools (Figure 1), while multicasting technology is adopted for synchronous communication (Figure 2). The system has project database for design data at the center, and design data are reported by project work schedule.

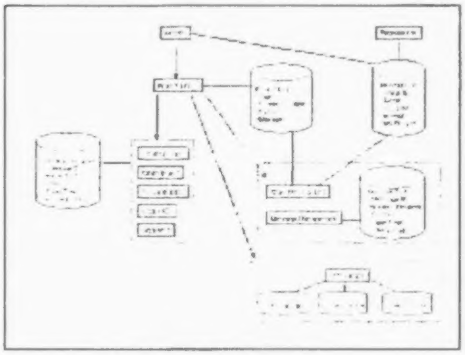

Figure 1 System structure

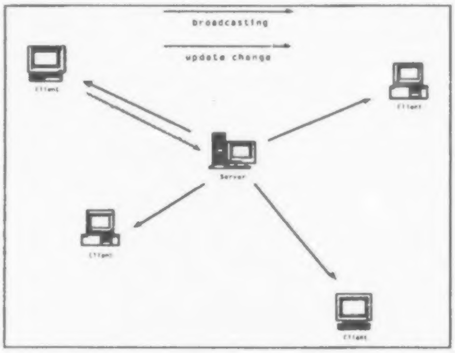

Figure 2 Multicasting concept

Design and communication tools

To support design and communication activities through the design process Web-based functional tools are implemented. The design process consists of primitive sketch, conceptual modeling, schematic modeling and detail construction modeling. For this study three early stages are taken into consideration to cover design studio curriculum at colleges. Light-weighted graphic programs which have limited graphic functions but enable designers to share work space in real time is very important for synchronous communication during early design stages. Following tools are developed to share work space by Internet for multi-users,.

Early sketch tool : Graphic whiteboard

At an early design stage designers need to communicate with a simple sketch tool. Graphic whiteboard is similar to existing electronic whiteboard augmented with graphics functions. However, sketch data are stored for reuse at later stages.

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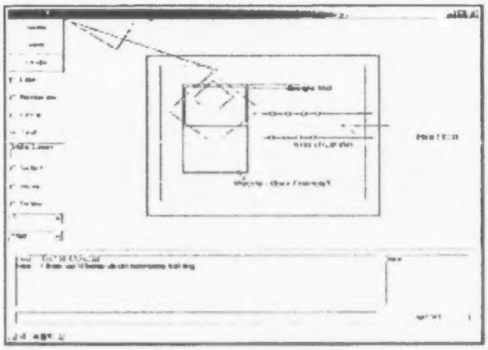

Figure 3 Grpahic whiteboard

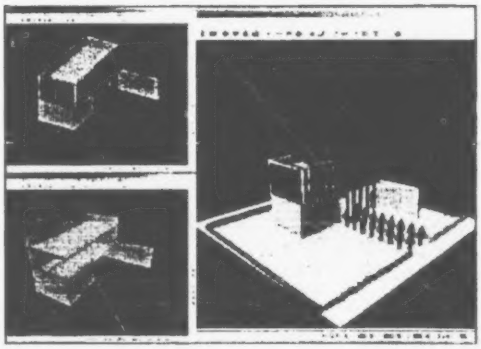

Figure 4 Mass builder

Mass design and study tool : Mass Builder

For a conceptual model 3 dimensional solid design objects (building mass) are represented and displayed in real time to project participants.

Space configuring tool : Space Planner

After a building mass is studied, division of the mass vertically and horizontally for interior space configuration is required. Space planner is developed as a separate module.

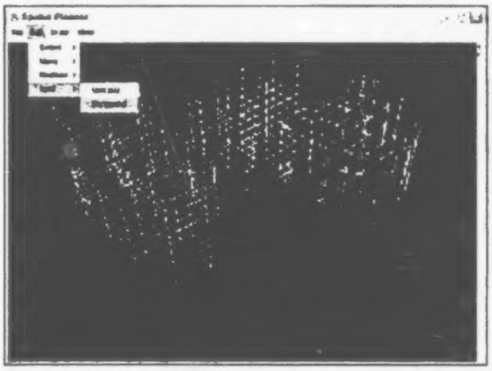

Figure 5 Space planner

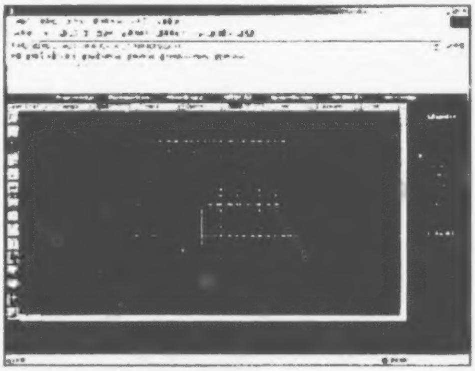

Figure 6 WebCAD

Schematic design and drawing tool : WebCAD

At the schematic design stage spaces are defined elaborately with precise dimensions and antidotes for building elements. For this purpose a Web-based CAD program is developed.

Design Information Center and Project scheduler

To evaluate a proposed design, related information is retrieved from the database through Web page interface. Building codes, construction and engineering specifications and similar project design data are primary data sets which will be growing richer as users contribute relevant information. When users participate in a project session, the project scheduler will provide work management space of a calendar type interface.

Figure 7 Related information

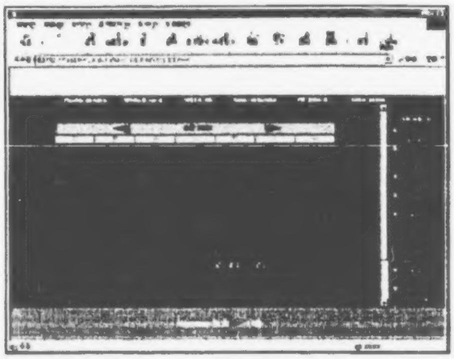

Figure 8 Project schedule

Notable features of virtual design system

Virtual design system provides an integrated collaboration design environment.
Collaboration design environment requires a number of networked computer application softwares which enable multiple users at different locations to share ideas, design information and data both synchronously and asynchronously. The system supports this kind of work environment.

The system has a number of rich multimedia databases.
Architectural design information is documented in tow primary formats; text and geometric objects. Project database, case database and scheduling database are constructed with various multimedia formats such as graphics, images, animated data, video and voice data. In an era of multimedia generation, it would be quite natural to store, search and use multimedia data for design projects.

The system has convenient visual communication tools.
General purpose communication tools such as web mail, text and voice chatting are included in the system. Furthermore, synchronous whiteboard for sharing ideas and data is embedded in the system. Therefore, synchronous / asynchronous and text/multimedia communications are supported in the system.

The system has outstanding web-based architectural design tools.
In architectural design, visual objects are used for effectiveness and efficiency in communicating with other members who are involved in the same project. At the early stage of design, visual objects are sketched images. As the design proceeds, they become geometric objects that have mathematical properties. To be more precise, physical object specification annotations are added to the objects. For the system, web-based visual tools for sketching, 2D drawing and 3D modeling are implanted.

The system has near-perfect work schedule management tools.
Design project management involves precise scheduling of design process and workers in various areas such as construction, electrical field, etc. Therefore, the system provides work calendars for keeping track of work progress. That could be used as checking points.

Usability test

Usability testing has been performed to evaluate the efficiency and effectiveness of the system. In order to increase the test authenticity, three real architectural design projects - museum, office and house design- were assigned to three different groups. Each group consists of three designers. The entire design process of three teams has been recorded using videotapes. A survey and interviews were also conducted to investigate the perception of the

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participants toward the function of the system.

On the basis of videotape data analysis, the design process of each team has been identified and integrated as the following steps:
First, after the log-in process, the designers opened the whiteboard and chatting board to communicate their initial ideas synchronously. They used the picture files of the ground and surrounding environment to review the possibilities. Secondly, the designers used the Info-center to search for the similar drawings and related regulations. Thirdly, they started to Mass Builder to generate 3D mass and communicate through the chatting board. Finally, they used the WebCAD to draw the 2D drawing and share their comments using bulletin board. Designers were hardly used the Space Planner to avoid the risk of spending too much time to build the 3D simulation.

The results of the survey and interviews identified the most used and comfortable functions and identified the most needed modification of the system. Whiteboard and Mass Builder were the two most used functions. Info-center, Mass Builder and whiteboard are the most comfortable functions perceived by the designers.

Designers asked to modify the following four functions the most:
First, designers asked to integrate the drawing and writing functions of the whiteboard. Second, designers asked to integrate the whiteboard and Mass Builder in order to share their ideas effectively as well as efficiently. Third, designers wanted to have their own team bulletin board and team Info-center for better communication and ownership. Finally, and mostly designers required to have data transfer. For example, data generated by whiteboard should transmit to the Mass Builder for the foundation to avoid the repeated work.

Other than functional requirement, the role of team leader or facilitator is a major variable to the success factor in collaboration. Therefore, the training or assisting function a team leader or project manager should be included in the system.

Conclusions and future works

Using the Internet as a communication method arises security problem of the system. This problem is not solely subject to technical solution, but multitudinously subject to communication models during the design process.

Virtual design system also needs extended works in following areas. First, graphic data file format should be standardized for the data exchange with existing systems. Second, mark-up methods should be developed to search and manage semantic values of design objects. Third, formalization of the design process should be elaborated to establish project schedule by stages.

References

Anderson, D., Barrus, J., Howard, J., Shen, C. and Waters, R. (1995). *Building Multi-User Interactive Multimedia Environments at MERL (Technical Report TR95-17)*. Cambridge, MA, Mitsubishi Electronic Research Laboratories.

Berge, Z.(1995). Facilitating Computer Conferencing: Recommendations from the Field. *Educational Technology*. 35(6). 22-30.

Broll, W. (1995). Interacting in Distributed Collaborative Virtual Environments. In: Preceedings of the *Virtual Reality Annual International Symposium*. VARIS'95 (pp.148-155). Los Alamitos, CA, IEEE Computer Society Press.

Broll, W. and England, D. (1996). Bringing Worlds Together: Adding Multi-User Support to VRML. In Proceedings of *Virtual Reality Modeling Language (VRML) Symposium*'96(pp.87-94). New York, NY, ACM.

Cheng, N., Kvan, T., Wojtowicz, J., vanBakergem, D., Casuas,T., Davidson, J., Fargas, J., Hubbell, K., Mitchell, W., NagaKura, T. and Papazian, P. (1994). Place, Time and the Virtual Design Studio. In Proceedings of the 1994 Conference of *The Associantion for Computer-Aided Design In Architecture*(ACADIA '94) eds. A. Harfmann, and M.Fraser ACADIA 1994, Saint Louis.

Engeli, M., Kurmann, D., Schmitt, G. (1995). A New Design Studio: Intelligent Objects and Personal Agent in a Virtual Environment. In Proceedings of the 1995 Conference of *The Associan for Computer-Aided Design in Architecture*(ACADIA'95) eds. L.Kalisperis and B.Kolarevic ACADIA 1995, Seattle.

Kim, S. (1997). *Version Management in Computer-Aided Architectural Design*. Doctoral Dissertation, Harvard University, Cambridge, Massachusetts

Mandeville, J., Furness, T., Kawahata, M., Campbell, D., Danset, P., Dahl, A., Dauner, J., Davidson,J., Kandie, K. and Schwartx, P. (1995). GreenSpace: Creating a Distributed Virtual Environment for Global Applications. In Proceedings of *IEEE Networked Virtual Reality Workshop*.

McCall, R., Bennet, P., Jgnson, E. (1994). An Over view of the PHIDIASII HyperCAD System. In Proceedings of the 1994 Conference of *The Association for Computer-Aided Design in Architecture*(ACADIA '94) eds. A. Harfmann, and M Fraer ACADIA 1994, Saint-Louis.

McCall, R., Mistrik, I., Schuler, W. (1981). An Integrated information and Communication System for Problem Solving Basic Comcepts. In Data for Science and Technology: Proceeding of the Seventh *International CADATA Conference*. Pergamon,1981, pp.107-115.

Renbensburg, K., Hetxer, D., Joans, K., Kaul, M., and Schafer, J. (1995) Distributing Virtual World in a Teleteaching Environment. In Proceedings of Fifth *IEEE Computer Society Workshop* on Future Trends of Distributed Computing Systems(pp.66-75). Los Alamitos, CA: IEEE Computer Society Press.

Tsai, D. and Kim, S. (1997). Human-Machine-Design Matrix: A Model for Web-Based Design Interaction. *CAADFutures* 97

Wojtowicz, J., Papazian, P., Fargas, J., Davidson, J. and Cheng, N. (1995). *Aspects of Asynchronous and Distributed Design Collaboration*. Virtual Design Studio. ED. Jerzy Wojotowicz. Hong Kong University Press.

Acknowledgements

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MLT: A database driven WWW Media Literacy Tool

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Abstract: This paper describes development of the Media Literacy Tool (MLT), a web-based media literacy and media effects research and learning tool. Media messages have permeated our world. Humans today, in many cultures, are bombarded with communications from advertising television, video games, etc. Many of these messages are created with specific intentions to evoke particular responses. Most of us are not equipped to critically receive these signals, and many of us fall victim to effects of media exposure. MLT is designed to address the poverty in media research and education. As a tool for supporting collaborative content research, critical observation and emotional awareness, MLT will facilitate media effects, literacy and resiliency research.

Rationale

Television, video games and music have been cited as a causal factor in increased levels of violent behavior in many studies including National Institute of Mental Health, 1982; Murray, 1980; Rehman & Reilly, 1985. Heavy viewing of television has been tied to increased fear about real world personal safety (Signorielli, 1991). Videogames have been found to play a role in the development of unhealthy self-image among girls (Children Now, 2000). Positive effects of viewing television have also been documented through the demonstration of increased prosocial behavior (Fairchild 1984) and the development of academic skills (Rice, Huston, Truglio & Wright, 1990).

Media educates both intentionally and unintentionally. Yet not enough research is conducted to document the contents of media messages and examine the effects of media exposure and possibilities of media education. Only a few countries, such as Canada and England, have recognized the need for formal media education at the pre-college level.

Many public interest groups and concerned individuals have recognized the need to have a media savvy society. Groups like Action for Children's Television, The Center for Media Education, Alliance for a Media Literate America, National Institute on Media and the Family, and Citizens for Media Literacy were formed to have greater political and programmatic influence over the production, consumption and monitoring of media.

The Media Literacy movement is desperate for consistent broad research and data collection. In only a handful of published studies have researchers taken a sustained look at a breadth of elements and their relationships. Research has focused on analyzing a specific aspect of a particular medium during a brief time period. Quantification and deconstruction of various media has never been done on a large scale for a sustained time period.

Media educator Rene Hobbs emphasizes the skills of reading and writing in relation to media literacy. In addition to data compilation, MLT focuses on the reading of media. Through the act of critical observation, participants will become more cognizant of what they are viewing. Becoming more observant and critical of media messages perhaps makes one more resilient to media exposure. As Anderson and Ploghoft (1993) suggest, awareness individuals build allow for better comparison and contrast with every day life. Pilot research will explore the potential of critical observation in viewing and its influence in developing media resiliency.

Program Design

MLT will collect, compile and organize information about the content and structure of various media, including television, music, movies, magazines, Internet, videogames and advertisements. The databases will be accessible through the web, enabling a wide range of individuals to access and contribute to the data and fields, and perform analyses of variables across different media. Example variable sets include character (such as species, gender, race, age, sexual orientation, occupation, behavior [acts of kindness]), setting (indoor/outdoor, view of sky), time (day/night, sequence of events, period, season), formal features (#cuts per second, dissolves). The goal is to compile the most comprehensive database, tracking all messages transmitted through various media, while fostering more critical observation of television content and greater consciousness of emotional reactions in media viewing experiences.

The original concept for MLT arose in development of "Television and Development of Youth" online (Kaplan, Espinet, Mouza, & Van Nest, 1999) and was discussed in a paper on tools for online collaboration (Mouza, Kaplan, & Espinet, 2000). Rough drafts of MLT were piloted by the Fall 1999 and Fall 2001 classes. Pooled data collected during individual television viewing was informative, documenting ethnic, gender and behavioral trends in television programming, and serving as a communal resource in discussion and research. Students reported that observation activity led to greater awareness of media messages.

MLT will include several interfaces for various age levels including: children age 2- 5; age 6-11; adolescents from age 12-17; and adults age 18 and up. Each interface will be designed for age appropriateness, informed consent will differ, and certain variables will not be accessible to all audiences. Most fields will be common to all users.

MLT encourages community data collection. One pool of "data" will be submitted by trained coders. Example media will be viewed, analyzed and discussed in order to achieve the highest degree of inter-coder reliability. A second pool of data will be contributed by participants who access the MLT via the web. A personal profile will include personal characteristics fields, and track submitted data (with permission).

Participants will respond to sets of fields about media under observation. Fields will be divided into sections based on characters, action, setting, and formal features. Databases will allow for comparison and compilation of fields. Participants will be able to customize the interface and variables sets for personal observation or for facilitation of use by a target group, curriculum or research study. A media diary will be available for participants to indicate what shows, songs, etc., they have experienced on a particular day, and thoughts and feelings they inspire. A lesson archive will provide frameworks around which to design, submit and conduct lessons involving viewing, observing and analyzing data. Printable forms will be available for offline work.

The project team plans to connect with several other database projects currently under development at Columbia University. One tool under development by Kaplan and Hasher, the *Ecology Observer*, will facilitate observation, data collection and analysis of ecological elements in real spaces, as in the corner of 120th and Broadway, over space and time. The combined use of both tools will allow for comparisons of the real world to the media world.

References

Children Now. (2000), Girls and Gaming,at http://www.childrennow.org/media/video-games/video-games-girls.pdf.

Fairchild, H.H. (1984). Creating, producing and evaluating prosocial TV. *Journal of Educational Television, 10(3),* 161-183.

Mouza, C., Kaplan, D., & Espinet, I. (2000). A Web-based Model for Online Collaboration between Distance Learning and Campus Students. *Proceedings of the World Conference on the WWW and the Internet.* San Antonio, TX.

Murray, J.P. (1984). Children and television violence. In J.P. Murray, & G. Salomon (Eds.), *The future of children's television: Results of the Markle Foundation/Boys Town Conference.* Boys Town, NE: Boys Town Center.

Kaplan, D.E., Espinet, I., Mouza, C., & Van Nest, C. (1999). *Television & the Development of Youth* online. Distance Learning Project (DLP), Teachers College, Columbia University.

Kazdin, A.E. (1997). Conduct disorder across the life span. In Luthar, J. Burack, D. Cicchetti, and J. Weisz (Eds.), Developmental psychopathology: Perspectives on adjustment, risk, and disorder (pp.248-272). New York: Cambridge University Press.

National Institute of Mental Health (1982). *Television and Behavior: Ten years of scientific progress and implications for the eighties (vol.I), Summary Report.* Washington DC: U.S. Government Printing Office.

Rehman, S.N., & Reilley, S.S. (1985). Music Videos: A new dimension of televised violence. *The Pennsylvania Speech Communication Annual, 41,* 61-64.

Rice, M.L., Huston, A.C., Truglio, R., & Wright, J.C. (1990) Words from Sesame Street: Learning Vocabulary while viewing. *Developmental Psychology, 26,* 421-428.

Interactive educational software for exploratory learning of Geophysics

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Abstract. *GAIA* is a microworld-based learning environment aiming to provide means for exploratory learning to secondary school students in the fields of physics, mathematics and geosciences. This paper presents *Gilbert*, one of GAIA's microworlds aiming to familiarize students with contemporary geosciences.

Introduction

Unlike in other fields of studies, such as physics and mathematics (Thornton and Sokolo, 1990), most of the available commercial educational software related to Earth School Studies, is either *drill-and-practice oriented*, where students are presented with problems to solve and they receive feedback about the accuracy of their responses, or tutorial-*based oriented*, following the archetypal form of text, graphics or multimedia information associated with relevant self-evaluation tests. However, such environments (Kali *et al.* 1997) do not strongly facilitate students towards constructing their own knowledge through open-ended experimentation (Jonassen, 2000). On the other hand, microworld-based educational software can provide the means for exploratory learning, by providing the environment for students to learn-by-doing, rather than just watch or listen to a description of how something operates. Briefly, a *microworld* is a computer-assisted problem exploration and experimentation space in which one can explore and construct. Typically, they are constrained versions of reality that enable learners to manipulate variables and experiments within parameters of some system. Furthermore, the most advanced microworld-based educational software provides the means to educators and learners to construct their own exploration spaces. This is this the case of *GAIA* which allows learners to represent their own thinking in the ways that they explore, manipulate and experiment with the environment.

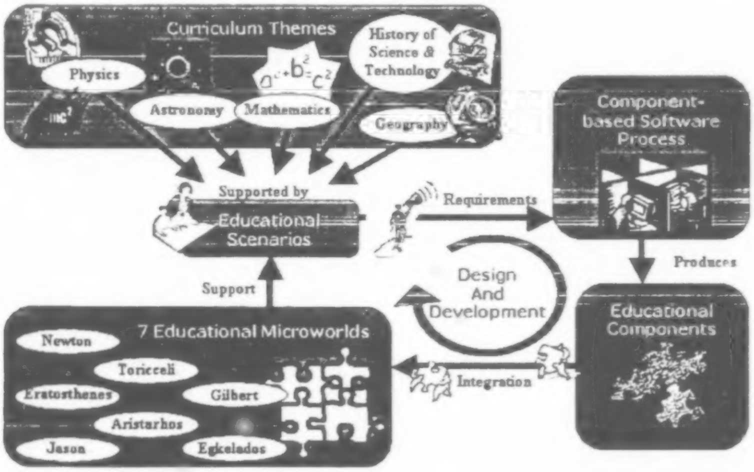
Curriculum Themes
Physics
Astronomy
Mathematics
History of Science & Technology
Geography
$a^2+b^2=c^2$
mc²
Supported by
Educational Scenarios
Requirements
Component-based Software Process
Produces
Design And Development
Support
7 Educational Microworlds
Newton
Toricceli
Eratosthenes
Gilbert
Aristarhos
Jason
Egkelados
Integration
Educational Components

Figure 1. Overview of the GAIA Project Design and Development Process (Papageorgiou et al, 2001)

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GAIA is a microworld-based exploratory learning environment in the field of geosciences education, physics and mathematics. This is accomplished through constrained simulations of real-world phenomena in which students can navigate, manipulate or even create objects, and experiment with their effect on each other. In the current version of *GAIA*, seven microworlds -named after great scientists - are designed and developed to provide the environment for replicating the essential functionalities needed to explore phenomena about the Earth and the planets, regarding their interior, atmosphere, morphology, magnetic field, their orbits in space as well as their astronomical environment. Figure 1 gives an overview of the *GAIA* project design and development process (Papageorgiou *et al*, 2001). The development of *GAIA* is based on the component-based educational authoring environment "E-Slate" (Birbilis G. et al, 2000), which provides a workbench for creating highly dynamic software with rich functionality (Roschelle et al, 1999).

The *Gilbert* microworld, presented in this paper, deals with Earth's magnetic field, within the frame of the school curriculum. This microworld aims to the comprehension of Earth's magnetic field concept and how contemporary science studies and explores this field. The Earth's magnetic field is one of the most attractive concepts to students' imagination, but its teaching becomes difficult as it is hard for them to resolve its vector within the 3D space in relation to geographical coordinates, and to precisely comprehend its existence as they do for instance with the concept of temperature. The *Gilbert* microworld contributes to all the aforementioned and familiarizes students with the existence and nature of Earth's magnetic field.

Earth's magnetic field study through *GAIA* software

The Earth's magnetic field can be directly noticed by the students with the use of a magnetic needle and that is the reason why they must be familiarized with the compass use in school laboratory. This is usually done through the measurement of the field's direction. Although laboratory measurement is useful, it limits students to identify and measure earth's magnetic field, only at the place they are.

The *GAIA* interactive software presented in this paper allows students to virtually travel everywhere on Earth, and measure earth's magnetic field elements (Figure 2). Students have also the possibility, besides the compass, to use a total magnetic field magnetometer. The selection of the virtual site for the experiment is accomplished either on a 3D rotating globe (see Figure 2: top left window) or on a plane geophysical map. The altitude where the measurement is taken place is set in another window (see Figure 2: top right window), by pointing the mouse on a magnetometer sketch on the screen, or alternatively by regulating a properly designed "slider" (see Figure 2: bottom right window). The perspective of earth's projection is done in such a way, as to show the magnetometer's sketch on the screen. In another window (see Figure 2: bottom left window) students can observe and use three instruments: a horizontally positioned compass that measures declination, a compass placed in the magnetic meridian plane that measures magnetic inclination and a total field magnetometer.

In parallel to the virtual measuring of the field, students can also observe the resolved components of the magnetic field vector at any point around the Earth (see Figure 2: top middle window). In this resolution the quantities of field's intensity, declination and inclination are clearly noticeable. The students have also the possibility to visualize and resolve the vector within the Cartesian system coordinates. In addition, they can rotate the projection of the vector representation for more convenient observation of the relative angles and vectors.

At a higher knowledge level, students can also change the value of the measurement date parameter, provided that they have been introduced in the field's variation with time. Of course, it is assumed that the students have also learned some basic notions about the origin of the Earth's magnetic field. Measurement values are simulated to real ones as they based on the IGRF (International Geomagnetic Reference Model) geomagnetic field model of International Association of Geomagnetism and Aeronomy (IAGA 1995). This model is designed to approximately calculate Earth's magnetic field from Earth's interior upwards into space without taking into account external magnetic field sources. It is based on the usual expansion of the spherical harmonics of the potential in geocentric coordinates (Campbell, 1997; Lowrie, 1997) and describes the field's variation within time. At regular times, new spherical harmonics coefficients supplement it in order to renew and fix its anticipation in the future. In view of the educational purposes for which the model was used, the magnetic field values had no higher accuracy than that of the order of 1 μ?.

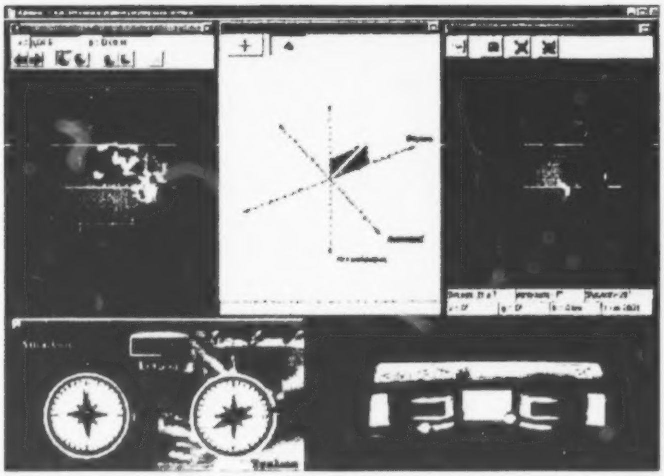

Figure 2. In a special configured environment, students can select whichever place of the world they like on a 3D rotating globe or on a plane map, and to measure the magnetic field's elements at a certain height, meanwhile they can see the field's vector analysis.

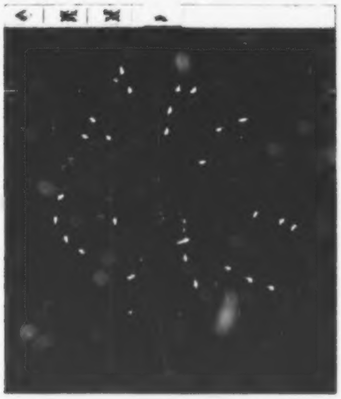

Figure 3. A window of *Gilbert* microworld that presents Earth's magnetic field main dipole component. Students experiment with placing and moving a number of compasses and finally become accustomed to the lines of force notion.

The dipole component of the Earth's magnetic field, which consists the 95% of the total field, is presented in another window of the *Gilbert* microworld (Figure 3). In that window, students can test the field's existence around the whole planet Earth by a number of compasses that can freely move into space. In this environment, students can easily learn the lines of force as well as to magnetic poles natural position. Field's lines of force may be displayed at student's choice.

Displaying the three elements of the magnetic field (intensity, declination, inclination) on maps (Figure 4), it helps students to realize that these three elements coexist in every point and are modified at the same time. For instance, students can observe the magnetic poles in the three maps, to compare their observations and to realize that in all of these three plots the poles have characteristic features. Students also realize that in many places on earth, compass points out to a direction deviating considerably from the North. The coincident display of these three maps reveals the value of the "multiple representations" as well as the "direct manipulation" of the objects (Teodoro, 1990; Shama and Layman 1997).

The introduction of examples from an Applied Geophysics geomagnetic survey was one of the essential innovations of *GAIA* in the teaching of the magnetic field in secondary education level. Beyond the comprehension of notions as the induced magnetization, the addition of the induced field vector to the Earth's field and the magnetic permeability of the materials, the microworld further aimed to present a simplified example of a practical application of Earth's magnetic field measurements, such as the detection of mineral deposits and the antiquities.

In the environment shown in Figure 5, students experiment with a buried plate of square or rectangular section. The plate is considered infinitely elongated in order to simplify the problem from the existence of edge anomalies. The plate is oriented E-W while the magnetometer is moving and measuring vertically to the plate, to N-S (Figure 6). The plate's magnetization is considered only induced and its material can be selected out of a large variety of geological rocks with different values of magnetic permeability. For each rock, typical values of permeability and susceptibility are given, in companion with the range of these values in the real state.

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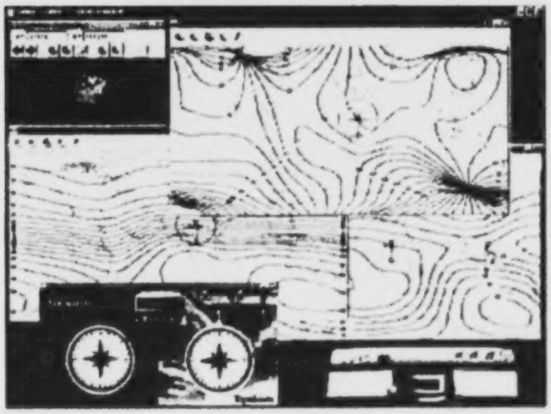

Figure 4. The coincident display of the magnetic maps facilitates the observation and modification of all Earth's magnetic field elements at the same time.

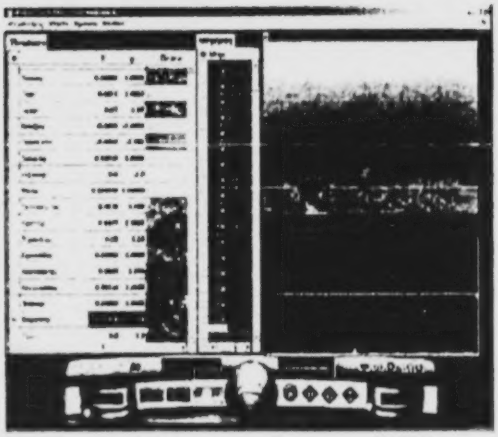

Figure 5. In the magnetic survey environment, students can expertise with the buried plate detection by the implementation of a magnetometer. They can also select the material of the plate, and the location where the experiment takes place. Here the experiment takes place with a magnetite plate of square section, at an area close to the North Pole.

Although the virtual experiment can take place everywhere on Earth, we suggest the choice of three places with characteristic inclination (?) values. These are: the North magnetic Pole (? = 90?), the magnetic equator (? = 0) and an intermediate place like North Africa with inclination equal to 45?. Anomalies observed in measurements of the total field above the buried plate in these three areas are advisable for the induced magnetization presentation to the high school students.

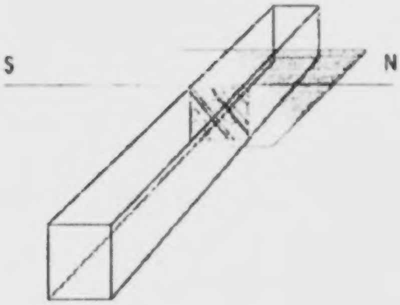

Figure 6. The orientation of the buried plate is E-W while this of the survey traverse is N-S

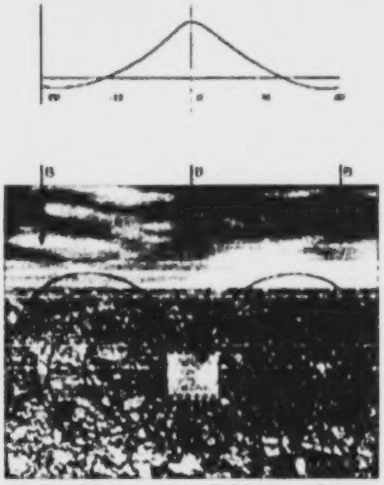

Figure 7. Earth's magnetic field anomaly caused by the induced magnetization of the square section buried plate in the North magnetic Pole.

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At the North magnetic Pole the Earth's magnetic field vector is perpendicular to the plane of measurements. Since the particle magnets of a paramagnetic material are polarized according to the field (a diamagnetic material causes the opposite effect) the induced magnetization will be also perpendicular to the plane of measurements. In the case of paramagnetic materials, which are the most common in nature, the plate's induced magnetization is shown in Figure 7. The lines of force of the induced magnetization field of the body are symmetrical relative to the vertical axis that passes through the centre of the body's section. The values of the measurements are increased at the points where the body's field has the same direction with Earth's field, while are reduced where the two vectors are opposed. At the points where body's field is horizontal (like on body's sides), no essential variation is resulted.

In magnetic equator (? = 0^7) Earth's magnetic field vector is horizontal. Following the aforementioned technique, it is easy to find out that the diagram of the measurements is also symmetric to the body but inversed in sign in relation to the one of the North magnetic Pole (Figure 8). In body's centre, the lines of force of the body's induced magnetization are opposed to the Earth's magnetic field and thus the field's anomaly is negative. In the case that inclination is 45^7, the lines of force are symmetrical to body's diagonal (Figure 9). The magnetic field's anomaly has an asymmetrical pattern and therefore its interpretation regarding body's position becomes more complicated. The point where Earth's field vector is vertical to that of dynamic lines is just above the body, and there we observe that field's anomaly is practically zero. With exception to the magnetic poles and equator the diagram is asymmetric at all the other positions (More details in Dobrin and Savit, 1988).

By the final stage of the microworld *Gilbert* students can comprehend the notion of induced magnetization and how it is depending on the magnetic properties of materials. From the example of the magnetic survey the students are introduced to the field of Applied Geophysics and its contribution to the detection of oil deposits, minerals, antiquities, etc. Contemporary science can provide students with many such examples, possibly exciting their interest for acquiring new knowledge.

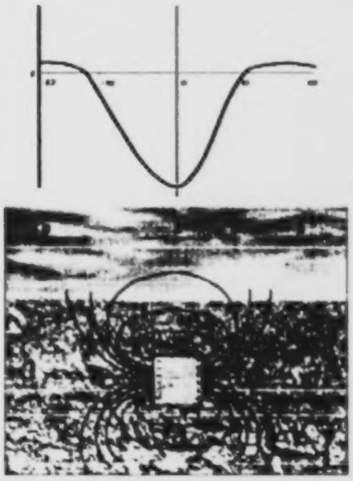

Figure 8. Earth's magnetic field anomaly caused by the induced magnetization of the square section buried plate in the magnetic Equator.

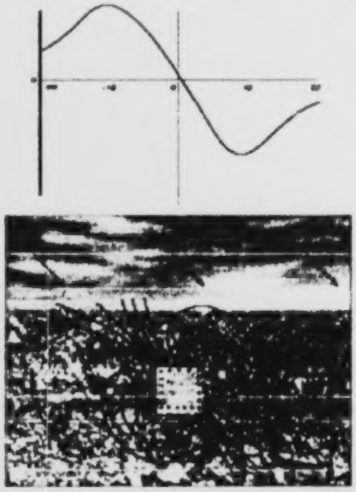

Figure 9. Earth's magnetic field anomaly caused by the induced magnetization of the square section buried plate in position with magnetic inclination equal to 45° (e.g. North Africa)

Conclusions

The GAIA software was designed and developed to allow to operate a virtual educational laboratory addressed in secondary school students. Students may comprehend basic notions of Earth's magnetic field and become accustomed to them as well as with other more fundamental notions of magnetic field theory, such as induced magnetization. A number of activities based on *Gilbert* microworld have been already created. Students, working in teams under teacher's guidance, can enhance their knowledge on Earth's magnetic field by experimenting with *Gilbert*. Initial evaluation of students performance indicate a significant advantage in their understanding on basic Geoscience concepts when using GAIA as compared to their traditional school teaching methods.

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References

Birbilis, G., Koutlis, M., Kyrimis, K., Tsironis, G., and Vasiliou, G. (2000). E-Slate: A software architectural style for end-user programming. *Proceedings of 22nd International Conference on Software Engineering*, Limerick, Ireland.

Campbell, W. (1997). *Introduction to geomagnetic fields*. Cambridge University Press.

Dobrin, M., B., and Savit C. H. (1988). *Introduction to Geophysical Prospecting*. McGraw-Hill.

IAGA, (1995) Division V, Working Group 8, International Geomagnetic Reference Field. *J. Geomag. Geoelectr.*, 47.

Jonassen, D. H. (2000). *Computers as Mindtools for Schools: engaging critical thinking*. Prentice-Hall

Kali, Y. Orion N., and Mazor, E. (1997). Software for assisting high-school students in the special perception of geological structures. *Journal of Geoscience Education*, v. 45

Lowrie, W. (1997). *Fundamentals of Geophysics*. Cambridge University Press.

Papageorgiou, A., Sampson, D., Kotsanis, Y. and Dapontes, N. (2001). Gaia: Curriculumbased Exploratory Educational Software Using 3D Components. Proceedings of *The World Conference on Educational Multimedia, Hypermedia and Telecommunications ED-MEDIA 2001*, Tampere, Finland, 25-30 June 2001

Roschelle, J., DiGiano, C., Koutlis, M., Reppening, A., Phillips, J., Jackiw, N., and Suthers, D. (1999) Developing Educational Software Components. *IEEE Computer*.

Shama, G., and Layman, J. (1997) The Role of Representations in Learning an Interdisciplinary Mathematics and Physics University Course. *Research Conference in Collegiate Mathematics Education*, Central Michigan University, Mt. Pleasant, Michigan. September 4-7, 1997.

Teodoro, V. (1990). The computer as a conceptual lab, Learning dynamics with an exploratory environment: *NATO Advanced Research Workshop Technologies in the teaching of Mathematics and Science*, Milton Keynes.

Thornton, R., K., and Sokolo, D. R. (1990). Learning motion concepts using real-time microcomputer-based laboratory tools. *American Journal of Physics*, v. 58.

Online Privacy, Security and Ethical dilemma: a Recent Study

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Abstract: The Internet remains as a wonder for the 21st century and its growth is phenomenon. According to a recent survey the online population is now about 500 million globally and this trend continues, it should reach 700 million by the end of 2002. This exponential growth of the Internet has given rise to several security, privacy and ethical concerns. There are laws governing those issues at several countries, but hard to apply it due to the rapid change of the technology and also security breach. Internet commerce or electronic commerce (e-commerce) poses constant threats to privacy and security. The web has become a playground for lawbreakers. The aim of this article is to give a snapshot of the current status of the Internet and also how it is creating a nightmare for governments to find a way to safeguard both consumers and providers of information from possible misuse. The author argues that the use of the Internet must be controlled with proper legislation to minimize its negative impact on our society. There should be an international law and or a 3rd party monitoring authority so that proper protection could be offered to the users of this ever-expanding technology.

Introduction

The rapid development of information technology and the Internet have dramatically increased the quantity of information available in digital form. This has resulted in a proliferation of uses of personal information. Some of these have major implications for the privacy of individuals. The World Wide Web (WWW or the Web) has created a totally new global business culture and environment. The new way of doing business across the globe is called electronic commerce (e-commerce) or online or Internet commerce or business by computers and networks. So the Internet will create a huge market in cyberspace and carry valuable information to a large number of people worldwide. This will give rise to a global knowledge based economy or information economy (Karmakar, 2001a & 2001b). The emerging electronically networked-based information economy will affect how we are governed and how we live (Kobrin 1998). The growth of the information economy also means that there are new threats of security, privacy, ethics and other types of online harassment such as fraud and deception.

The Internet Statistics in a Nutshell

The convergence of information and communication technology (ICT) is transforming most aspects of business and consumer activities. The growth of the Internet is dramatic. According to a recent survey by Nua[1], Internet population worldwide as of August 2001 was 513.41 million. The same survey gives the estimated number of online population around the world [Table 1].

Region	Number (million)
Africa	4.15
Asia/Pacific	143.99
Europe	154.63
Middle East	4.65
Canada & USA	180.68
Latin America	25.33

Table 1: The number of online population around the world

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[1] http://www_nua.ie/surveys/how_many_online/

Electronic Commerce: A Challenge

Electronic commerce will significantly increase online business across countries. It will help the delivery of wide range of goods and services in a cost-effective way. With e-commerce set to top $US1000 billion at the end of 2002, the potential for making a fortune by exploiting security breaches is huge. A recent survey of Fortune 500 companies indicated that 62 per cent of firms have suffered computer break-ins during the past year. Identity theft – the use of another person's credit card number and personal details – is on the rise, and threatens the viability of electronic trading (Besserglik, 2000). As more and more business goes online, confidential files are increasingly exposed to the risk of infiltration.

Cyber crime in the new millennium

Companies worldwide have lost $3 trillion from cyber crime. Requests for assistance from the Australian Securities and Investment Commission have increased from eight to 200 in the past two years (Cant, 2002). Research shows companies fail to report cyber crime for fear of negative publicity. A survey by the US department of Defence Cyber Crime centre showed 36 percent of companies reported such crimes. In one of the biggest attempted cyber-scams to date, a thief stole 300,000 credit card number from Internet music company *CD Universe* in December 1999 and posted them on a website after it refused to pay a $US100, 000 ransom. From January 1 to December 31, 2001, federal ID Theft Data Clearinghouse received 86,168 reports of identity theft from across the US, with the District of Columbia and California being the main hot spots. Other uses for stolen information involved employment related fraud (9 per cent) and government benefits fraud (6 per cent)(Deanne, 2000). Network security is not generally very strong, and web and web server vulnerabilities are the main source of credit card information breaches.

Ethical Issues in Cyberspace

Ethics is at the heart of social and political debates about the Internet. Ethics is the study of principles that individuals and organizations can use to determine right and wrong courses of action (Laudon & Traver, 2002). Companies using Web sites to conduct electronic commerce should adhere to the same ethical standards that other businesses follow. Ethical considerations are important in determining advertising policy on the Web. Shea (Shea, 1994) identified 10 Core Rules of Netiquette:

i. Remember the Human
ii. Adhere to the same standards of behaviour online that you follow in real life
iii. Know where you are in cyberspace
iv. Respect other people's time and bandwidth
v. Make yourself look good online
vi. Share expert knowledge
vii. Help keep flame wars under control
viii. Respect other people's privacy
ix. Don't abuse your power
x. Be forgiving of other people's mistake

Issues on Security and Privacy

Security and privacy are interrelated. Information should be used only for the purpose it is collected. Many companies are using the Internet with caution because of concern about network and transaction security. Similarly many customers do not feel secured to making payments over the Internet. As the information concerning credit card numbers or other confidential records traverses on the Internet, there is not yet a reliable method of preventing third parties from accessing this confidential information. A third party unlawful intervention arises when a hacker or some other source has the potential to interrupt data or network resources. This may bring to a company heavy economic loss, which may be in the form of destruction, disclosure, modification of data and other form of abuses. In order to allay consumer fear and protect the confidential data on public networks, companies are starting to pay greater attention to transaction privacy, authentication, and anonymity.

The Internet with no legal boundaries raises concerns about personal privacy. The security and privacy issues are very serious as long as hackers continue to hack on the Net. Personal information and privacy of communications must be protected without any question. Business and consumer concerns about security are legitimate irrespective of countries we live. To minimise risks, the protocols and infrastructure for secure transmission of information are in place or developing.

Security, Privacy in Cyberspace: Legal Framework

Real space means our physical environment consisting of temporal and geographic boundaries, where as *cyberspace* is defined the realm of digital transmission not limited by geography. Privacy online is a legal issue and there is difficulty of applying traditional law to the Internet. The creation and use of knowledge or information are key economic activities all over the world. Sometimes information does harm. It ruins reputations, exposes personal secrets, inflicts emotional injury, and misleads people into mistaken purchases and investments. The law must determine who bears the risk of loss from such harm-not only originators and victims, but also among originators, victims, and all the intermediaries who handle injurious information (Perrritt, Jr. 1996).

Commercialization of the Internet has created a difficult task to establish an international legal framework to maintain security and privacy in cyberspace. There should be technological means to secure data on the net and also a legal safeguard to protect individuals from the possible misuse of the medium. Electronic commerce presents fundamental challenge to the law. The suitable law should tackle the threat of security and privacy when we do business online in the digital economy (Karmakar et al., 2001).

Network security will help to protect privacy. Legal systems must be adaptive to the rapid changes of technology. Existing legal frameworks are outdated for protecting privacy (Loudon 1996). Until the legal environment of privacy regulation becomes clearer, electronic commerce sites should be conservative in their collection and use of customer data. Mark Van Name and Bill Catchings, writing in PC Week in 1998, outlines four principles for handling customer data that provide a good online for Web site administrators. These principles include (Schneider and Perry, 2000):

- Use the data collected to provide improved customer service,
- Do not share customer data with others outside your company without the customer's permission,
- Tell customers what data you are collecting and what you are doing with it,
- Give customers the right to have you delete any of the data you have collected about them.

International Dilemmas

Surveys have found that privacy, piracy, and pornography are the most serious concerns of Internet users. The European Union has established strict privacy laws: "all members countries of the European Union must restrict the export of personal data to countries that do not provide privacy protection that is up to European standards, at least from October 1998 for those that have not already done so, and the restrictions are much tougher than in previous European laws." The European Union's privacy Directive of 1995 is the most significant international statement of information privacy principles since the early 1980s [Greenleaf 1998]. The Organisation for Economic Cooperation and Development's *Guidelines on the Protection of Privacy and Transborder Flows of Personal Data* [2] attempt to balance the protection of privacy and individual liberties and the advancement of free flows of personal data through eight privacy principles: **Collection Limitation, Data Quality, Purpose Specification, Use Limitation, Security Safeguards, Openness, Individual Participation** and **Accountability** which, if observed, are supposed to guarantee a free flow of personal information from other OECD countries[Greenleaf 1998]. All 25-member countries of the OECD have adopted the Guidelines [Tucker 1988]. Most European countries have passed laws for the public and private sectors based on the OECD principles. New Zealand, Hong Kong and Taiwan also have privacy laws that apply to both public and private sectors. Other countries like Australia [3] have implemented them in part only.

The Council of the OECD has adopted Guidelines for a Cryptography Policy in March 1997[4], setting out criteria for encryption of computerised information for governments to adopt and for businesses, individuals and law enforcement officials to apply in safeguarding electronic transactions, communications and data storage.

The U.S. Government's *Framework for Global Electronic Commerce* calls for governing commercial transactions on the Internet 'consistent principles across state, national, and international borders that lead to predicable results regardless of the jurisdiction in which a particular buyer or seller resides' (Clinton & Gore 1997). European-American disagreement on encryption and piracy may lead to a constant problem to introduce a uniform safeguard (Kobrin 1998). An increase in the use of tools such as Email, data bases and computer networks has Canadian companies generally feeling more exposed when it comes to the security of internal communications and proprietary information (Church 1998). Northern Telecom, based in Toronto, Canada has programs to ensure that its employees realize how important it is to safeguard sensitive information. It also conducts physical and electronic audits to ensure that important papers aren't left on desks.

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[2] http://europa.eu.int/comm/dg15/en/media/dataprot/priv.htm

[3] The 11 Information Privacy Principles in the *Privacy Act 1988(Cth)* are intended to implement the OECD's 8 principles insofar as personal information held by Commonwealth public sector agencies are concerned. Australia has still failed to comply with the guidelines for thirteen years after announcing its adherence in 1984.

[4] http://www.oecd.org/dsti/sti/it/secur/index.htm

The global Internet governance is a big issue. Under the present system, an Australian company in dispute with a multinational company over a domain might have to fight that battle in a US court. There is now a genuine concern that Australian companies are going to be faced with having to go US courts to have their Internet disputes resolved (Riley 1998). The law should respond to business concern in the information economy. The existing law cannot cope with the transborder data flow. Technology and business are changing very rapidly, but law is somewhat static. Many business firms are very adaptive to rapidly changing global environment due to the information revolution (Johnston et al. 1997).

Privacy & Australia

The Commonwealth *Privacy Act 1988*[5] lays down strict privacy safeguards which Commonwealth (federal) and ACT government agencies must observe when collecting, storing, using and disclosing personal information. The Act also gives individuals access and correction rights in relation to their own personal information. The Act applies to the wider community (including the private sector and state and local governments) only in relation to specific categories of information: tax file number information and consumer credit information.

Privacy issues arise in a wide range of areas and circumstances. Privacy legislation deals mainly with information privacy - the handling of personal information. Other privacy issues such as video surveillance, telephone interception or 'bugging', and other laws may cover physical intrusion into private spaces.

In December 2000, the *Privacy Amendment (Private Sector) Act 2000* (the Amendment Act) was passed by federal Parliament. The private enterprises became subject to privacy laws on December 21, 2001. The application of the Privacy Act is triggered by the financial size of the organization and the nature and use of the data it collects or processes. It is also subject to some ad hoc exceptions and differing start dates. The National Privacy Principles (NPPs) in the Privacy Act set out how private sector organisations should collect, use, keep secure and disclose personal information. The principles give individuals a right to know what information an organisation holds about them and a right to correct that information if it is wrong.

The surveys showed that Australians regard privacy as a closely held and highly personal value. People look for signals that an organisation will manage their personal information well, for example, 59% said they would trust an organisation more if that organisation gave them control over how their information was to be used, 55% said that organisations with privacy policies would be more likely to gain their trust. Various government bodies have been involved in projects and activities designed to encourage the uptake of E-commerce and Electronic Service Delivery.

Among critics of the private sector privacy regime has been the European Commission (EC), which commented unfavorably. In essence, the EC said it did not regard Australia's privacy regime as sufficiently protective on about nine grounds. All in all, as noted at the time of is passage into law, the application criteria is open to criticism for being arbitrary and the wording of the provisions makes it less than crystal clear how, or even if, it is to apply in given cases, especially, to small businesses (Minahan, 2002).

Australia should be prepared to keep pace with technological innovation and join the new global business environment if it is to remain competitive internationally. Australian Business law in the current form cannot cope with the contemporary business operations. The technological change is revolutionary, but the change in the legal system is evolutionary. There should be a number of changes in Australian legal systems to accommodate electronic commerce. Under Australian law, if someone steals a credit card it is not an offence until the card is used. But in the US it is against the law to misuse an identity with the intention of committing a crime.

Concluding Remarks

We have introduced debate concerning Internet regulation. The U.S.A is the key player to bring about any effective change. There is a need to keep clean our online information environment through generally accepted international laws or other regulatory mechanisms. The Internet is global, multi-jurisdictional structure; national legal systems will not control the uses and abuses of Internet use. The continuing growth of the Internet has seen a corresponding growth in concern about online ethical privacy and security. Surveys continue to show that users are concerned about the collection, security, use and disclosure of information about them on the Net.

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[5] http://www.privacy.gov.au

References

Besserglik, B. (2000). Spotlight turned on cyber crime. *The Australian IT/Cutting Edge* (*The Australian*) Tuesday, May 16, p.3.

Cant, S. (2002). Cyber Crime a $3 trillion nightmare. *The Sydney Morning Herald*, Tuesday, March 5, p.5.

Church, E. (1998). Business Ethics/The on-line world has firms fretting about losing their ideas to rivals. *The Globe and Mail*, Thursday, March 26, B17.

Clinton, W. J. & Gore, Jr., A. (1997). A Framework for Global Electronic Commerce. Washington, D. C., July (http://www.iif.nist.gov/eleccomm/ecomm.htm), 4.

Dearne, K. (2002). Online ID theft is top of the pops. *The Australian IT* (*The Australian*), Tuesday, February 12, p.31.

Greenleaf, G. (1998). Global Protection of Privacy in Cyberspace – Implications for the Asia-Pacific. Internet Law Symposium, Science & Technology Center, Institute for Information Industries, World Trade Center, Taipei, Taiwan, 23-24 June.

Johnston, D., Handa, S. Morgan, C. (1997). Cyber law: What You Need to Know about Doing Business Online. Stoddart, Canada.

Karmakar, N.L., Kehal, H.S. & Agrawal, R (2001). Information Economy in the Digital Era: A Global View.
for a book *Globalization, Flexibility and Competitiveness, A Technology Management Perspective*,335-346, edited by Professors Sushil and Momaya (Indian Institute of Technology, Delhi) published by the Vikas Publishing House Pvt. Ltd., New Delhi, India, May.

Karmakar, N. L. (2001a). A Global Overview of New Business Paradigm: The Digital Divide Published in the *Proceedings of the* **World** *Conference on the WWW and Internet* (**WebNet 2001**), Oct.23-27, 2001, Orlando, Florida, USA.

Karmakar, N. L. (2001b). Emerging Issues in Information Economy & Electronic: A Strategic Analysis. Published in the *Proceedings of the World Conference on Educational Multimedia, Hypermedia & Telecommunications* (ED-MEDIA 2001), June 25- 30, 2001, Tampere, Finland.

Kobrin, S. (1998). You can't declare cyberspace national territory: Economic Policy Making in the Digital Age. In D. Tapscott, A. Lowy & D.Ticoll (Eds). Blueprint to the Digital Economy: Creating *Wealth in the era of E-Business*. McGraw-Hill, 355-370.

Laudon, K. C. (1996). Markets and Privacy. *Communications of the ACM*, Sept. Vol. 19, No. 9, 92-99.

Laudon, K. C. & Traver, K. C., (2002), *E-commerce: business, technology, society*. Addison-Wesley.

Minahan, S. (2002). European privacy rules pack some punch for Australia. *The Sydney Morning Herald*, Tuesday, February 26, p.6.

Perrit, Jr. H. H (1996). Law and the Information Superhighway: Privacy, Access, Intellectual Property, Commerce, Liability. John Wiley & Sons, Inc.

Riley, J. (1998). Forum seeks Net rules, The AUSTRALIAN: Tuesday, August 11, 36

Schneider, G. P. and Perry, J. T. (2000). *Electronic Commerce*. Course Technology.

Shea, V. (1994). *Netiquette*. ISBN: 0-9637025-1-3

Tucker, G. (1988). Present situation and trends in privacy protection in the OECD area. *Committee for Information, Computer and Communications Policy*, OECD, Paris.

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RESHAPING CURRICULAR CULTURE

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ABSTRACT

Curricular goals that traditionally focused on the delivery of the teaching rather than the outcomes of the learning are in a state of major transition. Implementation of academic standards requires the application of content and not merely its delivery. As a result, colleges of education must prepare a new genre of teacher leaders equipped to align students' classroom experiences with the changing realities of performance learning in an information era. This presentation focuses on preparing teachers who can link electronic information resources with engaging learning experiences. The work is grounded in the beliefs of cognitive theory and applied practice. It presents educational media as a support structure in the curricular architecture of teaching and learning rather than as an ancillary element. It specifically focuses on preparing educators to motivate their students through comparative, investigative, and collaborative problem solving.

1. INTRODUCTION

Words such as excellence, quality, equity, and opportunity dominate the rhetoric of school reform. But behind the words is a serious confrontation to rethink how we organize learning opportunities. Possibly nothing has more dramatically challenged curriculum construction than the accessibility and availability of electronic resources.

Much of my work over the last decade has addressed educational change in de-Sovietizing environments in East Central Europe. In that transitional time I observed teachers, administrators, and policy makers struggling with what they called the 'tunnel at the end of the light.' In this frequently used metaphor, the light symbolized political changes that externally were cause for celebration. The tunnel symbolized the internal challenges and the new mismatch of learning and life. For although simultaneous political, economic, and educational transitions created new opportunities, they also created new challenges regarding the organization of schooling and the acquisition of information. Presently my work environment is an American college of education. But although the geography of my attention has shifted, the circumstances that influence new alignments between school and society is marked by similar uncertainty regarding the realignment of learning experiences in a digital era.

2. GOALS OF TECHNOLOGICAL IMPROVEMENT: AN ISSUE OF USE

Policy makers in many nations portray social transitions to an information era and school improvement as associated concerns. As a result, schools on a global basis are in the midst of technology related reforms and their associated challenges. Linda Darling-Hammond (1997, p.2) aptly captures the cultural climate of this transitional time:

> "Never before has the success, perhaps even the survival, of nations and people been so tightly tied to their ability to learn. Consequently, our future depends now, as never before on our ability to teach."

The teachers at the core of these changes are realizing, however, that successful past practices may be incongruent or even obsolete in electronically rich environments. If teachers are indeed "navigators" (Bruer, 1994) into the future, then the altered fit of technology, teaching, and learning presents a contemporary navigational challenge.

The scope of technologies that have historically impacted education is vast. This work concentrates only on one technology that has dramatically altered available resource information in the past decade, the Internet. Although the Internet provides a powerful platform for accessing information, the educational impact of that body of information is dependent on its use.

3. DILEMMAS REGARDING TECHNOLOGY INVESTMENT

At both national and community levels, increasing expenditures are being appropriated to enhance student learning through technology. But unless such efforts give adequate attention to the changing alignment between resources and applied knowledge, such expenditures are questionable (Dede, 1997).

American studies indicate that over seventy-five percent of the general public believe that technology improves both teaching and learning (Trotter, 1997). But teachers who have Internet access do not necessarily change their pedagogical strategies (Johnston, 1997). And student learning does not increase in relationship to time spent with electronic resources, but rather in the manner in which new information is linked to problem solving (ETS, 1998) If we contemplate similar relationships for networked learning without attention to how teachers can most effectively use this resource as a means to better thinking, access to vast information banks may have limited impact on student achievement. So what should we do differently? Papert (1998) contends that we must stop trying to merely improve current practices, that we must fundamentally change how we organize learning opportunities to incorporate technological tools rather than teaching about them.

4. CHALLENGES TO EFFECTIVE TEACHING AND LEARNING

Studies indicate that while most teachers have incorporated technology's storage capabilities, they have not fully capitalized on its capacity to motivate knowledge construction and to facilitate problem-solving (Nicaise and Barnes, 1996; Perkins, 1992a). These two elements, constructing new knowledge and engaging students in the application of information to problem solving, are the focus of the following examples that share the use of Internet resources in a manner that is interesting, sustaining, and rewarding for both student and teacher.

5. SAMPLE EXPERIENCES BASED ON ELECTRONIC RESOURCES

Because of the dire statistics about American teachers' knowledge of geography, these examples grew from a core assignment requiring teachers to construct new knowledge about a global region about which they previously knew little or nothing. The follow-up assignment involved translating their new learning as adults into problem related experiences for students. Several examples follow.

In an electronic trip to France, one educator used her own new knowledge about art as a means to motivate the construction of historic and cultural knowledge that incorporated a multitude of Internet museum sites. Through focusing on a selection of chosen works of Impressionist art, she asked her students to hypothesize about the cultural climate of that era. Students themselves were then required to explore additional sites to gather more information through which they could support or negate ideas they had formulated. An extension opportunity encouraged students to further examine the life and work of an artist of their choice and compare it with the same art forms on other continents during that time frame.

An electronic field trip to Poland enabled another teacher to inspire his students to create comparative journals for an American teen living in the

Appalachian Mountains and a Polish teen in the Carpathian Mountains. Resources reprinted from the Internet ensured that students would have accurate data for this literacy-based activity that integrated written communication skills with geological and cultural information sources.

Another prospective educator used her electronic trip to Switzerland as the foundation for an innovative health unit that examined the effects of altitude on the human body. An electronic field trip to Kenya led to a lesson that asked students to first use Internet resources to explore actual habitats and then use data to assess whether community proposals for a new wildlife sanctuary were scientifically grounded. A less traditional journey involved applying Internet learning from the NASA site to design a playground in space addressing the particular problem solving challenges in building a playground in zero gravity.

A final case exemplifies how teachers can use Internet resources to motivate the synergy that results when students assume not only greater responsibility for their individual learning, but also contribute in a manner in which the whole class benefits from the combined efforts of its members. Their teacher used Internet resources to explore the themes of economic production, distribution, and consumption and to apply them in environmental relations within ecosystems. Students discovered how bacterium in geysers contributes to medical research on Lyme disease and AIDS, and they evaluated conflicting interests introduced by mining and the economic needs of communities surrounding protected environmental areas. As a follow up on the economic effects of oil spills, students used the Internet to share findings about how negative circumstances such as environmental disasters for some populations can create opportunity for other groups, such as new financial markets in environmental clean-up.

Traditionally, when teachers sent students to the library for independent research, most came back with similar information from the same basic sources. The richness of electronic resources provides opportunity for more expansive and encompassing learning opportunities for students if their teachers rethink the traditional construction of teaching and learning experiences.

6. FINDINGS AND CONCLUSIONS

Although no generalizations regarding variances in academic achievement can be drawn from these examples implemented in different school settings, one recurrent comment from other educators who observed and supervised the redesigned use of resources was how they enabled students to target particular standards for the social studies with greater clarity. Of ten particular national standards for the social studies, four performance areas were noted as being apparent to students. These were: 1) global connections, 2) time, continuity, and change, 3) people, places, and environments, and 4) production, distribution, and consumption.

The manner in which teachers align technology with curricular goals is largely dependent on the beliefs and experiences established in teacher preparation programs. If graduates of universities and colleges are to be effective navigators for their students, then they must become comfortable and competent in transforming large networks of mere information into significant problem solving experiences.

The process of redesigning the learning process in any nation must begin with the adult learners, the teachers. In order for educational change to be institutionalized it must be part of the teachers' foundational competencies (Hargreaves, 1992, Greenfield, 1995, Fullan, 1993). Just as successful businesses need workers who are better thinkers, so too do educational enterprises need both learners and leaders who use technology to become better thinkers (Crouter and Manke, 1994). These projects reflect the juxtaposition of electronic information and the thinking process. They use computers for what they do best, storage and organization, and the human mind for what it does best, judging, interpreting, analyzing, synthesizing, and constructing meaning (Jonassen, 1995). They present ideas that foster connections between information and thinking rather than fragmented and isolated approaches that mark failed educational changes (Fullan, 1996).

Although the long-term impact of cyberspace learning on student achievement is yet to be determined, the integration of Internet resources gives teachers the opportunity to significantly alter curricular construction.
While the Internet has the potential to bring the world into the classroom, quality teaching results from quality thinking. Teachers who successfully navigate journeys into more electronic environments are those whose old way of thinking become transformed and who see themselves as both learners and leaders, as change agents, and as individuals who can consistently add value to their profession.

REFERENCES

Bruer, J. (1994). Schools for thought, A science of learning in the classroom. Bradford.
Crouter, A. and Manke, B. (1994). The changing American workplace:Implications for individuals and families. Family Relations, 43(2), 117-125.
Darling-Hammond, L. (1997). The right to learn. San Francisco: Jossey-Bass.
Dede, C. (1997). Rethinking how to invest in technology. Educational Leadership, 55, (3), 12-16.

Educational Testing Service (ETS). 1998. Computers and classrooms:The status of technology in U.S. schools. Educational Testing Service Policy Information Center.

Fullan, M. (1993). Why teachers must become change agents. Educational Leadership, 50 (6), 12-17.

Fullan, M. (1996). Turning systemic thinking on its head. Phi Delta Kappan, 77(6), 420-423.

Greenfield, T. (1995). Improving chances for successful educational reform. Education, 115(3), 464-475.

Hargreaves, A. (1992). Time and teacher's work: An analysis of the intensification thesis. Teachers College Record, 94(1), 87-108.

Johnston, R. (1997, November 10). State by state profiles. Education Week, XVII (11), 82-83.

Jonassen, D. (1995). Computers in the curriculum: Mindtools for critical thinking. Upper Saddle River, NJ: Merrill Publishing.

National Commission on Teaching and America's Future. (1996). What matters most: Teaching for America's future. Woodbridge, VA.

Nicaise, M., & Barnes, D. (1996). The union of technology, constructivism, and teacher education. Journal of Teacher Education, 47 (3), 205-212.

Papert, S. (1998). Technology in schools: To support the system or render it obsolete? hppt://www.milkenexchange.org/feature/papert.html.

Perkins, D. (1992a). Technology meets constructivism: Do they make a marriage? In T.M. Duffy & D. H. Jonassen (Eds.), Constructivism and the technology of instruction (pp. 45-55). Hillsdale, NJ: Erlbaum.

Perkins, D. (1992b). Smart schools: From training memories to educating minds. New York: Free Press.

Perkins, D., and Salomon, G. (1989). Are cognitive skills context-bound? Educational Researcher, 18, 16-25.

Trotter, A. (1997, November 10). Taking technology's measure. Education Week, XVII (11), 6-11.

The Virtual Factory Teaching System (VFTS): Project Review and Results

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Abstract: This paper presents a review of the Virtual Factory Teaching (VFTS) project, a web-based, multi-media collaborative learning network. The system allows students, working alone or in teams, to build factories, forecast demand for products, plan production, establish release rules for new work into the factory, and set scheduling rules for workstations. Included in the paper are a system description and list of project tasks. The evaluation component involving three different campuses is described and the results of three-years of analyses are presented, including demographic descriptions, self-assessment results, performance results, attitudinal responses, and usability. In addition, instructor observations and course project output is also examined as components of the VFTS evaluation effort. It is believed through the analysis that the VFTS is an excellent instructional method to teach students the integration of the different modules in operations planning.

Background

To address the manufacturing educational needs of new engineers, a web-based, multi-media collaborative learning network, referred to as a Virtual Factory Teaching System (VFTS), was developed under an National Science Foundation (NSF) grant (Dessouky, et. al 1998; Dessouky, et. al. 2001; Kazlauskas, et. al. 2000; Kazlauskas, 2001). This tool is currently being used by engineering students from the University of Southern California, San Jose State University, the University of Virginia, and most recently North Carolina Agricultural and Technical State University. The overall aims of the project are:

- To provide, disseminate, and evaluate a manufacturing education pedagogical tool that promotes student understanding of complex factory dynamics.
- To improve student skills in communication, persuasion, negotiation, and management, as well as in the technical arenas of production planning, forecasting, simulation, scheduling, and integration.
- To provide a forum in which engineering and business school students can participate in virtual teams that cut across universities.

The research plan of the project is aimed at exploring the interface between virtual factories, engineering education, intelligent agents, and the Internet for new ways of teaching modern manufacturing problems, practices, theory, and techniques to engineering and business undergraduate students. In addition, it is aimed at examining its potential for use as an information vehicle on the topic of manufacturing for K-12 students. Various research questions are addressed, such as: how students perform when using new technology-enhanced modes of learning; what are the effects on attitudes; how intelligent agents might assume tutoring and participative roles; and how team performance, hampered by geographical separation, might be enhanced via advanced communication technologies.

The project timetable consisted of the following: a Baseline period to provide an understanding of the Industrial Engineering courses (with scheduling content) using traditional instructional methodologies, i.e. without the VFTS; the use of the VFTS to provide an understanding of the Industrial Engineering courses (with scheduling content) offered at the various institutions; then the use of an expanded version of the VFTS at the same institutions with pedagogical agents and use of virtual teaming included. The following presents an overview of the features of the VFTS; a description of the evaluation approaches; and three-year project results.

System Description

The architecture of the VFTS was kept simple and modular. There are three layers in the design: AweSim Server, VFTS Java Server and Clients. Clients, which are students in our case, use standard WWW browsers like Microsoft Internet Explorer, to connect to the VFTS Java Server using its Web Page. Most of the communication between the clients and the server takes place using Java applets. The Java-Server functions as a mediator between the AweSim factory servers and the clients. The Awesim Server is responsible for factory knowledge and simulation. The layers interface using a message protocol set up to minimize bandwidth requirements. Other components of the VFTS include the use of Ptolemy, a graphing package, and Drasys, an Operations Research (OR) package.

The system allows students, working alone or in teams, to build factories, forecast demand for products, plan production, establish release rules for new work into the factory, and set scheduling rules for workstations. They can run simulations where an animated panel displays jobs progressing through their factory, with queue counts, finished goods counts, graphs, and reporting functions all available. Students access via the VFTS, using computers in university computer labs, or in their dorms or homes, a virtual representation of the factory. The professor posts assignments related to this factory over the Internet, "unfreezing" parameters as necessary so students may experiment without redefining the entire factory. Students observe the effects of their decisions, and student teams assume factory roles to solve problems; if they reach an impasse, intelligent agents provide guidance. Selective information may be given based on student roles; for example, the production supervisor may have equipment information, the engineer new technology information, etc. Students sort out strategies and can discuss options via e-mail and electronic chat rooms. Since this course is a common one found in many universities, collaboration among universities is feasible. Faculty members virtually "team teach" the course. Intelligent agents are incorporated into the VFTS to monitor student progress and provide immediate feedback.

The latest version of the VFTS software includes support for user account management, adding security to allow students within a group to share data while preventing access to it from students outside the group, a more easy to use interface, instrumentation so that the software will gather data on student usage patterns, on-line help, on-line documentation and an on-line tutorial to help for students and faculty learn how to use the VFTS, and an introductory homework exercise to help students learn how to integrate the VFTS into the course. A project that uses the VFTS was developed to complement the students' classroom learning and was integrated into the courses at the participating universities. The latest version also includes a pedagogical agent that monitors students' use of the VFTS and provide guidance. This required integrating the pedagogical agent software (ALI) into the VFTS, adding the ability for ALI to maintain a persistent model of each student's knowledge across sessions, extending ALI to include more sophisticated explanation capabilities, adding VFTS-specific knowledge to allow ALI to understand the instructional objectives of the VFTS and provide appropriate support to students, and instrumenting ALI to maintain a log of interactions with students to aid our evaluation.

The current version VFTS is available at http://vfts.isi.edu.

Project Tasks

The VFTS project included a large set of tasks involving design, development, usage, evaluation, and dissemination. The various tasks associated with the VFTS project are as follows:

- Define instructional objectives and complete evaluation design.
- Develop and/or acquire evaluation instruments.
- Solicit feedback on the instructional objectives, evaluation design, and VFTS use from each university.
- Gather evaluation data for control group (engineering classes without the VFTS).
- Analyze evaluation results for control groups.
- Complete instrumentation of the software to support evaluation
- Teach engineering classes with the VFTS and gather evaluation data.
- Analyze evaluation results for experimental group and compare to control group.
- Use the evaluation results to revise and refine the VFTS and its use in the engineering curricula, its instrumentation, and the pedagogical agents.
- Teach engineering classes with the VFTS, including the use of virtual teams that span multiple universities, and gather evaluation data for this final experimental group.
- Analyze summative evaluation results.
- Make final revisions to the VFTS software based on evaluation results.

Evaluation

In the preceding list of project tasks, it should be noted that considerable emphasis is placed on the design and implementation of an extensive, multi-university evaluation, which is a central component of the VFTS project. The initial evaluation efforts were used a) to check to make sure each project step was implemented according to plan and that milestones are being met; and b) to consider project modification. This evaluation, formative in nature, assisted in modifying the design and development of the evaluation, as well as of the overall design of the web-based VFTS. For example, a Computer Competencies Multiple Domains instrument that was used initially to determine the level of entering competency in such areas as spreadsheets and statistical packages was dropped. It was determine through initial surveys that the learners were homogeneous in terms of a high level of computer competencies. Through the evaluation process, it was decided to gather more data on such issues on the ease of use and operation of the web-based VFTS, and to modify the actual design by changing the opening screen, and by including more tutorial help.

An emphasis of this project is to evaluate learner outcomes, attitudes, and learning. This effort includes the use of various instruments and examination of student work.

The following are the instruments that are presently being used in evaluation:

- Student Pre-course and Post-course Survey instruments which are used to gather data on student demographics and student self-rated assessment of entering/post-course knowledge of operations scheduling, such as the skills, knowledge, and abilities in the use of gantt charts and regression and time series models.
- Operations Scheduling Pre-test/Post-test instruments which are used measure course content before and after instruction and use of the VFTS.
- Affective-Level/Attitudes Instrument (VFTS Participant Opinion Survey) Pre-test/Post-test instrument which are used to measure reactions to the use of the VFTS, such as reactions to use of simulations, working collaboratively, and relevance to future career.
- Usability Evaluation instrument which is used to gather data on such issues on the ease of use and operation of the web-based VFTS.

The VFTS Studies

Various studies were conducted in the VFTS Project. The first of these was the Baseline evaluation conducted at the various universities, to provide an understanding of the Industrial Engineering courses (with scheduling content) using traditional instructional methodologies. The second of these was an investigation of the use of the VFTS at the same universities, to provide an understanding of the Industrial Engineering courses (with scheduling content). A second usage of the VFTS occurred, an enhanced version with teaming and pedagogical agency. The following represents the findings from these investigations (at three universities to-date).

Demographics

For the most part the demographic analyses showed similarities between both the Baseline and VFTS groups at the various universities, and the demographics appear to parallel those that are found in most engineering programs. Most students were in the 21-22 age category, with the age distributions at most universities typical of a 'traditional' undergraduate student. However, students at one institution had an older mean and the age range was quite large. At all institutions, students were mostly seniors. The majority of students at all three campuses were male, as reflects the common engineering enrollment pattern. There was no significant difference on the gender variable between the groups. The primary language was English but many other languages were represented, with 50% or more students at two institutions having a language other than English as their first language.

Self-Assessment

Instruments gathered pre and post data on a student's interest in the course and on their self-assessment of knowledge of course content, such as whether they could apply forecasting methods to new problems.

Students have a moderate interest in the course. One can support the general statement that students know little, if anything, about the content of the course but think that it will help them in a more general way. At two institutions, students indicated that they did see the course assisting in developing industrial engineering fundamentals. Pre and post-test measures of self-assessment indicate significant gains in most areas. In particular, the overall gains in self-assessment in the second year offerings of the VFTS at two universities were significant. The self-report assessment provides evidence that the students feel as if they have learned the subject in the course.

Performance

As a general statement, it seemed desirable to determine if there are significant differences between and among the participant groups. Representative analyses reflect: performance at each institution in both the Baseline and VFTS options; and Baseline to VFTS Comparisons. In examining Baseline and VFTS groups at the various institutions, analysis indicated overall gains in learning in each offering of the course between pre-test and post-test, and in specific content areas of scheduling. There appears to be a significant difference among the schools on the pretest measure, with one institution scoring significantly higher than the others. Comparison between the Baseline and VFTS performance at each institution indicated a difference on selected pre-test items. Correlations were calculated for the pretest instruments, Baseline to VFTS groups. Although there were some correlations between age and certain items and among certain items, it appears that these results were of no significance in this particular study. There were no significant difference between the Baseline and the VFTS groups on the final exam except for a few selected items. As noted, the VFTS groups did not perform as well on the pretest as the Baseline groups, yet scored approximately the same on the final examination. This could imply that the less strong content-knowledge groups, using the VFTS, performed equivalent to the stronger content-knowledge groups. The post-test scores at one institution are significantly higher than at the other universities. We remark that at only this university was the post-test a component of the student's final grade. In fact, it was treated as the final examination so in this case the students took it much more seriously where they most likely studied for the examination. A comparison of the post-test scores between the baseline and VFTS groups at this university show a significant gain for the VFTS group, although for a smaller class size.

Attitudes

Instruments gathered pre and post data on a student's opinions, on such scales as usefulness, interest, importance, difficulty, and confidence, for example whether students thought learning to use computer simulations to work on class assignments would be useful to their future career. Results of the analysis indicated that there was no significant change in the attitudes of the students, even with the use of the VFTS.

Usability

In regard to the use of the VFTS, most students seem to be using Internet Explorer on a Windows 98 platform. Student comments on the usability of the software isolated several problems that were resolved in the updated version of the VFTS. The various modules well-received; for the most part the online documentation and tutorials not used or students commented that they were of limited value; students were not positive towards the use of the VFTS teaming aspect of the course. However, effort is being made to modify the teaming aspect of the course with the assertion that this may impact usability findings on this topic.

Other Results

Input was solicited from the instructors of the courses at the various universities. Their comments regarding the use of the VFTS were positive. They noted, in particular, that students using the VFTS had a more realistic course project than their counterparts in the Baseline classes.

The NSF funding for this project has supported five graduate students at the University of Southern California. These students have gained valuable experience in Web-based software development, user interface principles, pedagogical agent technology, educational materials development, and educational evaluation. Perhaps the most valuable training for all the students is the close multidisciplinary collaboration between computer scientists, engineering educators, and educational researchers and educators. These students will have a much broader perspective on research than typical graduate students that work closely with others only in their own field.

Conclusion

The VFTS was instrumental in facilitating students' understanding of the integration between the models for forecasting, production planning, material planning, inventory planning, and scheduling.

It was demonstrated through an analysis of project reports that students had a better understanding of the integration between the different modules. This was illustrated by the fact that students clearly spent a good part of their time, with the VFTS, in testing many different scenarios, and students were able to see the impact of changing a parameter on the output. It is suggested that another major benefit of the VFTS is that a more complex system can be modeled than otherwise. Thus, it was seen that students had a more realistic project than their counterparts in the Baseline groups. To summarize, it is believed through the analysis that the VFTS is an excellent instructional method to teach students the integration of the different modules in operations planning.

References

Desouky, M. Bailey, D., Verma, S, Adiga, S. Beckey, G and Kazlauskas, E. (1998) A virtual factory teaching system in support of manufacturing education. *Journal of Engineering Education. 459-467.*

Dessouky, M., Verma, S., Bailey, D.E., Rickel, J. (2001). Methodology for Developing a Web-based Factory Simulator for Manufacturing Education. *IIE Transactions,* 33(3), 167-180.

Kazlauskas, E.J., Desoukky, M., Rickel, J & Johnson, L. (2000) A Web-based Factory Teaching System: Design and Development. *Proceedings of WebNet2000: World Conference of the WWW and Internet.* San Antonio TX. October 30- November 4, 2000.

Kazlauskas, E.J. (2001). Integrating University-based Technology Projects into Education Programs. In Lee, C. (Ed.) Enhancement of Quality Learning through Information and Communication Technology. The 9th Annual International Conference on Computers in Education. Seoul, Korea: ICCE, 269-275.

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Faculty Development in Technology: Outcomes of a Project Based Team Approach

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This paper is a report on the implementation of a grant funded project designed to provide faculty development in the effective integration of technology into the teacher education programs at a large, public, urban university in the Eastern United States. The principal immediate goal of the project was for the faculty to acquire specific basic knowledge and skills regarding computer hardware and software. The principal medium-range goal was that faculty would develop technology related products or projects that would result in more effective and/or efficient teaching and learning of a unit of a teacher education course. A long range-goal was the modification of the teacher education curriculum to reflect greater integration of technology and to meet technology standards of various professional organizations and government agencies. This paper will describe the faculty, the intervention strategy utilized with the faculty, and finally, the types of data that have been obtained, and on the basis of this data, the degree to which each of the principal goals has been achieved to date.

The Faculty

The subjects were 17 faculty members who teach pre-service teachers in an urban, public university program, and 4 public school teachers who serve as master or mentor teachers to pre-service teacher candidates during the required semester of student teaching in a public school. At the start of the project a modified version of the School Hardware Technology Survey (U.S. Department of Education, 1998) was administered to the population of faculty from which the sample was drawn. The results of the survey, which faculty completed anonymously, were supplemented with data from faculty focus groups, and information from the college's administration regarding funds allocated for the purchase of equipment. The data revealed that faculty all had basic computers with Internet access and printers in their offices. However, at the time the most common uses of technology reported were word processing and accessing e-mail. Only 1 of the 17 in the sample was teaching a course that specifically included computers and was taught in a computer laboratory. Most faculty members could not identify the specific configuration of their office computer or report the specific software it contained.

The Intervention

The main focus of the intervention was the provision of staff development activities to enable faculty to integrate technology into coursework. Development activities followed a constructivist model in which each faculty member was responsible for developing a technology product to improve the effectiveness and efficiency of teaching and learning one unit of a course they were currently teaching. Intervention activities unfolded in 4 phases over the course of one academic year.

Phase 1: Faculty attended an intensive 2-day, hands-on staff development workshop on PowerPoint Basics, Advanced PowerPoint, Internet Searching Strategies, and Inspiration (semantic mapping/outlining software) conducted by national experts in the integration of technology into teaching. The workshop included application components that allowed faculty and staff to create an actual "mini" product by the end of the second day.

Phase 2: Faculty worked on their individual projects to develop technology products for use in a course. While the projects were individual, following a constructivist approach, the faculty was grouped into supportive teams, to share ideas, assist each other, and perhaps most importantly, have a forum for discussion.

Faculty development teams: Five (5) teams, each consisting of 2-5 members were established, in each case with the mutual consent of all team members. The focus of 4 teams, and hence the projects of team members, was a specific content area. Each of these teams was named according to the respective content area: Educational Research, Science Instruction, Language & Literacy, and Social Studies. The 5th team was Interdisciplinary, and included special education, health education, and art education. On each of the teams, with the exception of the Science Team, one of the 4 technology-skilled public school master teachers served as a consultant to the faculty. As consultants the master teachers did not have to produce a technology product. Instead, the consultant's role was to assist with design and implementation issues, and in particular, provide feedback regarding the real-life classroom viability of the technology products being developed. Also consistent with the constructivist tradition, faculty members were given a set of guidelines for completing the technology projects. The guidelines required that faculty demonstrate application, analysis, synthesis and evaluation on Bloom's Taxonomy for the cognitive domain.

Phase 3: Faculty incorporated their technology products into the course.

Phase 4: Faculty evaluated the effectiveness of the technology products.
As an incentive for successful completion of all phases of the project faculty are released from teaching 1 course a subsequent semester.

The Outcomes

Phase 1: The benefits of staff development activities were almost immediately noticeable.

- Most of the faculty had not used PowerPoint and were not even aware of the existence of Inspiration. By the end of the workshop each person had produced a PowerPoint presentation for one lesson of a current course, some also incorporating a search strategy or an Inspiration concept map.
- Most faculty members used the PowerPoint and Inspiration software in classes and presentations in the weeks immediately following the workshop.
- 16 of the 17 faculty had never utilized the computer laboratory, where the workshop was conducted. They learned about the networked computers and how the network functions.
- 14 of the 17 faculty have since independently taken an additional workshop offered at the college, to learn Blackboard, a Web-based course management system.

Phase 2: The teams varied considerably in the degree to which they completed Phase 2. See Table 1 below.

TABLE 1

Team	Num. of Members	Phase 2 Completed	Phase 3 Completed	Phase 4 Completed
Educational Research	4	2	2	0
Inter Disciplinary	4	3	2	0
Language & Literacy	5	4	3	0

Science	2	2	2	0
Social Studies	2	2	2	1

On the basis of the number of members who completed Phase 2 and Phase 3, the Science and the Social Studies teams, those with the fewest number of members, were clearly the most successful. However, the numbers do not reflect another aspect of the teams' success, namely the degree to which team members were engaged in the process of not only developing their projects, but also in the process of acquiring technology knowledge and skills. By this measure the Language & Literacy group was clearly the most successful, as indicated by responses to formal interview questions, email communications among group team members (teams were asked to send a confirmation copy of team emails to the project director), and number of queries for assistance with hardware, software, or expertise. The Language & Literacy Team communicated with the greatest frequency and engaged in the greatest number of technology skill building activities. They met and/or exchanged emails almost weekly, and placed the greatest and most consistent demand on the project staff for assistance. The difference among the teams is an issue worthy of further analysis which due to space limitations is not possible here.

Phase 3: As Table 1 reveals, faculty who completed the design of their projects were almost certain to implement the projects in a course the following semester. The single exception to this rule was found in the Social Studies Team and was due to the fact that the faculty member did not teach the course for which the project was designed.

Phase 4: As Table 1 reveals, only 1 of the faculty members has completed the evaluation of the implementation of the project. However, the numbers do not adequately represent state of completion of the projects. In actuality all faculty who completed Phase 3 did gather obtain data to evaluate the effectiveness of the implementation. However, until a formal written analysis of the data is provided, Phase 4 is not considered completed.

DISCUSSION

In summary, technology faculty development activities for faculty who teach pre-service teachers were described. These activities, aimed at increasing the faculty's level of technology proficiency and its ability to integrate technology into teacher education courses were based on constructivist principles. Among the constructivist elements were hands-on workshops, project-based learning, and learning teams of mutually supportive members. The development activities were divided into 4 phases and the success of the members of each team at each phase was compared and analyzed. The role of the incentive provided to faculty for successful completion of the project and a detailed analysis of the various dimensions of the teams that may have fostered or inhibited project completion are areas worthy of further study.

REFERENCES

U.S. Department of Education (1998). School Hardware Resource Survey. An Educator's Guide to evaluating the use of technology in schools and classrooms. Washington, DC: Office of Educational Research and Improvement.

Brownfield Action: An Integrated Environmental Science Simulation Experience for Undergraduates

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Abstract: This paper presents the results of three years of development, implementation, and evaluation of a cd-rom/web hybrid simulation known as Brownfield Action for an introductory environmental science course at an independent college for women located in a large city in the northeastern USA. Brownfield Action is not intended as a cost-cutting measure, a time-saver, or a replacement for other material. It is a method of integrating what was formerly disparate labs and lectures into a seamless learning experience that improves student learning and motivates students to critically consider the importance of all the issues involved in the system of human impact on the environment. Brownfield Action gives students a skill set for conducting scientific work and the perspective that science is connected to one's everyday experience.

Background: Science instructors and students often struggle to link the material in lecture and laboratory. Laboratories are often taught by different personnel, and must fit into constraints of equipment and time, as well as safety and level of difficulty. A large survey course often covers dozens of topics, but a student typically experiences no more than fifteen laboratory periods in a given semester. Life science lectures require rapid note taking and passive concentration as verbal information is streamed at students for one to two hours. Laboratory sessions typically require two to three hours of recipe-following and occasional problem solving. These two elements of the course operate in isolation because there is little time in lecture to discuss experimental technique (if the lecturer even knows that information), and a laboratory is not typically set up for someone to give verbal instruction as occurs in the lecture hall. Typical science students spend most of their time memorizing verbal information for lecture examinations, and memorizing techniques, anatomy, and taxonomies for laboratory practical examinations. Rarely is information from one relevant to the other because the lecture focuses on concepts and the laboratory is intended to teach technique.

In response to this disconnect between laboratory and lecture, many science curricula incorporate problem sets as a third element in an attempt to provide some unification. Unfortunately, the typical drill-and-practice nature of the problems backfires as it encourages students to follow a similar surface study approach that primarily consists of pattern matching. This approach prevents students from tying lectures to laboratories as the problem sets become their own separate entity within the course. Some schools even create separate class sessions monitored by teaching assistants to accommodate this reality, but these sessions only reinforce the separateness of the problem sets. Upon completion of the semester, students of these science courses often feel they have taken two or three courses. They fail to get a sense of the content as a whole, and they never actively engage the content at more than a surface level. One might even propose that in order to succeed in these types of courses as they are designed, it is in the student's best interest to remain at the surface with his or her engagement.

Related Work: Several studies in recent years have led to the development of design principles for the construction of computer-based learning environments such as simulations, many of which can be found in Brent Wilson's compilation *Constructivist Learning Environments: Case Studies in Instructional Design* (1996). Peter Honebein's "Seven Goals for the Design of Constructivist Learning Environments" outlines a set of instructional design principles. He then evaluates two projects based on those principles (Wilson p11-25). John B. Black and Robert O. McClintock, similarly, provide an "Interpretation Construction Approach to Constructivist Design," a seven-point system that they apply to three projects created under the Dalton Technology Plan (Wilson p26-31). John R. Savery and Thomas M. Duffy borrow from Barrows' model for case-study teaching and learning in order to create a set of principles for problem-based learning (Wilson p135-148). More specific to simulations, Margaret Gredler examines one approach for the design and evaluation of simulations in *Designing and Evaluating Games and Simulations: A Process Approach* (1993). Her work involves an interwoven three-part design of role, task, and environment.

The closest work to the experience of the Brownfield Action design and development process is found in Goodrum, Dorsey, and Schwen's work on defining and designing Enriched Learning and Information Environments (ELIEs) (*Educational Technology* November 1993). In this paper, they describe how their experience with designing educational environments led them away from entirely technology-based and theory-based definitions and more towards what they define as a socio-technical definition that focuses on the people involved and the specific work they are asked to perform. They perceive that the latest learning theory and the latest technology does not necessarily lead to innovation. Instead they claim that all innovations are situated within a context of people trying to accomplish work in a particular environment, and a well-designed teaching and learning tool should support that work. They go on to describe their design work as a series of relationship building with users, rapid prototyping with mock-ups and a focus on the tasks that users needed to perform.

Methods: The Columbia Center for New Media Teaching and Learning (CCNMTL) developed a cd rom/web hybrid simulation from 1999-2001 known as Brownfield Action. It was implemented at Barnard College, a women's college affiliate of Columbia University. The project demonstrates how an undergraduate Environmental Science course can directly integrate its lecture and laboratory components through the use of a simulation. In a semester-long course, students solve a complex problem that requires the application of knowledge and skills learned in lecture and in the laboratory setting. Student performance and engagement is improved while developing real-world problem solving skills, and students experience environmental science as a highly integrated field. Rather than reserving higher level thinking skills such as analysis and synthesis for smaller, more advanced courses, Brownfield Action allows introductory students to see environmental science as an integrated and dynamic part of society, rather than a series of abstract concepts and recipe-driven techniques.

Context of Brownfield Action: Brownfield Action is a simulation that provides a learning environment for applying many of the major concepts of environmental science. Students operate in a virtual town serving as consultants to a real estate developer who wants to avoid purchasing potentially contaminated land. Students must become actively involved in the lecture and laboratory in order to succeed. They must learn to explore and to discover a path to a solution to the problems they encounter to reach a valid conclusion. Pairs of students form environmental consulting companies to investigate a hypothetical abandoned factory site in a small town. A mall developer who wishes to purchase the factory site contracts with each two-student company to conduct an investigation. Students collect socio-historical and scientific data, construct maps of the site's basic geology, topography, and any contamination they discover while operating within a given simulated budget. Their investigation culminates in a report to the mall developer that summarizes their results and gives recommendations about how to proceed.

Socio-Historical Component:

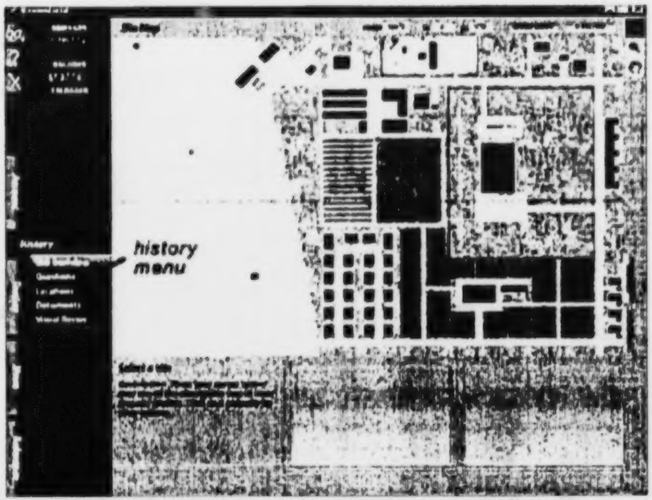

Figure 1: the site map interface for Brownfield Action

To complete the maps and report, students must first gather a site history from the town's resources using the Site Map (Figures 1 and 2). Through the simulation, students visit government offices, businesses, and residences to conduct interviews with town's officials and citizens. They also obtain and analyze simulated public documents.

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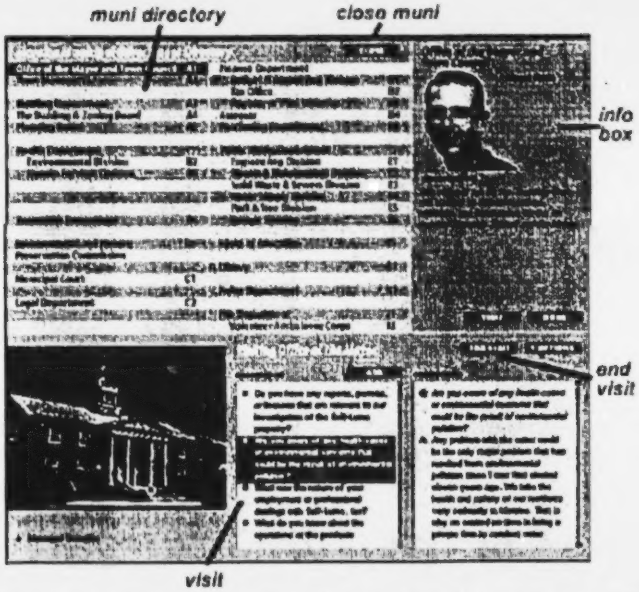

Figure 2: the municipal directory where students visit government offices

Scientific Testing Component: Using the information obtained from the town's history, students then conduct a series of environmental tests to determine the presence, extent, and probable cause of any contamination (Figure 3). Some tests, such as soil permeability, are conducted as traditional laboratory exercises placed within the context of the simulation. Other tests, such as well monitoring, are conducted virtually using the computer. Over two million data points are available for collection over the 64,000 square foot virtual site map, including bedrock and water table data as well as contamination concentrations at depths of over 150ft. This vast quantity of data, both through the site history and the environmental testing, allows for an infinite number of strategies for testing and a unique data set for every student company. Successful students work within the given operating budget and clearly identify the cause and extent of the contaminated areas on the site.

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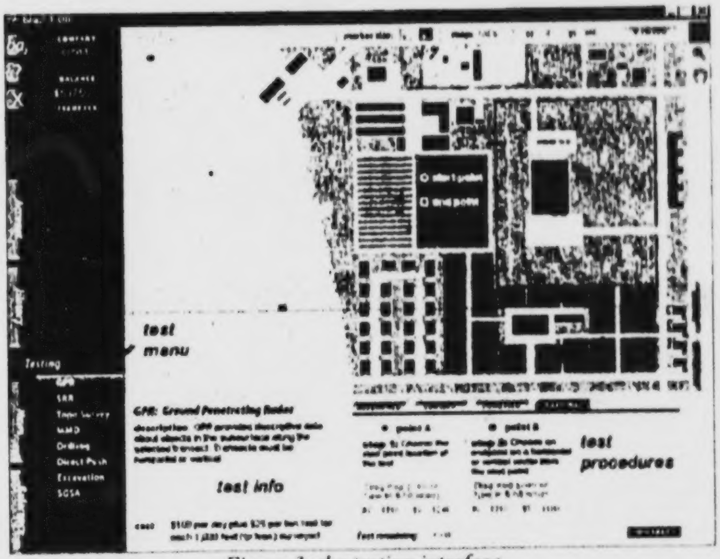

Figure 3: the testing interface

Brownfield Action is not intended as a cost-cutting measure, a time-saver, or a replacement for other material. It is a method of integrating what was formerly disparate labs and lectures into a seamless learning experience that improves student learning and motivates students to critically consider the importance of all the issues involved in the system of human impact on the environment. Brownfield Action gives students a skill set for conducting scientific work and the perspective that science is connected to one's everyday experience.

Course Objectives: The primary faculty member and subject matter expert identified the following objectives:

After experiencing Brownfield Action, students will be able to explain how to approach and solve a scientific problem by:

- describing the strategy used to discover contamination sites in Brownfield Action;
- identifying and explaining the outcomes of environmental tests they conduct and related information, making recommendations and being aware of the consequences of their decisions;
- drawing inferences from data about structures that contribute to environmental contamination;

and students will:

- read articles on ecology with different understanding, interest, and personal commitment;
- appreciate that real world decision-making about ecology involves ambiguity rather than certainty.

Evaluation: To assess the effectiveness of Brownfield Action (BfA2.0) in meeting its objectives in Fall 2000, students were surveyed at the beginning of the simulation to obtain an indication of their perceptions of the levels of knowledge and skill targeted by the course with which they started. The laboratory directors prepared a daily implementation log providing detailed documentation of the BfA2.0 experience in the labs. The evaluators observed five lectures and six of the three-hour labs to further their understanding of the instructional setting within which the Brownfield Action simulation was conducted. At the end of the course, students rated Brownfield Action on how well it had contributed to the objectives of the course and other matters, and all students participated in hour-long focus groups to provide in-depth responses to questions not amenable to discovery through written survey questionnaire. The evaluators conducted hour-long, post-course interviews with the lead designer of the simulation; the primary faculty member and subject matter expert, and the laboratory directors. Finally, a cross section of the papers prepared by BfA2.0 students in the fall, 2000 was reviewed and compared with student papers from previous years.

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Data Sources: The entire course of one hundred and twelve female students were surveyed using two questionnaires (one at the beginning of the semester, one at the end) and a series of focus groups at the end of the term (one for each of the eight lab sections).

In the survey questionnaire and focus groups we investigated students'

- perceptions of pre- and post-test levels of their knowledge;
- perceptions of the success of BfA2.0 in meeting its objectives;
- perceptions of the contributions of various components of BfA2.0 in assisting them to solve the overall problem addressed by BfA2.0, and how well BfA2.0, the lectures and the lab succeeded in directing them to focus on the major problem addressed by BfA2.0.
- overall evaluation of BfA2.0, positive and less positive;
- recommendations for technical improvements in BfA2.0;
- perceptions of the most valuable parts of BfA2.0;
- perceptions of what could be done to improve BfA2.0.

The evaluation team also examined students' final reports in accordance with the learning objectives outlined by the primary faculty member as well as the daily laboratory implementation log prepared by the laboratory directors.

Summary of Results:

- Students learned more and in greater depth using Brownfield Action than in previous years without it.
- Student work looked more authentic and professional, closer to what would be expected of a professional performing these tasks.
- Students appreciated how the simulation contributed to their understanding of the material.
- Brownfield Action was successful in (1) enhancing the scientific literacy of students, (2) facilitating their construction of new meaning based upon what they saw and experienced and (3) enhancing practices leading to increased student learning.
- Students' abilities to construct new meaning based upon what they saw and experienced were expanded.
- Students found the content useful and the simulation a good way to learn it.
- More staff development is necessary to foster the teaching strategies needed for a true discovery process and to build comfort with technology.
- Minor technical glitches created levels of frustration that interfered with its ability to meet its educational potential. These glitches notwithstanding, the students gave high ratings to other features of the technology. In particular, eight out of ten students noted the ease with which it was possible to move through information in each of the sections of the simulation.

Simulations: For as long as there has been computing, many have tried to *simulate* aspects of reality with computing power, but the reality is that all that has been built to date would be better called *simulators* rather than *simulations*. Simulators model real-world processes with mathematical equations and variables that can be manipulated so that changes can be observed and analyzed. Simulators have inputs and outputs and variables that can be manipulated. The bulk of the software for Brownfield is no different upon close inspection. It is a model of a town with a mathematically driven contamination event. Students input instructions through the map in order to receive the outputs.

A *simulator* only becomes a *simulation* when it is given a narrative, and participants are given roles to fulfill, a problem to solve within a given context, and tools to help them solve the problem. In Brownfield Action, the components of the simulation are in the classroom environment supported by the technology and in technology itself. The course curriculum provides the problem to be solved and the roles to be played in the form of an assignment. The context for the problem is provided in the course lectures. Tools are provided within the software in the form of testing tools, in the laboratory in the form of soil samples and mapping techniques, and in the lectures and reading material in the form of mathematical formulas and models of other investigations.

Brownfield Action could be run in a classroom without any technology at all, and in fact it was done on a smaller scale for many years using an elaborate note card scheme. The computer software supports the expansion of the simulation created in the classroom, giving it a visual space with the map, a more efficient process for collecting data in the form of better tools, a means for communication with email and links to the course materials, and more definition and depth (literally and figuratively) to the environment that is to be examined in the form of a complex three-dimensional contamination simulator and a cast of characters that creates the socio-historical narrative. The software itself does not teach. Instead it invites the user to engage in the problem. To foster engagement, one needs motivation and a safe space to take risks, and that is where the classroom, the curriculum, and the instructors come in to play.

Simulations can be powerful teaching and learning environments because learning to operate within a simulation is good training for operating within the real world. Everyone has roles to play in the real world (probably more than one), and there are problems, conflicts, and obstacles to be encountered and overcome in each of those roles. The method for overcoming these problems is in communication and experimentation, which includes hypothesizing, collecting data, analyzing, synthesizing, and applying previous discoveries with other role players using the tools that are available. Solving these problems in a simulation is no different. The major difference is that simulations provide a simplified set of conditions within a contained space for students to operate in. A good simulation still has ample noise that must be sorted through in order to find the important, or signal information that will lead them to a solution, but students can operate with confidence that the signal exists. Simulations also provide a safe environment, away from the consequences of the real world: the money involved isn't real, one's job isn't at stake, etc. Students can essentially practice living in the real world by immersing themselves in the problem to be solved in the simulation.

References

Black, John B. and McClintock, Robert O. (1996) An Interpretation Construction Approach to Constructivist Design. In Wilson, Brent (Ed.) *Constructivist Learning Environments: Case Studies in Instructional Design*, Englewood Cliffs, NJ: Educational Technology Publications.

Goodrum, Dorsey, and Schwen (1993) "Defining and Building an Enriched Learning and Information Environment," *Educational Technology*, 33(11):10-20.

Gredler, Margaret (1992) *Designing and Evaluating Games and Simulations: A Process Approach*, Houston, TX: Gulf Publishing Company.

Honebein, Peter (1996) Seven Goals for the Design of Constructivist Learning Environments. In Wilson, Brent (Ed.) *Constructivist Learning Environments: Case Studies in Instructional Design*, Englewood Cliffs, NJ: Educational Technology Publications.

Savery, John and Duffy, Thomas (1996) Problem Based Learning: An Instructional Model and Its Constructivist Framework. In Wilson, Brent (Ed.) *Constructivist Learning Environments: Case Studies in Instructional Design*, Englewood Cliffs, NJ: Educational Technology Publications.

Making the Transition From Print: Integrating Concept Mapping and Online Communication With Traditional Distance Education Materials

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Abstract: The move from traditional paper-based distance education subject materials to the use of information and communication technologies (ICT) has increased the ways in which students can engage with their lecturers, peers and the unit materials. In this paper, strategies for enhancing print-based learning resources are discussed. These include concept mapping by which the conceptual structure of a unit can be articulated, and online communication that can enhance the interactions between students and teachers. A review of student responses to concept mapping indicates a general acceptance of the tool, with comparisons of assessment grades between successive years of students suggesting an improvement for students who were exposed to concept mapping in conjunction with online communication. The study highlighted several curriculum issues that need further work.

The Context

> *The problem faced by any university ... is how to structure itself so that its central academic activity is facilitated, not undermined, by technological developments* (Laurillard & Margetson, 1997, p. 4).

Monash University is a large institution with campuses or affiliates in Australia, Malaysia, South Africa, Italy and the United Kingdom. The use of ICT is increasing at Monash because of changes in higher education attributed (but not limited) to, funding, diverse student backgrounds (Australian Vice Chancellors' Committee, 1996), changing student expectations and lifestyles, new developments in technology, and opportunities for improved approaches to learning and teaching.

In 1994, Monash University was asked to provide coursework for the Australian Department of Foreign Affairs and Trade (DFAT) in Canberra. At that time, students were either existing or newly appointed officers of DFAT, as well as diplomats from developing countries throughout Africa, Asia and the South Pacific. As a consequence of this endeavour, the Monash University Diplomacy and Trade Program began. The program is run by the Department of Management in the Faculty of Business and Economics of Monash University and is designed specifically for aspiring, trainee or existing diplomats. Successful completion of the course results in the conferring of a Graduate Diploma or Master degree.

For the cohort under review in this paper, students generally range in age from 24 to 40 years of age. Approximately half are Australian, with the other half being international students. In almost all cases, academic backgrounds and vocational experiences are dominated by socio-political training. As a consequence, there is a minimal understanding of the more numerate sciences, of which economics is one. At the time of the review, the numbers in each off-campus class are small (approximately six), though there are approximately 40 students in each concurrent on-campus class. Thus, this unit is economically viable, especially as the fees are high.

Given the importance of economics in a global trade context, the two economics units, Principles of Microeconomics and Macroeconomics, as well as the Economics of Trade and Investment, are core compulsory subjects. This paper discusses the learning design of the unit, Principles of Microeconomics and Microeconomics. The unit incorporates all of the key issues raised in a full first yearcourse of undergraduate economics, with the added emphasis of trade protection and microeconomic reform (Reiman, 1999). The challenge is to teach these fundamentals in one semester so that students are conversant with the policy-orientated approach of their next unit, Economics of Trade and Investment. A second challenge involved the physical location of the off-campus students where there are issues of access to the proposed online environment (for example, one student travelled very frequently and logged into the online discussions from a variety of countries during the course of the semester).

The team who developed the unit materials reached consensus on a view of learning based upon constructivist principles, in which knowledge is constructed individually and socially co-constructed by learners based on their interactions and experiences with the world (Biggs, 1999; Jonassen & Rohrer-Murphy, 1999; Kennedy & McNaught, 1997a). Integrating computer-mediated communication (CMC) to support a more student-centred learning environment was a key component of the design of the unit materials. The incorporation of online discussion groups has been shown to foster collaborative learning (Agostino, Lefoe, & Hedberg, 1997), improve flexibility in teaching and learning (Freeman, 1997), and support problem-based learning (Oliver & Omari, 1999).

In the past, the study materials for the off-campus cohort were entirely print-based. These materials were redeveloped to be used in conjunction with concept maps, and a number of online discussion groups. The on-campus students had a traditional set of lectures and tutorials; the concepts maps were given to the students and used by the lecturer during classes.

The Concept Maps and Online Discussion Groups

Concept mapping has a history of extensive use for improving student learning and metacognition. It has been used in domains as diverse as chemistry (Cullen, 1990; Ross & Munby, 1990); biology (Jegede, Alaiyemola, & Okebukola, 1990); physics (Pankratius, 1990); microbiology (Barenholz & Tamir, 1992); hypermedia development (Kennedy, 1995; Kennedy & Taylor, 1994), and the design of computer-based learning tools (Kennedy & McNaught, 1997b).

The concept maps were developed using software called *Inspiration* (Helfgott, Shankland, Stafford, & Samson, 1997). In Figure 1, the master concept map is shown. Very positive feedback was received from a number of students on its usefulness (discussed later). The master concept map was further broken down into sections that addressed a single week. In Figure 2, the concepts in italics are from pass and future weeks, while the concepts related to week 11 are in normal style print.

Online discussion groups were linked to the content of the print-based materials. Five discussion groups were created. These were announcements (read-only by students), general discussion (for ongoing discussions during the semester), and three groups associated with specific assessment tasks. The three online assessable discussion groups were designed to:

- help the students' written communication skills;
- develop their ability to structure an economic argument;
- develop their understanding of economic concepts;
- allow students to share ideas with peers, wherever they may be; and
- develop online collaborative skills.

Students' marks for these discussion groups contributed only 15% to the final grade. The overall assessment strategies were not markedly changed and were similar for both off-campus and on-campus groups.

Development Issues for the Unit

In the frequently perceived headlong rush to put all course content online, academics and students are expected to engage with new ways of thinking and working, while simultaneously developing new skills. In the transition between more traditional approaches to curriculum development and design, older technologies are often disregarded as being irrelevant and outmoded. The second author of this paper was an experienced lecturer in face-to-face situations, but new to the use of concept maps as a holistic organisational learning tool, and the use and management of asynchronous online discussion groups.

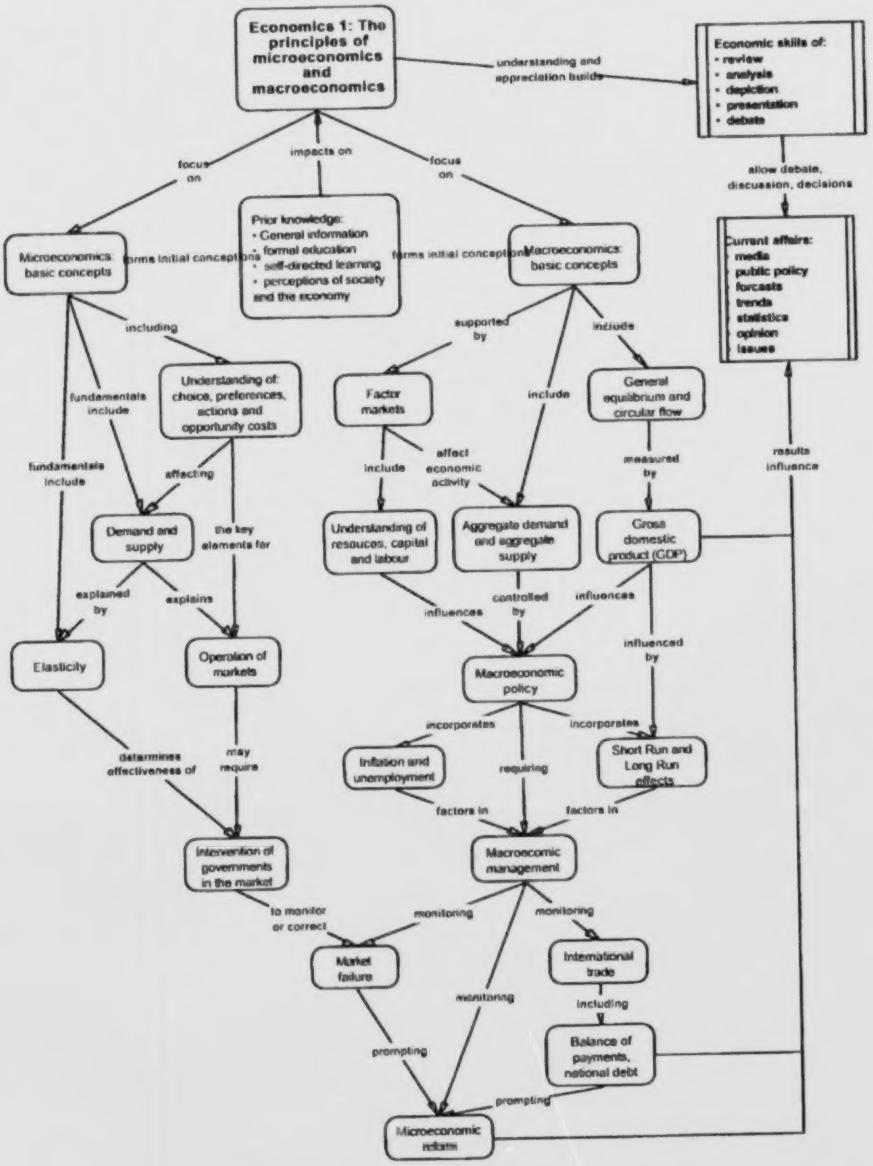
Economics 1: The principles of microeconomics and macroeconomics
understanding and appreciation builds
Economic skills of:
• review
• analysis
• depiction
• presentation
• debate
allow debate, discussion, decisions
Current affairs:
media
public policy
forcasts
trends
statistics
opinion
issues
focus on
impacts on
focus on
Prior knowledge:
• General information
• formal education
• self-directed learning
• perceptions of society and the economy
forms initial conceptions
forms initial conceptions
Microeconomics: basic concepts
Macroeconomics: basic concepts
including
fundamentals include
fundamentals include
Understanding of: choice, preferences, actions and opportunity costs
affecting
the key elements for
Demand and supply
explained by
explains
Elasticity
Operation of markets
determines effectiveness of
may require
Intervention of governments in the market
to monitor or correct
supported by
include
include
Factor markets
include
affect economic activity
General equilibrium and circular flow
measured by
Understanding of resouces, capital and labour
Aggregate demand and aggregate supply
Gross domestic product (GDP)
influences
controlled by
influences
influenced by
results influence
Macroeconomic policy
incorporates
incorporates
requiring
Inflation and unemployment
Short Run and Long Run effects
factors in
factors in
Macroecomic management
monitoring
monitoring
monitoring
Market failure
International trade
including
Balance of payments, national debt
prompting
prompting
Microeconomic reform

Figure 1: The major concept map for the course

The development of these unit materials represented a departure from his previous experience. The first author is an educational designer, experienced in the use of both learning tools. The development of the unit materials involved building effective electronic communication methods (fax, email and telephone) between the two

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authors, as author one was based in Melbourne, while author two was in Canberra, a one-hour air flight away. The development of the concept maps, in particular, required extensive use of the fax, particularly as hand written comments on the drafts of Figure 1 were crucial to the final outcome.

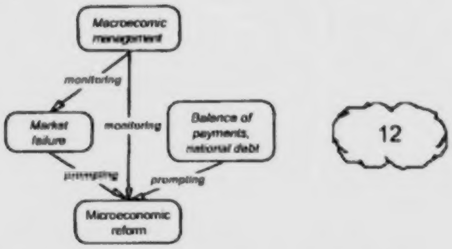

Figure 2: The individual concept map for Week 12.

The development of the online communication groups was less problematic, as Monash University had recently developed a web-based virtual doorway (the MyMonash Portal) to support students' administrative and educational needs(Kennedy, Webster, Benson, James, & Bailey, In press). Issues of managing the online discussion groups were addressed in the development of the print-based materials, with particular focus on the assessment linked to the participation in three of the discussion groups, and access to appropriate readings (Berge, 1995; Mason, 1997; Salmon, 2000).

Evaluation of students' perceptions of the concept maps

This small study was with a class taught in 1999, with the evaluation data being collected early in 2000 after the completion of the unit. A questionnaire that focused on the integration of the concept maps in the written materials was given to both the off-campus and on-campus students. The responses to selected questions are shown below in Table 1. None of the students had any prior experience with concept mapping. There were three off-campus students and all replied; there were 48 on-campus students, but only eleven students responded to the questionnaire. As with all groups of students, there are differing levels of interest in the unit matter, and diversity of learning styles, such as whether students were 'visual' in their cognitive approaches. Few of the on-campus students used the concept maps; they cited the complexity of the maps and their lack of time for the reasons. The off-campus students appeared to use the maps more but these questionnaire results suggest that they found the concept maps more useful with revision rather than as a primary learning tool.

Q1: Did you find that the major concept map was informative? Please explain your answer.	
Off-campus	On-campus
• The Concept Map was useful for seeing how all of the sectors of the course interrelated. It was informative although I didn't use it or retain the information in it when I was enquiring what was up next. • It was to some extent as it visualised the big picture of economics and where each concept fitted in. However, I only ever used it for reference between topics to see how things interacted.	• Yes. It briefly explains the basic concepts and guides us as to the differences (and similarities) between macroeconomic and microeconomics throughout the semester. • By the end of the course I found it useful to assist in reviewing the topics studied and to connect them together in context. • It was useful to look at once or twice, but I have to admit I didn't really use it. • No – hard to follow and confusing. • I found it useful to review prior to tests, in terms of 'putting it all together'.
Q2: Do you believe that the major concept map assisted you in your overall process of learning in this unit?	
Off-campus	On-campus
• Yes, but not until later, when I had the earlier ideas in my mind • It was a good diagrammatical representation of the course's concepts, and helped me to know where my knowledge was lacking, or where I needed to review my understanding	• Helped with an overview of the topics when reviewing, and to understand how they connected. • Didn't use it. • When I first started economics, I was confused because I had to learn so many things in a short time. The concept map guided me in finding the right approach to economics. • There was too much to learn within a short space of time.

Q3: Did you attempt to construct, as the study guide suggested, your own concept maps of your understanding of economics?	
Off-campus	On-campus
• Because I tend not to be a very visual person, they do little to expand my learning or understanding of a topic. Lots of other people might benefit greatly from them though • Had no time and the existing concept maps were good enough for revision etc.	• Maybe not as detailed as the attached concept map, but it helps simplify relationships. • Didn't occur to me! • It doesn't help me. • No time. • It never occurred to me. I would probably do it in the future given time. • Yes, specific issues only: not 'the big picture'. • Since we had little time for Economics 1, to understand and learn economics in a systematic way is very crucial. Your map helped me a great deal in understanding the subject. • Yes, for microeconomics test.

Table 1: Sample questionnaire responses for both groups of 1999 students

It may be that the lack of familiarity and their inability (mainlya lack of time) to develop their own concept maps were problematic. The development team has learnt that an innovation in learning design, such as the use of concept maps, must be carefully budgeted for in terms of students' time.Students may appreciate these maps, but the time to become familiar with them, and to explore their potential, must be allocated carefully. The question of whether, to what degree, and how innovations such as concept mapping and online discussion groups should be assessed has not been resolved; assessment is likely to become one of the main curriculum issues in the next few years. The use of the discussion groups was not evaluated by specific questionnaires, or requests for specific feedback. However, all online assessment tasks were completed extremely well, with students able to articulate a deep understanding of specific concepts.

Unit Learning Outcomes

With concept mapping and online discussions providing a focussed approach to the learning of economics, it may be anticipated that students might learn more about the unit. This added learning may result in higher marks. These results should be seen as anecdotal rather than definitive, if only due to the small sample size. In this regard, it should be noted that the nature and content of the course work in the two economics units taught in the Diplomacy and Trade program remained relatively unchanged over a two-year period under review in this paper. Specifically, assessment details were available for the year prior to the introduction of concept mapping in Economics 1, as well as in the year during which Economics 1 concept mapping was provided as an additional educational tool. As noted earlier, the major assignments for the two groups, off-campus and on-campus, were similar. Note also that the lecturer was the same for all cohorts.As a consequence, a comparison was made between assessment scores gained bystudents who had been exposed to concept mapping and online discussion, as well as scores gained by students who had not seen either. As can be seen in Table 2, scores for individual tests, and the total, were higher, on average, for the innovation cohort. An overall advantage of 16.1 per cent is noted between successive years.

Assessment	Pre-concept mapping	Post concept mapping	Change (%)
First test	62.6	76.4	22.0
Second test	60.6	66.1	9.1
Third test	65.3	82.9	26.9
Overall result	64.2	74.6	16.1

Table 2: Sequential first semester results: Before and after concept mapping

Conclusions and Summary

The design and development of the unit materials involved the establishment of trust, understanding and good communication between the content expert and the educational designer. The current structure of the unit is being used by the Faculty of Business Economics as an example for other academics who wish to start the transition from more traditional distance education materials to more engaging, interactive ways of developing student knowledge. The book (paper-based unit guide) still has its place, but integration of online communication enables students, who are often isolated from their colleagues, to engage with their peers, receive feedback from the lecturer and complete assessment tasks that are more relevant to the desired learning outcomes. Whilst there are potential confounding factors at work when making absolute comparisons between two groups of students across years, the anecdotal inference is that there is a benefit to students who have been exposed to an holistic view of the unit by the use of concept mapping as an advance organiser and revision tool, and had the opportunity to engage in asynchronous online discussions.

References

Agostino, S., Lefoe, G., & Hedberg, J. (1997, 16 July). *Online collaboration for learning: A case study of a post-graduate university course* [Conference paper]. AusWeb97. Retrieved 6 October, 1998, from the World Wide Web: http://ausweb.scu.edu.au/proceedings/agostinho/index.html

Australian Vice Chancellors' Committee. (1996, 9 October). *Exploiting information technology in higher education: An issues paper*[An issues paper]. Retrieved 10 February, 1997. Available: http://www.avcc.edu.au/news/public_statements/publications/eitihe/sec6.htm.

Barenholz, H., & Tamir, P. (1992). A comprehensive use of concept mapping in design instruction and assessment. *Research in Science and Technological Education, 10*(1), 37-52.

Berge, Z. L. (1995). Facilitating computer conferencing: Recommendations from the field. *Educational Technology, 35*(1), 22-30.

Biggs, J. (1999). *Teaching for quality learning at university*. Buckingham: Society for Research into Higher Education & Open University Press.

Cullen, J. (1990). Using concept maps in chemistry: An alternative view. *Journal of Research in Science Teaching, 27*(10), 1067-1068.

Freeman, M. (1997). Flexibility in access, interaction and assessment: The case for web based teaching programs. *Australian Journal of Educational Technology, 13*(1), 23-39.

Helfgott, D., Shankland, J., Stafford, J., & Samson, T. (1997). *Inspiration* [Software]. Inspiration Software Inc. Available: http://www.inspiration.com/.

Jegede, O. J., Alaiyemola, F. F., & Okebukola, P. A. (1990). The effect of concept mapping on students' anxiety and achievement in biology. *Journal of Research in Science Teaching, 27*(10), 951-960.

Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology, Research and Development, 47*(1).

Kennedy, D. M. (1995). Students' prior knowledge: Implications for instructional design of interactive multimedia. In J. M. Pearce, A. Ellis, C. McNaught & G. Hart (Eds.), *Learning with technology: ASCILITE 95*. Proceedings of the 12th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education, (pp. 288-296). The University of Melbourne: The Science Multimedia Teaching Unit.

Kennedy, D. M., & McNaught, C. (1997a). Design elements for interactive multimedia. *Australian Journal of Educational Technology, 13*(1), 1-22.

Kennedy, D. M., & McNaught, C. (1997b). Use of concept mapping in the design of learning tools for interactive multimedia. *Journal of Interactive Learning Research, 8*(3/4), 389-406.

Kennedy, D. M., & Taylor, P. C. (1994). Hypermedia design for enriching conceptual understanding in chemistry. In C. McBeath & R. Atkinson (Eds.), *IIMM 94*. Proceedings of the Second International Interactive Multimedia Symposium, (pp. 218-225). Perth, Western Australia: Promaco Conventions Pty. Ltd.

Kennedy, D. M., Webster, L., Benson, R., James, D., & Bailey, N. (In press). My.monash: Supporting students and staff in teaching, learning and administration. *Australian Journal of Educational Technology*.

Laurillard, D., & Margetson, D. (1997). *Introducing a flexible learning methodology: Discussion paper* ((Publication No. 7). Brisbane: Griffith University: Griffith Institute for Higher Education.

Mason, R. (1997). *Integrating synchronous and asynchronous teaching technologies* [OTD Report No. 11]. Institute of Educational Technology. Retrieved 27 November, 2000. Available: http://www-iet.open.ac.uk/otd/OTD11.html

Oliver, R., & Omari, A. (1999). Using online technologies to support problem-basedlearning: Learners' responses and perceptions. *Australian Journal of Educational Technology, 15*(1), 58-79. Available: http://cleo.murdoch.edu.au/ajet/ajet15/oliver.html.

Pankratius, W. J. (1990). Building an organised knowledge base: Concept mapping and achievement in secondary school physics. *Journal of Research in Science Teaching, 27*(4), 315-333.

Reiman, C. (1999). *Principles of Microeconomics and Macroeconomics Subject Guide: ECX9140* (Study Guide). Melbourne: Monash University.

Ross, B., & Munby, H. (1990). Concept mapping and misconceptions: A study of high-school students' understandings of acids and bases. *International Journal of Science Education, 13*(1), 11-24.

Salmon, G. (2000). *E-moderating: The key to teaching and learning online*. London: Kogan Page.

Authentic Patient Encounters in Paediatric Dentistry

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Abstract: This paper examines a multimedia learning design which utilises a virtual dental clinic and a fictitious eight year old patient - "Matthew", to situate students within an authentic learning environment. A case is presented which requires the student to examine clinical information about "Matthew" in the form of patient history, clinical slides, radiographs and expert information from teachers, psychologists and an endocrinologist. The dental student creates a legitimate treatment plan for "Matthew" by analysing information typically obtained in a real patient encounter. A situated learning design was adopted as it provided a means of engaging the dental student with a legitimate case of a child with diabetes. A virtual "Matthew" was created because it has become increasingly difficult to access suitable patients, especially child patients, for dental students. Consequently dental students may not be adequately experienced in treating paediatric patients with medical conditions such as diabetes. This scenario aims to improve dental clinical management through case management of medically compromised dental patients - in this case a child with diabetes.

Authentic Learning Environments

Authentic learning experiences are "those which are problem-or case-based, that immerse the learner in the situation requiring him or her to acquire skills or knowledge in order to solve the problem or manipulate the situation" (Jonassen, Mayes, & McAleese, 1992, p. 235). "Authentic tasks enable students to immerse themselves in the culture of the academic domain, much like an apprentice" (Young, 1993, p. 43). Interest in environments that immerse students in authentic learning experiences, where the meaning of knowledge and skills are realistically embedded, has been longstanding (Dewey, 1938; Piaget, 1952). More recently, attempts to enhance cognition in authentic learning-performing tasks have become widespread (e.g., Brown, Collins, & Duguid, 1989; Cognition and Technology Group at Vanderbuilt, 1991, 1992, 1993). The need for realistic experience and real-world problem solving is also advocated. Ramsden (1987) suggests that university graduates are not obtaining deep conceptual knowledge that will allow them to think like experts in their discipline. We contend that a key role of a university education is to produce health professionals who are capable of solving complex and ill-structured problems and have the ability to reflect on their professional practice. This practitioner is capable of reflecting on the practical demands of the real world, continually monitoring their own professional thinking for the ultimate aim of solving related or new professional problems. However, there is a continuum of knowledge acquisition that leads to a fully-fledged expert in professional practice. Jonassen, Mayes, and McAleese (1992) suggest a continuum of introductory, advanced and expert learning phases. The introductory phase is typified by initial knowledge acquisition by the novice learner which involves learning about well-structured content domains. The advanced phase deals with ill-structured domains.

"During this phase, learners acquire more advanced knowledge in order to solve more complex, domain- or context-dependent problems" (Jonassen, Mayes & McAleese, 1992, p. 231). Expertise is the third phase in the continuum. Experts appear to be able to uniquely represent problems, which facilitates the solving of problems in an efficient and effective manner. The role of providing authentic learning experiences in the university setting is an attempt to immerse the learner in the advanced phase in order to move them toward the development of expertise.

Authentic learning contexts like the virtual dental clinic may have a number of advantages over more decontextualised teaching and learning settings. The authentic nature of the technology-enhanced, student-centred learning environment may create a context within which knowledge is anchored in authentic contexts. An effective learning environment enables learners to use its resources and tools to process more deeply and extend thinking (Jonassen, 1996; Jonassen & Reeves, 1996; Kozma, 1987). Harper, Squires and McDougall (2000) suggest that "only in complex, rich environments will learners have the opportunity to construct and reconstruct concepts in idiosyncratic and personally meaningful ways" (p. 118).

Learning Design

Teaching dental students to treat patients safely and efficiently presents many challenges. The declining availability of suitable patients attending the teaching clinics of the Royal Dental Hospital of Melbourne in association with the University of Melbourne prevents students from developing a range of experiences in total patient management. A disadvantage of traditional preclinical laboratory teaching is that students are not able to integrate theoretical and practical skills. Consequently there are concerns that dental students are not competent in combining preventive and restorative management philosophies while integrating diagnosis and treatment planning (Suvinen, Messer, Franco, 1998). Multimedia case simulations were considered to be a viable alternative as they replicate the dental clinic without requiring 'live' patients. The diabetes module provides an opportunity to develop and consolidate the concept of integrated patient care. In particular, the learning outcomes for the modules focus on: (1) competence in history, examination, diagnosis and treatment planning skills, (2) integration of theoretical and practical aspects of total patient management, (3) understanding of the relevance of the medical condition to dental health and dental treatment with attention to precautions when delivering treatment, and (4) recognition of the significance of medical conditions in treatment planning for their dental condition.

In order to create a realistic learning experience for the student dentist it was essential that we immersed the student in an authentic case. We utilised principles of situated learning which suggests that there should be "an active relationship between an agent and the environment, and learning must take place during the time the student is actively engaged in with a complex, realistic instructional context" (Young, 1993, p. 45). We utilised the following principles of authenticity to guide our creation of the diabetes scenario. These include:
- real-life problem-solving
- ill-structured complex goals
- opportunity for the detection of relevant versus irrelevant information
- active/generative engagement in finding and defining problems
- involvement of student's beliefs and values
- opportunity to engage in collaborative interpersonal activities (Young, 1993, p. 45). Likewise Herrington and Oliver (1995) suggest nine critical characteristics of situated learning which focus on the interactive multimedia program, implementation and the learner.

The virtual dental clinic provides an authentic learning environment in which the trainee dentist can examine information (patient records, clinical slides, radiographs and expert reports) about a paediatric patient with diabetes. This approach attempts to immerse the learner within a typical clinical scenario and then asks them to create a relevant treatment plan. The virtual case attempts to bridge the gap between novice and expert by asking the trainee dentist to begin thinking and acting like an expert dentist.

The first step in our design process was to select a situation suitable for authentic situated learning. Previously we had created two other modules on Congenital Heart Disease and Down syndrome in which scenarios were used to engage the student with the relevant content. A module on diabetes created unique challenges for the design team. A virtual paediatric patient with diabetes was created in order to address the difficulty of obtaining relevant patient photographs. In our interactions we wanted to increase the level of student engagement with the content and embarked on contextualising the scenario content within a virtual dental clinic. We were also careful not to overwhelm the dental student with an overly complex case. "While complexity may be necessary to provide authentic learning environments, too much complexity can make learners feel insecure and lose track of learning objectives" (Harper, Squires & McDougall, 2000, p. 127). This setting would allow the embedding of authentic activities such as the examination of radiographs and patient information within a realistic clinical situation. We began by photographing the dental clinic and then creating the virtual dental clinic and waiting room. Figure 1 illustrates the virtual dental clinic with "Matthew", the virtual patient.

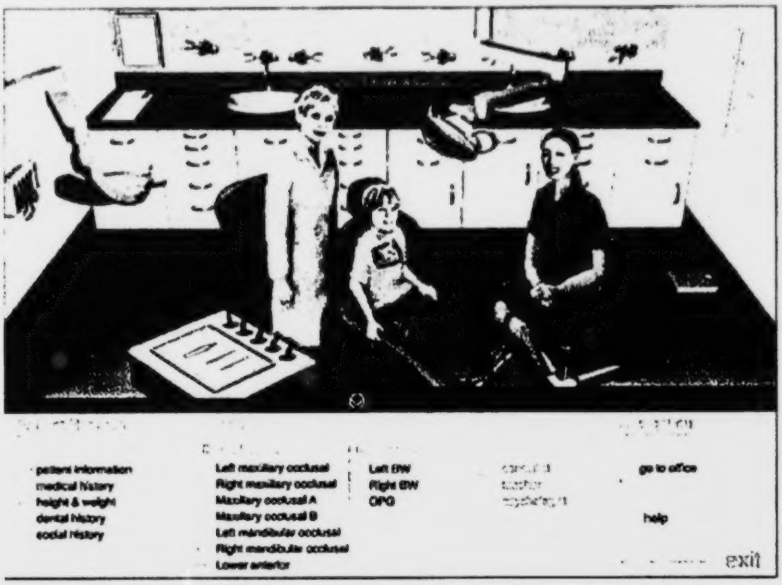
patient information
medical history
height & weight
dental history
social history
Left maxillary occlusal
Right maxillary occlusal
Maxillary occlusal A
Maxillary occlusal B
Left mandibular occlusal
Right mandibular occlusal
Lower anterior
Left BW
Right BW
OPG
teacher
psychologist
go to office
help
exit

Figure 1: Virtual dental clinic and drop-down menu which allows access to clinical information about "Matthew"

Secondly, we provided multiple entry points into the clinical information. This allowed the user to explore the clinic and obtain the necessary clinical information about Matthew. We wanted the student to "criss-cross the landscape of knowledge" in order to obtain information that would enable them to complete the relevant treatment plan (Young, 1993, p. 46). The user can navigate around the clinic and find information in two ways. By travelling around the clinic they will find 'hotspots' which provide clinical information. A site map also provides clinical information enabling the student to access patient records (patient information, medical history, height and weight, dental history and social history), seven clinical slides, three radiographs, and expert information from a teacher, psychologist and endocrinologist. By providing the necessary scaffolding for the novice learner we attempted to move the learner toward expert case management.

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The Case
Presenting Complaint: "Matthew" is 8 years old. He presented with sensitive teeth, the left side being worse than the right. His mother mentioned that he will not brush his teeth because they hurt. She is concerned that he has not been eating well during the past few weeks.
Dental History: "Matthew's" last dental visit was when he was 5 years old. The school dental service performed a checkup and no treatment was required at that stage. Matthew brushes his own teeth once a day and does not floss his teeth. He has fair oral hygiene.
Medical History: This young boy was diagnosed with insulin dependant diabetes at 14 months of age. He has 2 injections: before breakfast and dinner. The injections consist of a combination of short-acting and intermediate insulin. "Matthew's" parents give the injections. "Matthew" has a high carbohydrate diet with frequent intakes throughout the day. "Matthew" has regular medical checkups with his paediatric endocrinologist every three months. His diabetes is well monitored and stable. There have been no complications.
Height and weight measurements: Height: 130 cm (75th percentile); Weight: 27 kg (50th-75th percentile)
Social History: "Matthew" was born in Victoria and lives with his parents and two older brothers. He attends a primary school close to home. He has tennis lessons every Sunday morning, swimming lessons on Thursday afternoons and last year he started rugby on Saturday mornings. "Matthew" has cello lessons on Tuesday after school. "Matthew" belongs to the local cub pack and they meet every Monday evening.
Teacher Due to his checkups at the hospital, "Matthew" is absent from school for a significant number of days. He is in an age-appropriate level at school and has remedial teaching to keep him at the same level as his class. The other students are aware of "Matthew's" medical condition and they are supportive of him, especially when he misses a day of school to go for his checkups. He has many friends in his class. "Matthew" does not need his insulin injections during school hours. In case of emergencies, "Matthew's" teachers will contact his parents for instructions.
Endocrinologist "Matthew" has been a diabetic for 7 years. He attends for regular checkups every 3 months to assess his blood glucose control and to decide if there is any need for adjustments in medication. He adapted well to a modified diet and daily administration of medication by his parents. There was a period of time when "Matthew" experienced some frustration regarding his lifestyle. His parents were supportive through this episode. If any treatment under general anaesthesia is required, it should be performed in a major hospital so that the endocrinologist can monitor "Matthew" and adjust his glucose level. "Matthew" should be admitted the day prior to the procedure for blood glucose monitoring. He will be able to return home on the same day as the treatment if his glucose level is stable. It is important that "Matthew" has not had any recent episodes of hypoglycemia.
Psychologist A year ago "Matthew" went through a difficult stage. He was angry that he needed his insulin injections twice a day. During medication times, he would refuse the injections and his parents would spend significant time convincing "Matthew" to have his medication. At birthday parties "Matthew" was upset that he could not eat the whole bag of sweets like other children. I consulted with "Matthew" and his parents over a number of sessions and these issues were resolved.

Table 1: Case information that can be accessed in the virtual dental clinic

Our third strategy provided an expert-supported learning environment. Lab sessions were scheduled in which students interacted with the module and were supported by specialist paediatric dentists. "From the perspective of situated cognition, the teacher's role should be to 'tune the attention' of students to the important aspects of the situation or problem-solving activity, specifically those attributes that are invariant across a range of similar problems and therefore will transfer to many novel situations" (Young, 1993, p. 47). Educators also assisted the dental academics in the tutorial setting by facilitating their efficient use of the technology-enhanced environment. "Instructional designs for situated learning must not only provide scaffolding for students: they must also provide scaffolding for teachers" (Young, 1993, p. 51). The advantage of expert support is that case information could be clarified, explained and elaborated by the specialist. The use of specialist paediatric dentists was a central focus of our approach as they were able to support learning and monitor student engagement with the module. By providing this support it meant that we did not need to overly simplify the authentic task (Barab & Duffy, 2000).

Young (1993) suggests that traditional forms of assessment in situated learning may prove to be inadequate. Authentic learning tasks must be assessed using methods that best align with the task. Our

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fourth strategy was to align activities/assessment with the creation of the authentic learning situation. We matched the task and assessment by asking students to develop a treatment plan using the protocols utilised in a traditional clinic. In order to simulate the use of this chart, an electronic dental chart was created to allow users to create treatment plans within the multimedia module. The electronic dental chart allows the trainee dentist to select a category of dental services and allocate a specific treatment for individual teeth. This chart also allows the user to complete cases and submit information to obtain expert feedback. The expert feedback provides precise information about the treatment protocol for each tooth. The student can compare their treatment plan to the expert and then re-enter the virtual clinic to rectify any inaccuracies and misconceptions. This concept of authentic assessment tasks is essential in the instructional design as "assessment should be a seamless, continuous part of the activity (a learning/assessment situation)" (Young, 1993, p. 48).

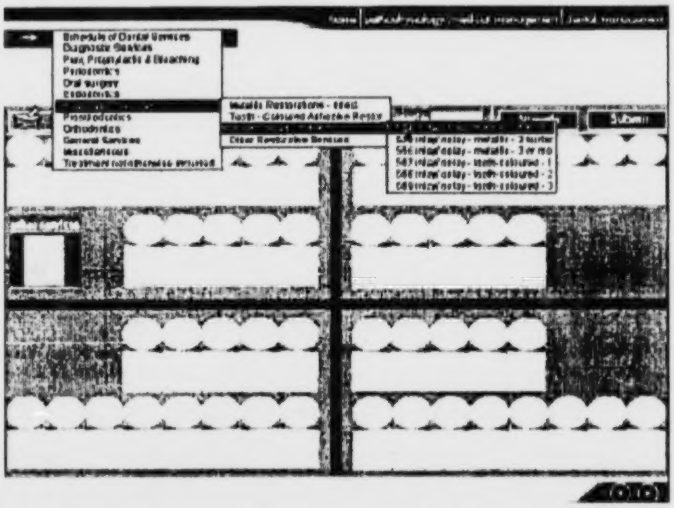

Figure 2: Electronic treatment plan utilised for the diabetes clinical case

Our fifth strategy was to provide detailed feedback to the student in relation to the case. At the conclusion of the case and after reinforcement activities the student is provided with comprehensive patient feedback in relation to "Matthew's" case. The following information provides an example of this detailed feedback about the case. "The patient with diabetes should be placed on a frequent recall maintenance program after dental treatment is completed until his susceptibility to recurrent oral disease has been established. Regular topical fluoride applications may be considered at home and professionally. Sealants can be placed as the permanent teeth erupt. A mouthguard for sports activities will need regular replacement with development of the dentition. Patients and parents should be aware of the importance of oral health in relation to the diabetic condition. The dentist should take time to inform them of the potential for increased susceptibility to oral infection and periodontal disease in the inadequately controlled diabetic patient. The well-controlled diabetic patient will have good oral health especially if the child maintains good home oral care and continues recall compliance".

Conclusion

Our next step in the process is to create a number of scenarios that may foster transfer to similiar cases and to more ill-defined cases. This is important as "one of the major concerns about situating instruction in specific contexts is that students' understanding and application of these concepts will stay welded to the context" (Cognition and Technology Group at Vanderbuilt, 1993, p. 52). In order to address this issue we intend to construct new dental scenarios that are directly analogous to the diabetes case. This is considered to be 'transfer to analogous problems'. The virtual dental clinic can be reconfigured with different information and different case parameters. Individual treatment plans can be developed in

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conjunction with specialist paediatric dentists utilising other cases of importance to the learner. Numerous cases can be completed allowing the trainee dentist to become familiar with expert dentist strategies and treatment plans. The overall aim of designing authentic learning tasks is to improve dental health care. Once we have achieved transfer to real-contexts the individual dentist should continue to adapt to complex real-world cases.

References

Barab, S. & Duffy, T. (2000). From practice fields to communities of practice. In D. H. Jonassen & S. M. Land (Ed.) *Theoretical foundations of learning environments*, Mahwah, NJ: Lawrence Erlbaum (pp. 25-55).

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Cognition and Technology Group at Vanderbuilt, (1991). Technology and the design of generative learning environments. *Educational Technology, 31*(5), 34-40.

Cognition and Technology Group at Vanderbuilt, (1992). Emerging technologies, ISD, and learning environments: Critical perspectives. *Educational Technology Research and Development, 40*(1), 65-80.

Cognition and Technology Group at Vanderbuilt, (1993). Anchored instruction and situated cognition revisited. *Educational Technology, March*, 52-70.

Dewey, J. (1938). *Experience and education*. New York: Collier Macmillan.

Harper, B., Squires, D. & McDougall, A. (2000). Constructivist simulations: A new design paradigm. *Journal of Educational Multimedia and Hypermedia, 9(2)*, 115-130.

Herrington, J. & Oliver, R. (1995). Critical characteristics of situated learning: Implications for the instructional design of multimedia. In J. Pierce (Ed). *Proceedings of the twelfth annual conference of Australian Society for Computers in Tertiary Education (ASCILITE)*. University of Melbourne, Australia.

Jonassen, D., Mayes, T. & McAleese, R. (1993). A manifesto for a constructivist approach to uses of technology in higher education. In Duffy, T. M., Lowyck, J. & Jonassen, D. H. (Eds.)*Designing environments for constructive learning*. Berlin; Springer-Verlag.

Jonassen, D. (1996). *Computers in the classroom: Mindtools for critical thinking*. Englewood Cliffs, NJ: Merrill.

Jonassen, D., & Reeves, T. (1996). Learning with technology: Using computers as cognitive tools. In D. Jonassen. Ed., *Handbook of research on educational communication and technology*, (pp. 693-719), New York, Scholastic.

Kozma, R. B. (1987). The implications of cognitive psychology for computer-based learning tools. *Educational Technology, 27*(11), 20-25.

Piaget, J. (1952). *The origins of intelligence in children*. New York: International University Press.

Suvinen, T., Messer, L.B. & Franco, E. (1998). Clinical simulation in teaching pre-clinical dentistry. *European Journal of Dental Education, (2)*, 25-32.

Young, M. (1993). Instructional design for situated learning. *Educational Technology Research and Development, 41*, 43-58.

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Evaluation and Redesign of the Clinicians Health Channel

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Abstract: The Clinicians Health Channel (CHC) is a resource-based portal web site providing online access to information sources that assist Victorian clinicians in decision making, research and education. Resources include an electronic health library with citation databases and full text journals, links to clinical reference materials and guidelines & protocols. An inter-disciplinary, collaborative team from the University of Melbourne is undertaking an evaluation to determine how successfully the introduction of the CHC has met its original aims specifically in relation to the development, implementation and impact on changing behaviour and increasing usage of evidence-based health care. The addition of online communities of practice may assist the sharing of practitioner knowledge and may complement the resource-based nature of the channel.

Rationale

Clinical decisions about options for a patient's care should be based on both individual clinical expertise and best available external clinical evidence (Sackett, Rosenberg, Gray, Hayes & Richardson, 1996). However, it has been estimated that for the medical profession to keep up to date with advances in drugs, treatment and technologies alternatives, they would need to read 19 articles per day, 365 days of the year (Evidence-based working group, 1992). Information resources made available to clinicians via telecommunication are increasingly being advocated because it is believed that they can provide better access to and use of the evidence to allow the clinician to keep up to date and enhance the quality of care (Lindberg, Siegel, Rapp, Wallingford & Wilson, 1993; Elson & Connelly, 1995).

However, these resources have had limited use in direct patient care settings, meet only a small part of clinicians' information needs, and have not had significant impact on clinical practice. While some may disagree with the need to prove benefit to advocate the use of information resources, most will agree with the need for further research into the content and delivery methods as well as the social and behavioural impacts of such resources on clinicians, their patients, work practices and organisations (Gorman, Ash & Wykoff, 1994; Covell, Uman & Manning, 1985; NHS Centre for Reviews and Dissemination, 1999; Hersch & Hickam, 1998). Our evaluation is thus concerned with the use of evidence-based information in the context of clinical practice, and with the use of a web-based portal to facilitate evidence based practice.

The introduction of the Clinicians Health Channel (CHC) is a four-year project which aims to provide equity of access to critical clinical knowledge resources for clinicians in the public health care sector throughout Victoria. The CHC (http://www.clinicians.vic.gov.au/) is a portal web-site providing online access to current, accurate and reliable sources of information to help inform and assist clinicians in decision-making, research and education.

Evaluation Approach

Our approach to the evaluation is notable in three key respects. Firstly, the evaluation is conceptualized as the evaluation of strategic change to work-practices, not simply as the evaluation of a web-site. Secondly, and as a consequence of this broad conceptualisation, the team is multidisciplinary - made up of people with experience and expertise in medicine, multimedia design, educational evaluation, socio-technical relations, workplace ethnography, and qualitative and quantitative research methods. Thirdly, the approach is one that intends to be formative as well as summative, and takes the CHC to be an emergent system rather than stable or fixed.

The evaluation is an integral part of improving the quality and usefulness of the CHC. The University of Melbourne team has adopted a collaborative approach to research and evaluation of the CHC, and the wide range of disciplines represented on the team is a major strength. The evaluation focuses on issues related to professional clinical practice (specifically, an anticipated increase in the practice of evidence-based health care), and on issues related to technological mediation (specifically, the use of the web to achieve this objective). These two intertwined research areas require an analysis through three dimensions – social, behavioural and technical – and these constitute our conceptual framework for the evaluation of the CHC.

The **social dimension** focuses on the regional, institutional, professional and education context in which clinical practice occurs. It acknowledges the fact that the CHC is situated in particular social spaces and is attentive to those spaces. It addresses and evaluates the aim of the CHC to provide equity of access to critical clinical knowledge resources for clinicians in the public health care sector throughout Victoria. The evaluation questions will include the "who, when, where" as well as impacts of the CHC on accessibility of resources. The **behavioural and professional dimension** focuses on the extent and character of the intersection or overlap of the CHC program and evidence based practice. It addresses and evaluates the aim of the CHC to support integration of evidence based practice into the health care system. The evaluation will address the use of the CHC by clinicians and whether it met their information needs. We will identify knowledge resources, awareness of available resources, ability to access these, current usage patterns and factors influencing utilisation. The evaluation will also address any impact on decision making by measuring clinician change and examining the barriers/opportunities, any relevant forces at work, and strategies to positively influence behaviour. The **technical dimension** addresses and evaluates the aim of the CHC to facilitate electronic dissemination of these resources and other clinically relevant information, so that the information can be accessed whenever and wherever required. The evaluation will examine the useability of the system in terms of functionality, frequency of use, purpose of use, user satisfaction, user friendliness, time required to locate information, searching utility, success or failure of searches for relevant information, flexibility, and customisation. Training and support will also be examined here as we consider it an integral component of the CHC program. Evaluation areas will include teaching and learning needs, critical appraisal skills, evaluation of teaching and learning, best practice teaching methods, training models, and the development of a tool kit for trainers.

Questionnaires

The first stage of the baseline evaluation comprised a paper based questionnaire survey (online). This survey was provided to both users and non-users of the CHC across Victoria. We focussed on both users and non-users of the CHC as we wanted to begin with how clinicians make decisions before investigating how clinicians use electronic sources of information for making decisions. Over 600 surveys were distributed across Victoria to 114 hospitals. 233 surveys were returned.

153 female and 75 males responded to the survey. The average number of years respondents worked in the health care profession was 18.65 years. Fifty-five allied health, 49 medical doctors, 102 nurses and 26 others (managers, administrators, etc) responded to the survey. A detailed examination of the survey results will not be examined in this paper. However we will examine a question on 'how clinicians use information resources to make a clinical decision'.

How do you use information resources in your clinical decision making?

Information Resources	Guide current treatment	Assist with diagnosis	Check patterns of illness	Confirm my actions	Refresh my knowledge	Access local information	Background research	*Overall*
People Based								
Conference	61	18	21	45	83	38	42	*90*
Consultation with colleagues	70	59	40	83	52	55	28	*97*
Staff meetings	42	17	20	42	36	59	16	*84*
Workshops,seminars	75	30	29	52	85	45	44	*94*
Paper Based								
Clinical guidelines & protocol	78	33	26	60	54	28	34	*90*
Journals	73	43	41	43	72	21	66	*92*
Local handbook	27	15	12	23	20	32	9	*58*
Local services directory	6	3	2	6	6	59	6	*61*
Textbooks	52	58	46	49	73	9	57	*89*
Computer Based								
CD ROMS	30	18	16	18	38	11	30	*43*
Internet search engines	51	30	32	30	53	25	61	*75*
Academic based sites	55	36	29	32	54	18	65	*73*
Other internet sites	30	17	21	20	35	20	42	*59*
Clinical guidelines & protocols	52	23	14	39	37	20	30	*65*
Journals	53	29	27	33	50	15	57	*67*
Local handbook	13	9	4	10	11	21	6	*31*
Local services directory	4	2	3	5	6	38	3	*39*
Textbook	31	31	24	27	37	8	35	*49*

Overall refers to percentage of respondents that use the information resources for at least one of the activities listed.

Table 1: Information resources utilised by clinicians (doctors, nurses, allied health) to make a clinical decision

The most frequent resources used to:

- guide current treatments included: paper-based clinical guidelines and protocols, workshops/seminars, journals and **consultation with colleagues**.
- assist with diagnosis included: **consultation with colleagues**, textbooks, journals and academic-based websites.
- check patterns of illness included: textbooks, journals, **consultation with colleagues** and internet search engines.
- confirm my actions included: **consultation with colleagues**, paper-based clinical guidelines and protocols, workshop/seminars and textbooks.
- refresh my knowledge included: workshop/seminars, conferences, textbooks, journals.

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- access local information included: staff meetings, local services directory, **consultation with colleagues** and workshops/seminars.
- for background research included: journals, academic based websites, internet search engines and computer-based journals.

As seen from Table 1 and the above analysis, clinicians carefully choose information resources appropriate for the function. The most frequent resource utilised to 'assist with diagnosis' and 'confirm my actions' involved consultation with colleagues. Consultation is a high priority in six out of seven clinical decision making activities. Electronic resources appear to be extensively used for background research as opposed to obtaining point of care information. This emphasis on peer consultation for making decisions is supported by Young and Ward, (2001) who suggested that "the most frequently nominated source of information participants actually would turn to in a time of clinical uncertainty were specialists colleagues (74%), textbooks (36%), other GPs (16%) and the Internet (12%)". (p. 207). This is understandable where colleagues are available for consultation in large metropolitan hospitals. However, a major part of our evaluation is to examine how resources can be accessed more effectively by rural clinicians throughout the state of Victoria. This finding may suggest implications for the redesign of the CHC website in order to provide equity of access to expert colleagues in rural areas. Presently the site acts as a resource-based portal whereas isolated clinicians may require access to colleagues either in person or through an online community.

Focus Groups

In addition to the surveys, eight focus groups have been completed at six sites chosen to represent a range of size, rurality and level of enthusiasm and readiness (infrastructure and organizational processes) for the CHC. The focus groups were conducted as open-ended interviews on targeted or focussed issues surrounding the introduction of computer-based resources to Victorian public hospitals. There were a number of factors, which were indicated to influence clinical decision-making. These included: routines, traditions, commonsense, doctor preferences, patient needs, cost, availability of medical service, number of staff available and time available. As a result, decision-making was seen as situational, depending on the information available at the time.

Focus group participants used computers to access patient records, email, results and local protocols. Less commonly they were also used to access clinical information. Issues of time, training and perceived clinical need for information would decide whether clinicians would become regular users. Participants wanted more efficient computers and more portable computers, so that they could be utilised at the bedside. Speed of computers was a common concern for the participants. The design of online resources utilised by busy clinicians in emergency departments or clinics needs to optimise time and minimise tiers of information. '*Any web site [requires] minimum key strokes – like to get the information quickly. So even if our computers are slow or fast, if you've just got the function keys to get into certain things rather than accessing all the sub menus – short cuts*'. Ease of use was an important aspect of the computer environment. Clinicians want computers and resources that are both useful and user-friendly. However, lack of resources, training and time prevented clinicians from making best use of computers.

Interviews

Interviews were structured around the themes of the study – in this case information needs, resources use and computer experience. The project interviews were semi–structured, with questions asked around the themes and opportunity for interviewees to discuss other related issues. Interviews examined participants detailed personal accounts. Twenty-four interviews have been undertaken and are currently being analysed. In the preliminary analysis of interviews there appears to be a number of consistent themes. In particular there were numerous comments on the applicability of databases for research as opposed to point of care information. For instance some databases provide background research whereas others provide specific point of care information. It is also a consistent theme that clinicians desire a 'readers digest' of pertinent information and that access to suitable computers would assist CHC usage. It is also suggested that informal training and support is more appropriate then formal large group sessions. Understandably, isolated rural clinicians also desire access to other professional colleagues or people resources. The use of a 24 hour help desk could provide assistance to the isolated clinician.

Design Principles for the CHC Website

In completing the evaluation for stage 1 of the project it was essential to focus on how clinicians use all types of resources to make a decision - not just web-based resources. In the second stage of the project we are utilising a variety of methodologies including: focus groups, interviews, online questionnaires, direct observation and log analysis in an attempt to improve the CHC portal website. Part of our discussions as an evaluation team focus on redesign of the website. These redesign principles are based on multimedia and online experts' evaluation of the existing website and an analysis of the surveys, focus groups and interviews to date. By accounting for these user viewpoints we recommend a number of principles that may improve clinical use of the CHC.

1. The current website needs to be restructured conceptually in order to improve navigation, useability and access to the resources. Time is a precious commodity in the health care setting as suggested by the following quote. *I want to get in, get it, go to the bottom line and get out – I don't want to be in there for half an hour.* The use of a site map, clearer layout and the application of instructional design principles will assist this process.
2. Further instructional design on the CHC website should reduce the time required to access information and make searching for relevant information more intuitive. The application of these principles should provide a seamless entry into using online resources for clinical practice. One participant commented that clinicians need *predigested information on specific topics that you encounter frequently in clinical practice, you want a readers digest version, you want to know what to do and you want to know quickly. For unusual cases you want to be able to identify relevant literature and examine it yourself.* Frequently asked questions (FAQs) may also assist novice users and their utilisation of resources best suited to clinical practice. The use of FAQs may provide guidelines for "newcomers to move toward full participation in the sociocultural practices of a community" (Lave & Wenger, 1991, p. 29). It is envisioned that these FAQs would be continually updated with user experiences and hints.
3. Training is a major aspect of encouraging utilisation of the CHC for clinical practice. Face-to-face training is currently being undertaken by the Department of Human Services. However there needs to be a variety of training strategies. *I think a lot of the time people haven't got the time to get to the education sessions, it needs to be a little bit more user friendly for people who just want to get on and go in.* Another project on the CHC is developing online tutorials to assist clinicians use of the channel. The aim of these tutorials is to teach users evidence-based practice and critical appraisal of research resources. By utilising this approach the user will learn how to use the databases and search mechanisms and also efficiently navigate around the CHC. Training was also seen as a critical issue with participants asking for local, individualised training at their worksites as well as more help on the CHC site itself. Suggestions included context -specific help, on-line tutorials and just-in-time training.
4. The final concept focuses on assisting clinicians in remote areas to interact with colleagues. Currently the CHC is a web-based portal which allows users to access resources similiar to a library catalogue. Stuckey, Lockyer & Hedberg, (2001) outline a model for evaluating the characteristics of portals, networks, interest groups and online communities. They suggest that portals are resource-based entities where consumers may be passive, have varied membership with no ties between members and allow users to link to resources and indexed sites that are database driven. In this model there are few interactions with clinical colleagues over the internet. Participants in both focus groups and interviews have suggested that communication with other health professionals could be a major benefit of the CHC. *I suppose if there's one thing that could be added to an online server it would be posting questions. Where a professional dilemma, a diagnostic dilemma – so if you are remote and you are removed from colleagues and you can't just go to the residents quarters and discuss it with the registrar – you are able to put it online so you can discuss it with a hematology registrar within that system. That's what they're doing in physiotherapy – the chat room is fantastic. You can say I've got this really difficult patient and get everyone from around the world.* The ideal community "requires member participation and contribution, ownership, quality support and

facilitation, shared direction, goals and projects" (Stuckey, Lockyer, Hedberg, 2001, p. 1). Within this ideal community collaboration between colleagues for the purposes of improving clinical practice requires both experts and novices "to communicate, contribute to and initiate ideas and joint projects" (p. 6). Fostering an online community requires sustained committment from developers and members, multi-dimensional communicat ion, shared focus of attention on a real problem and members and facilitators who can collaborate, mentor and develop solutions together in a clinical setting (Stuckey, Lockyer & Hedberg, 2001).

Conclusion

Overall this paper has outlined our rationale, approach, evaluation strategies and findings from selected aspects of the questionnaires, focus groups and interviews. Our evaluation website (http://www.medfac.unimelb.edu.au/health_channel/) continues to update our latest findings in relation to the three-year evaluation. The questionnaires, focus groups and interviews provide an insight into clinical decision making and how clinicians use resources in evidence-based practice. In our evaluation of the website portal we have accounted for clinical perspectives and have suggested a number of key principles for the redesign and reorienting of the portal so that it embodies some online community principles that complement the resource-based characteristics of the website. In addition the website should provide recommendations to professional groups regarding information needs and recommendations to novice and experienced clinicians. The use of web-based clinical scenarios will also significantly reinforce navigation and use of the resources on the Clinicians Health Channel. *Ultimately that's what a good single site is about. Where it can offer you two or three different opinions, so that you can be reasonably sure that the decision you're making is based upon current practice and evidence. Whatever is on there, there should be at least one or two different approaches for a problem. I don't trust any one person or any one thing; I need to have several approaches before I agree to anything.*

References

Covell, D., Uman, G. & Manning, P. (1985). Information needs in office practice: Are they being met? *Annals of Internal Medicine, 103*, 596-599.

Clinicians Health Channel. [online] Available: http://www.clinicians.vic.gov.au/ [30 April, 2002].

Clinicians Health Channel Evaluation Project. [online] Available: http://www.medfac.unimelb.edu.au/health_channel/ [30 April, 2002].

Clinicians Health Channel Evaluation Survey. [online]. Available: http://www.medfac.unimelb.edu.au/health_channel/CHCSurvey.pdf [30 April, 2002].

Davies, D. (1998). Continuing medical education: Global health, global learning. *British Medical Journal, 316*, 385-389.

Elson, R. B. & Connelly, D. P. (1995). Computerised patient records in primary care: Their role in mediating guideline-driven physician behaviour change. *Archives of Family Medicine, 4*, 698-705.

Evidence-based medicine working group. (1992). Evidence-based medicine: A new approach to teaching the practice of medicine. *Journal of American Medical Association, 268*, 2420-2425.

Gorman, P., Ash, J. & Wykoff, L. (1994). Can primary care physicians' questions be answered using the medical literature? *Bulletin of the Medical Library Association, 82*, 140-146.

Hersch, W.R. & Hickam, D.H. (1998). How well do physicians use electronic information retrieval systems? A framework for investigation and systematic review. *Journal of American Medical Association, 280 (15)*, 1347-1352.

Lave, J, & Wenger, E. Situated learning: Legitimate peripheral practice. New York: Cambridge University Press. 1991.

Lindberg, D., Siegel, E., Rapp, B., Wallingford, K. & Wilson, S. (1993). Use of MEDLINE by physicians for clinical problem solving. *Journal of American Medical Association, 269*, 3124-3129.

NHS Centre for Reviews and Dissemination. (1999). Getting evidence into practice. *Effective Health Care, 5*, 1-16.

Sackett, D.L., Rosenberg, W.M.C., Gray, M., Hayes, R.B. & Richardson, W.S. (1996). Evidence-based Medicine: What it is and what it isn't. *British Medical Journal, 312*, 71-2.

Stuckey, B., Lockyer, L., & Hedberg, J. (2001). The case for community: On-line and ongoing professional support for communities of practice. Open and Distance Learning Association of Australia. 15th Biennial Forum, 1-12.

Young, J. M. & Ward, J. E. (2001). Evidence-based medicine in general practice: Beliefs and barriers among Australian GPs. *Journal of Evaluation in Clinical Practice (7)*, 2, 201-210.

Virtual Collaboration by and with Executives: Collaborative Learning in Principle and Practice

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Abstract: In the case of executive learning, the imperative is to create new collective knowledge, the fuel of personal and organizational effectiveness. It is also to improve personal and organizational effectiveness, the fuel of new collective knowledge. We discuss this conundrum and how it is addressed: a collaborative approach between participants, who relate the group's discussion to their own organization's challenges, and vice versa. However, if ongoing collaboration is desired, virtual collaboration is a necessity given current organizational realities. We consider the impact on instructors and participants, and then show how the use of a relatively simple web-based discussion forum effectively enables this approach.

The Executive Context and the Collaborative Approach

The profile of an executive education participant that we consider here is based on our institute's experience of conducting programs for over 5000 executives every year. These executives are drawn from a worldwide geographic base, and also come from a wide range of companies, industries and functions. A typical participant is 40+ years old, and has an average of 15 years' management experience. For these executives, the essence of management is the capability to make decisions and act wisely in a wide range of complex situations, especially those that require judgment, discretion, and risk-taking (Squires, 2001). Decisions are often made under time pressure, in an environment of constant change and pressure for quick results, and with incomplete information and analysis. Such situations typically are found in the fields of leadership, strategy, and others that require adaptive decision-making as more information emerges or conditions change (Mintzberg, 1996).

Given this profile, "an [ideal] executive learning experience exposes one to tensions, interactions and discussions, which in turn result in action, experimentation and implementation, with the ultimate purpose being to improve one's personal effectiveness" (Lorange & Gilbert, 2001). Yet personal effectiveness is only one part of the equation. In organizational life, we cannot discuss and act in isolation. Views on topics such as leadership are beginning to recognize to a much greater extent the collaborative element involved – for example, "all kinds of different people [contribute] critical leadership in initiating and sustaining and diffusing significant organizational innovations" (Senge, 2001).

Through their interactions, executive learning participants construct a shared understanding, or a collective knowledge of how things are represented (Brown & Duguid, 1991). The benefits of creating new collective knowledge are significant: collective knowledge is the most strategically significant advantage that executive managers seek (Spender, 1996).

Not Guides: Instructors are placers, spacers, and provocative challengers

Once settled on a collaborative approach, the traditional role of an instructor is redefined. Tradition says instructors are responsible for delivering content, presentations and lectures to participants who absorb and apply – acting as "sponges". Being a star instructor who delights and entertains with energetic delivery of well-packaged insights produces instant gratification. These insights fade, however, when the realization sets in that the "lessons learned" are not truly situated in the context of the participant. The instructor has made all of the choices: what is important, for whom, when, and why. It is not the creation of meaning, but the transfer of content, from one to many, in a relationship devoid of significance.

For the delivery of lasting impact, participants need to not only take center stage, but to create the experience themselves. So the instructor structures the time and space in which the dialogue and action occurs.

A complementary role is the highly skilled and sometimes intuitive process of framing the discussions. The highly skilled instructor's role is to provoke, probe, challenge, surface latent curiosity, encourage divergent thinking, facilitate synthesis, encourage adoption of a systemic view, make sure learning is linked to action, and ensure reflection is built into the process (Kolb, 1984; Lorange et al., 2001).

The Participant's Realities and Role: Going Virtual – A Fait Accompli

Participants need the opportunity to gather information from different sources to craft arguments, create and explore viewpoints, investigate alternate courses of action, consider complex patterns of interaction within and beyond their own organizations, and observe and reflect on the effects of applied action learning over time. These longer, more complex, more uncertain paths tend to favor longer collaboration timeframes. However, collaborators are rarely co-located all of the time, given today's global organization structures and division of responsibilities. Virtual collaboration allows participants to carry on the construction and development of shared understanding in multiple contexts and over the longer term of project work. Participants construct new content, as a by-product of collaboratively exploring, making connections, hypotheses, experiments, reflecting, building a new shared understanding and synthesizing and embodying new collective knowledge.

Virtual Collaboration Example: International Political Economy in a Business Context

The assignment is to draw lessons from history regarding the impact of cultural, structural and systemic factors and natural advantages on the competitiveness of a region, and find parallels for business, strategy and competition. Participants have a common basis to begin their discussions due to the assigned reading of a contemporary survey work on this topic. In addition, prior to this assignment, participants have already collaborated face-to-face in an exploration of the political and economic dynamics of a growing city. This increases their personal and group fluency with the topic, and becomes both a basis for further investigation and a shared lens through which participants view the current assignment's readings and discussions.

The initial task is to read the survey work and post key ideas in a web-based discussion forum, along with explanations of the parallels participants find for business. Then, they read each other's comments and begin to virtually debate, share, and build further on each other's ideas. During the process, a particularly striking passage or example from the reading sometimes becomes a shared metaphor, and therefore a shorthand expression of a broader business issue. For example, the metaphor of using instruments to navigate at sea, a key development in the exploration and exploitation of new worlds, could serve as a metaphor for navigating business performance in the modern company Future reference to an in-depth discussion and its associated dilemmas, talking points, issues of resolution and confusion, can be raised by reference to this metaphor. The most powerful metaphors stay with the participants into their field expeditions assignments and even beyond.

References

Brown, J. S. & Duguid, P. (1991). Organizational Learning and Communities of Practice: Towards a unified view of Working, Learning and Innovation. *Organization Science, 2,* 40-57.

Kolb, D. A. (1984). *Experiential Learning*. Englewood Cliffs, NJ: Prentice-Hall.

Lorange, P. & Gilbert, X. (2001). The Difference between Teaching and Learning. www.ebfonline.com/debate [On-line].

Mintzberg, H. (1996). Learning 1, Planning 0. *California Management Review, 38,* 92-93.

Senge, P. (2001). Leadership in the Knowledge Economy. Keynote address at the *5th Annual Berkeley Knowledge Management Forum,* University of California at Berkeley, September 18, 2001.

Spender, J. C. (1996). Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal, 17,* 45-62.

Squires, G. (2001). Management as a Professional Discipline. *Journal of Management Studies, 38,* 473-487.

Does the medium dictate the message?
Cultivating e-communication in an asynchronous environment.

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Abstract

Virtual learning environments (VLEs) are often perceived by education establishments as an opportunity to widen access without traditional overheads. An integral part of most VLEs is asynchronous computer conferencing and on-line moderators must help students migrate quickly to the new virtual environment to minimize learning disruption. This paper focuses on 21 new on-line moderators and reports their changing perceptions re their role and concerns, from their first appointment through to the end of the delivery of their first on-line course. The findings suggest that it is only after socialization occurs that information can be exchanged and lead to knowledge construction. These are supported by, and extend, prior research by Z Berge, R Mason, M Paulsen and G Salmon and are reinforced by empirical work with a further 19 new on-line moderators.

1. INTRODUCTION

Virtual Learning Environments (VLE) are increasingly being used in education because they offer a potential solution to current academic problems of increasing student numbers within a climate of reduced funding. Whether they provide the solution is debatable however, it is only by recognising and fully utilising their potential that maximum effectiveness can be achieved [11] [16]. Computer conferencing is an essential part of VLEs [4]. It promises the ability for dispersed students to communicate with each other and experience the pedagogical techniques of collaborative learning and support. When learning moves on-line, students and tutors do not automatically adapt to the new medium [3] and for some people it can even provoke strong negative reactions [1]. Therefore, a cultural shift needs to take place and we "…must learn how to cultivate communication in a largely asynchronous environment." [5]. This will engender confidence in the new environment, for all participants, and enable effective learning to take place.

This paper follows 40 distance learning tutors during their first experiences as on-line conference moderators within an on-line course. It investigates how they adapt to the role of moderator and focuses on what they perceive as their role and reports on their concerns. Of these, 21 tutors provided the initial focus and further empirical work with 19 tutors, plus previous research in this area, reinforce those findings. Qualitative data is also drawn from students studying on their courses [7]. The results, in conjunction with an analysis of their concerns will enable us to improve the support and training we offer new on-line moderators.

2. PRIOR RESEARCH

Research into the role of an on-line conference moderator began in the mid 1980s and was articulated largely from a group of very experienced moderators. Robin Mason's seminal 1991 paper "Moderating Educational Computer Conferencing"[12] organised the skills required for effective moderation from several researchers [Kerr 1986, Davie and Palmer 1985, Brochet 1985. Feenberg 1986, Hiltz 1988, McCreary 1990. Davie 1989] into three key roles: Intellectual, Social and Organisational. Researchers worldwide cite this classification in their work (Berge 1995 (America) [3], Paulsen 1995 (Norway)[14], Salmon 1998 (UK) [17], Green 1998 (Canada) [8], Murphy & Collins 1998 (America) [13], Pearson 1999 (Australia) [15]).

Further research in 1995 by Zane Berge and Morten Paulsen built on this work and related it to their native lands ie America and Norway. Their results supported and reinforced Mason's paper with one additional role being added by Berge, ie technical. She felt it was important that the moderator should help those new to conferencing to overcome the initial technical issues associated with going online and becoming familiar with new software.

Table 1: On-line moderator roles

CLASSIFICATION OF THE ROLE OF THE ON-LINE MODERATOR

Task	Researcher	Task	Researcher
Intellectual Role			
Facilitate	Mason 1990	Present conflicting opinions	Paulsen 1995
Summarise	Mason 1990	Respond to students comments and weave them together	Paulsen 1995
Support/Shape/Guide Discussions	Mason 1990		
Ask questions	Paulsen 1995	Make material relevant by developing questions and assignments that relate to student experiences and current affairs	Paulsen 1995
Don't reply on off-line materials	Paulsen 1995		
Explain	Paulsen 1995		
Social Role			
Create context conducive to thought	Berge 1995	Provide a good social environment	Mason 1990
Deter negativity	Berge 1995	Encourage good netiquette	Mason 1990
Encourage contributions	Berge 1995	Provide positive feedback on student input	Mason 1990
Mediate	Berge 1995	Reward positive contributions	Mason 1990
Encourage equal participation	Berge1995	Praise and model positive discussant behaviour	Mason 1990
Be sensitive to participants needs	Mason 1990	Discourage inappropriate material	Paulsen 1995
Organisational Role			
Set the Agenda: declare discussion objectives, state the timetable, state the decision-making norms, provide strong leadership and direction.	Berge 1995	Refer inappropriate digressions to another conference	Paulsen 1995
		Synchronise and resynchronise	Paulsen 1995
Move misplaced content	Paulsen 1995	Give a decisive end to each discussion	Paulsen 1995
Technical Role			
Make participants comfortable with the system			Berge 1995

Although it is ten years since Mason's original classification of an on-line moderator's role and five years since Berge and Paulsen's work, the roles and tasks identified are still cited today. The intellectual role is sometimes referred to as pedagogical and the organisation role, managerial. The tasks therein are the same and the original names have been used here for consistency. To provide a frame of reference for the research a matrix depicting the roles and tasks of on-line moderators identified by these researchers was compiled and is shown in Table 1. Although some of the tasks listed can be said to be subset of others, for example a facilitator does support and guide discussions, no attempt has been made to change the level of granularity to enable a more consistent matrix to be compiled.

Gilly Salmon's action research into on-line moderation introduces a five layer model of teaching and learning on-line through computer mediated communication which she invites us to explore and contextualise into our own discipline. The five layers are: access and motivation; online socialization; information exchange, knowledge construction and development. She summarises her model thus: " Stage One: Individual access and the ability of participants to use CMC are essential prerequisites for conference participation. Stage two involves individual participants establishing their online identities and then finding others with whom to interact. At stage three, participants give information relevant to the course and each other. Up to and including stage three, a form of co-operation occurs, ie support for each person's goals. At stage four, course-related group discussions occur and the interaction becomes more collaborative. At stage five, participants look for more benefits from the system to help them achieve personal goals, explore how to integrate CMC into other forms of learning and reflect on the learning process." [17]

3. BACKGROUND

1. The Course

The Open University in the UK piloted a pioneering on-line course during 1999 entitled 'You, Your Computer and the Net'. It is a first year degree module and it aims include:

1. introduce students to computers and the internet;
2. give students direct experience of working at a distance by themselves and as a group;
3. develop the new skills needed for studying and communicating using online media;

The course is web based and runs from the middle of February to the beginning of October. The main study material is delivered via the World Wide Web. The asynchronous text based conference facility is central to the delivery model with the primary computer conference being the tutor group ie the tutor and their students (15-20 members). Moderated by the tutor, it is the main area for course activities, discussions, and general chat. All tutor groups are within one of the 13 Open University regions and this research is based on one of those regions.

2. The Students

All Open University courses use distance learning and students enrol on that premise. They are part-time, usually mature and have other commitments ie work and/or family.

3. The Tutors

Student demand for the 2000 presentation of the course resulted in a large number of tutors being recruited. Two key attributes the interviewers were looking for was either a neutral or positive attitude towards the delivery of a course on-line plus the required underpinning skills and knowledge necessary for the academic content of the course. The 40 tutors who participated were over 30 years of age, predominantly male (76%) and had all tutored a distance learning course before. 61% were in the 41-50 age bracket and almost half are teachers/lecturers. None had used asynchronous conferencing as an integral part of a learning programme.

4. METHODOLOGY

To support new tutors there was a regional briefing day where each tutor met their mentor who they could go to for advice during their first year. Each mentor had tutored on the pilot year of the course. In order to track the new tutors changes in perceptions about their role as an on-line moderators a number of questions were administered at significant points throughout the course. These were at the beginning of the briefing day (November), before the course started (end January), mid course (end June) and at end of the course (October). The questions used to ascertain their perceptions and concerns were:

1. What are your perceptions of the role of an on-line moderator?
2. What concerns do you have about the role of an on-line moderator?

They were open ended because although responses are complex to analyse, if one offered them a list of tasks from the role/task matrix (Table 1) it could stop innovative thoughts and preclude new tasks being identified. The responses for the question 1 were compared to the moderator role/task matrix and any similarities/differences noted. A list detailed their concerns was also produced.

During the regional briefing day in November new tutors were put into groups and participated in a 30 minute session to experience the medium of text based narrow-band communication. No questionnaire was issued at this stage to allow any immediate changes in perception to dissipate. Between their regional briefing day and the start of the course an informal group conference was used to enable them to practice their skills. At the end of January, before the course started, tutors completed a second questionnaire without any reference to the first. It comprised their name and the two key questions given above. The third questionnaire was issued mid course and the final one just after the course was completed. The participants had no reference to their previous responses. Completed questionnaires were analyzed to identify what, if any, changes had occurred. The research was then extended to cover a further 19 new on-line moderators to reinforce, or otherwise, the original findings.

5. RESULTS

Tutor responses to the question "What are your perceptions of the role of an on-line moderator?", were examined and compared to the on-line moderator role/task matrix (Table 1). It was interesting to note that only two tasks mentioned by tutors did not map directly to one of these tasks, ie housekeeping and control. The statistical data gathered from the tutors provided evidence that as the course evolved so did their perception of their role (Figures 1 and 2).

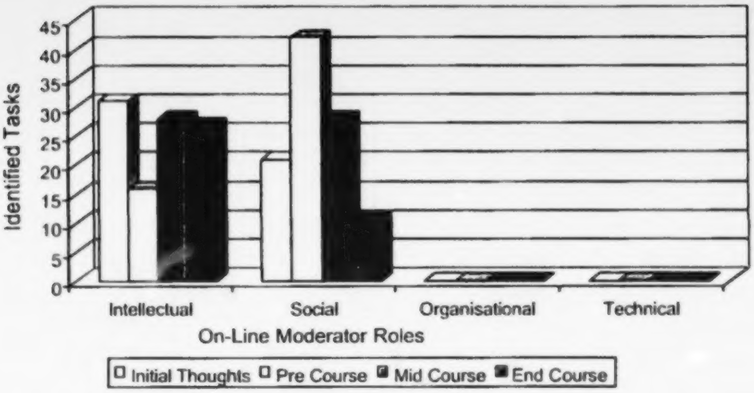

Figure 1: 21 new on-line moderators perception of their role at four key stages.

Initially they were concerned primarily with intellectual issues however, after a short submersion in an asynchronous environment there was a significant switch to social issues. It remained their focus two months later just before the start of the course and suggests that they became more concerned with the issue of ensuring that students adapt to the new environment. This concurs with one of the concerns identified for Internet based learning ie loss of social interaction.[5] [10]. As the course progressed the perceptions of 21 of the tutors implied that the importance of social issues decreased and by mid-course the balance between intellectual and social tasks equalized (Figure 1). The extended research with a further 19 tutors reinforced this pattern (Figure 2).

The end of course questionnaire was completed by all 40 tutors. It suggests that whereas the number of intellectual tasks almost returns to the original level when they were appointed to the role of an online moderator, the social tasks cited decreased. The following results from the four roles are drawn from the input of all 40 tutors and feedback from their students.

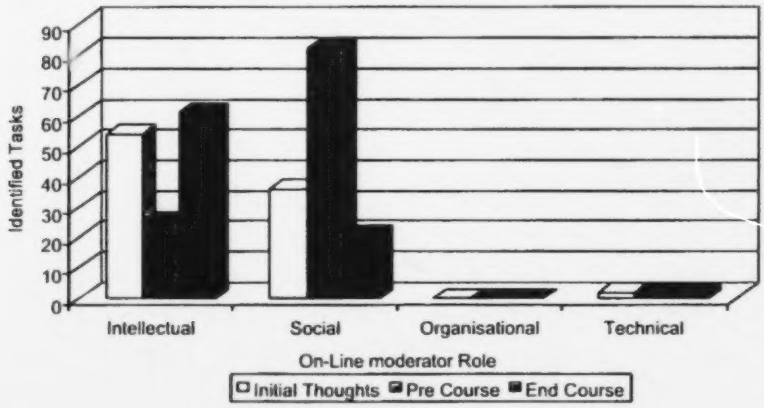

Figure 2: Extended research: A further 19 new on-line moderators perception of their role at three key stages

1. Intellectual Role

Four of the tasks under the intellectual role were mentioned (Table 1) ie explainer, facilitator, summarizer and to support/shape/guide discussions with the last task representing over 50% of the replies. All of the remaining tasks except one in the on-line moderator role/task matrix could be considered as a subset of these four. The exception was Paulsen's "don't reply to off-line materials".

2. Social Role

Their initial thoughts were that it was important to encourage contributions for everyone and, when required, they should mediate. After experiencing asynchronous conferencing the number of tutors citing these tasks increased significantly. Providing a good social environment, deter negativity, discourage inappropriate material, and to create context conducive to thought, were also mentioned. Fewer tasks were identified mid course and by the end of the course only four tasks were cited: encourage contributions, ensure equal participation, deter negativity and mediation. It was interesting to note that tutors did not mention; be sensitive to participants needs, praise and model positive discussant behaviour, provide positive feedback on students' input and to reward positive contributions.

3. Organisational Role

No organisational tasks were mentioned, including; to provide the framework and rules within which the conference will operate [12]. This encompasses the activities, schedule and the requirements of the course. Perhaps this is because all of the module material is provided on the course web site. Housekeeping was mentioned, but does not appear on the role/task matrix in Table 1. It has not therefore been shown in Figure 2 but should be added upon update of the role/task matrix.

4. Technical Role

Only one on-line moderator cited this. The Open University offers a comprehensive computer support service for tutors and students. However, students still raised technical issues [7] as an area for concern and expected that the on-line moderator should solve them.

5. Areas of concern

Time became of increasing concern to 50% of all tutors by the end of the course. It took a lot longer than they had anticipated to assimilate messages and the responses took longer to compose because they were aware that the written word could be misinterpreted. As one student said, "Many people have problems not being able to articulate easily on-line". They stated that tutors must have superior written skills as body language and voice intonation do not apply [7].

Lack of experience of what the role of an on-line moderator was also a key area for concern. Although it decreased by the end of the course, the post-course student survey showed that some of the students were also unaware of what the role of an on-line moderator is. This is an area for future research.

Table 2: Concerns raised by 40 tutors as they adapted to their role as an on-line moderator.

Concerns of 40 Tutors.	Initial Thoughts	Pre Course	End Course	Category
How to control multithreading	0	2	0	Intellectual
Lack of visual clues	1	4	0	Social
Serve student needs	3	5	2	Social
How to encourage participation	8	5	3	Social
Becoming too involved	2	5	0	Social
When to intervene	7	6	0	Social
Censorship	4	3	0	Social
Impose own views	1	5	0	Social
Technical problems	1	1	0	Technical
Time	5	11	21	New
Cost	2	8	6	New
Lack of experience of what the role is	12	16	5	New
Students not be aware of moderator role	4	7	0	New
Not knowing all the answers	0	1	0	New
Total	**50**	**79**	**37**	

6. CONCLUSIONS

The results suggest that tutors new to moderating text based online computer conferences come with the preconception that their primary role is intellectual. However, even a short exposure to the medium raised many new social issues. These were still the overwhelming issues two months later just before the start of the course. As the course progressed and online socialization occurred, social and intellectual issues became of equal importance. At the end of the course social issues had decreased to below their initial level. The issue of gleaming information only from text without any visual and/or oral clues remained an issue, primarily from the students' viewpoint. Some students also expected technical help from online moderators whereas the moderators did not perceive this to be part of their role. There is a need to match the expectations of the online moderator and the students to avoid discontentment.

Stages two, three and four of Gilly Salmon's five layer model of teaching and learning online through CMC [17] ie that online socialization must take place before information can be exchanged and lead to knowledge construction, are also supported.. No data was available from this research to comment on stages one (access and motivation), or five (development) of her model.

Two key areas for on-line moderator concern were: time and lack of experience. Time became increasingly important as the course progressed. It took far longer than they had anticipated to compose new messages. This may partly answer some students concerns about feedback time. Lack of experience decreased as the course progressed however their knowledge is only based on experiential learning from one group of students on one course and from dialogue with colleagues.

Training and support for new on-line moderators must include on-line conferencing as an integral part of the process in order to cultivate the ability to confidently communicate by text. This will enable them to realize the importance of socialization before pedagogical issues can be fully addressed.

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8. REFERENCES

1. Bates, A.W. Technology, open-learning and distance education London:Routledge. 1995.
2. Berge, Z.L. Concerns of Online Teachers in Higher Education Tel Ed 1998
3. Berge, Z.L. Facilitating Computer Conferencing: Recommendations from the Field. Educational Technology. 35(1) 22-30 1995
4. Britain, S. A Framework for Pedagogical Evaluation of Virtual Learning Environments. Higher Education Funding Council JISC Technology Application Programme. 2000.
5. Carswell, L. Does Internet Communication Affect performance? Some results for Distance Learning Introductory Computing Students OU Research Report No:96/12. 1997.
6. Carswell, L. Thomas, P., Petre, M., Price, B., Richards, M., Distance Education via the Internet. Open University 2000.
7. Gaskell, A. & Simpson, O. Student Support in Distance Education – What do students want from their tutor? OU Paper2001.
8. Green, L. Playing Croquet with the Flamingoes. A Guide to Moderating Online Conferences. Office of Learning Technology, Canada. 1998.
9. Harasim, L., Hiltz, S.R. Telex, L., & Turoff, M. Learning Networks: A Field Guide to Teaching and Learning Online, Cambridge MA: MIT Press. 1995.
10. Hiltz, S. R. Evaluating the virtual classroom. In Online Education: Perspectives on a New Environment, ed. L. M. Harasim, 133-184. New York: Praeger.1990.
11. Kiernan, M. Does the medium dictate the message? How 30 minutes changed the perceptions of new online conference moderators. Edict 2000
12. Laurillard, D. Rethinking University Teaching:A Farmework for the Effective use of Educational Technology. London: Routledge, 1994..
13. Mason, R. Moderating Educational Computer Conferencing. DEOSNEWS 1(19) 1991.
14. Murphy, K. Collins, M. Development of Communication Conventions in Instructional Electronic Chats Paper presented at the Annual Convention of the American Educational Research Association, Chicago. 1997.
15. Paulsen, M.F. Moderating Educational Computer Conferences. In Z.L. Berge and M.P. Collins (Eds) Computer-Mediated Communication and the Online Classroom Cresskill NJ: Hampton Press. 1995..
16. Pearson, J. (1999) Electronic networking in initial teacher education: is a virtual faculty of education possible? Computers and Education, 1999 Vol 32, No. 3, pp 221-238. 1999.
17. Postman, N. Technopoly: The surrender of Culture to Technology. New York: Alfred A. Knopf. 1992.
18. Salmon, G., E-Moderating. The key to teaching and learning online. Kogan Page 2000.
19. Salmon, G., Developing learning through effective online moderation. Active Learning Dec 98. pp 3-8. 1998.

4-D Modeling Tools and Mental Models: What Can We Learn From Usability Testing?

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Abstract: Developers of computer-based tools face a dual challenge when trying to understand users' mental models, because users are simultaneously building mental models of the tool and of the world represented by the tool. Understanding users' mental models of complex computer-based tools, such as the 4-D modeling tool described in this article, can help inform the design and development of those tools. For this study, usability tests using the teaching method were conducted to determine the method's usefulness for determining the mental models of both advanced and novice users. The results of the tests revealed sufficient information about the differentiation between users' mental models to inform further development of the software.

Introduction

The Virtual Solar System (VSS) is a powerful virtual reality (VR) modeling tool in which students create four-dimensional (4-D) models of the solar system to investigate astronomical phenomena (Hay & Barab, 1998). Students construct and test their models to answer inquiry-oriented questions, using their models as a source of data for their answers. The 4-D environment allows students to navigate through their model in all three physical dimensions as well as backward and forward in time so as to look at astronomical phenomena from multiple viewpoints. For example, students are able to watch solar and lunar eclipses from the viewpoint of the Sun, the Earth, or the Moon, or anywhere else they choose. This tool affords students the ability to explore the solar system from perspectives that were previously unattainable through other media. However, this new environment raises new questions: How do students get their bearings in this new world? Can they understand the tools well enough to explore this world? Are they able to differentiate between their mental models of the solar system and their mental models of the tool and its interface? If so, how do they incorporate this new modeled reality into their existing mental models of the solar system?

Developers of computer-based tools face a dual challenge when trying to understand users' mental models, because users are simultaneously building mental models of the tool and mental models of the concepts represented by the tool. Understanding users' mental models of complex computer-based tools like the VSS 4-D modeling tool can help inform the design and development of such tools. One potential method of exploring users' mental models is through usability testing. Although the term "usability testing" is often used in its most restrictive sense, that is, to find and document usability problems in software and then to make recommendations of how to fix these problems, our definition of, and purposes for, usability testing are much broader. We believe that the data uncovered using certain usability testing methods is suitable for determining novice and advanced users' mental models when they are immersed within complex computer environments.

Theoretical Frame work

The VSS project (http://lpsl.coe.uga.edu/vss/index.html) is based on two educational theories: constructionism and inquiry. Constructionist learning environments require students to create artifacts as an essential component of personal knowledge construction (Papert, 1993). Inquiry-oriented instruction recommends that student's individual interests should guide their learning activities (Welch, Klopfer, Aikenhead, & Robinson, 1981). Their natural curiosity into exploring phenomena leads to a cycle of questioning, designing investigations, seeking solutions, and then asking new questions. Student curiosities are satisfied when they have constructed mental frameworks that adequately explain their curiosities (Haury, 1993).

Models are powerful ways of understanding that are integral to scientists' research. The act of model building allows learners to engage in a design process (Jackson, Stratford, Krajcik, & Soloway, 1994; Lehrer, Horvath, & Schauble, 1994), which begins with a set of tentatively accepted theories that evolve into coherent understandings as represented in their models (Roth, 1996). Model building forces learners to make clear their understandings of phenomena, validate their resultant model, and iterate the process to develop increasingly richer conceptions (Confrey & Doerr, 1994). When students use computer tools to work in real and virtual (or modeled) scenarios, they develop richer, more complex mental models of the content being studied, but they must also develop mental models of the software environment itself in order to facilitate their movement between the two realities. The software programs used in modeling are examples of cognitive tools.

Cognitive tools refer to technologies, tangible or intangible, that enhance cognitive powers during thinking, problem solving, and learning (Jonassen, 1996). One goal of cognitive tools is to assist students to follow mental models similar to experts' cognitive processes to find and solve problems, set achievable goals, test hypotheses, and make their own discoveries (Collins, 1991). As visualization, simulation, and modeling become more important for mathematicians and scientists, the use of similar technologies for learning mathematics and science has also increased in importance (Roschelle, Kaput, & Stroup, 2000). For cognitive tools to emulate the professional tools that scientists use, the developers of these tools must be cognizant of the differences in mental models between novice and advanced users.

People try to understand the external world by constructing internal representations of it in their minds; we call these representations mental models (Johnson-Laird, 1989). These models are assumed to have structures that reflect our perception and interpretation of what the world contains, how those pieces are related, how it works, and why it works the way it does (Bibby, 1992; Carroll & Olsen, 1988; Jih & Reeves, 1992; Kearney & Kaplan, 1997). Thus, the process of building mental models becomes an important issue in balancing between what exists in the world and what the knower understands.

Users of computer-based cognitive tools build two kinds of mental models: a mental model of the tool and a mental model of the world represented by the tool (Payne, 1992). Learning about the tool and gaining a clear mental model of it takes place throughout the user's interactions, but it is more pronounced in early stages of learning about the tool. Building mental models of the tool requires users to become aware of what external knowledge they need to acquire and how to approach the provided functionalities (O'Malley & Draper, 1992). The next developmental stage requires users to construct a mental model of the situations and actions of the world that is represented by the system (Bower & Morrow, 1990). Their previous mental models affect the decoding of the meanings and relationships, depending on the level of proximity of the user's language or interface to that of the system (Calvin, 1996).

Novice and expert users' mental models are different in two respects: sharing tasks with the tool and reasoning through the represented world. Novices usually do not have enough knowledge about what the system can do to decide what needs to be internalized by the user and what the tool can do to fill in the gaps (Kelly, 1995). This lack of knowledge might lead novice users to spend too much time on tedious tasks that the system could take care of. Novices build and process their mental models by focusing on visible objects that simulate processes in real time, whereas experts are able to construct mental models of abstract relations and properties (Johnson-Laird, 1989). The greatest challenge of researching mental models comes from our inability to directly observe users' mental models (Kelly, 1995). Additionally, researchers have no choice but to rely on their own mental models to conceptualize users' mental models, which may affect their interpretation of research results (Rouse & Morris, 1986; Rutherford & Wilson, 1992).

Usability Testing

Usability is generally thought of as how easy it is to learn and use a product (Nielsen, 1994). The level of usability for a product can be tested through a variety of methods. Quantitative methods typically include measurements of the length of time users take to complete specific tasks. Qualitative methods are more descriptive in nature and lend themselves to holistic overviews of usability problems. One of the most commonly used methods is the think-aloud method, where a single user interacts with a product and talks aloud about what he is doing and thinking during the test. This method, although highly effective in revealing the thoughts of the user, seems unnatural for many users. A closely related method, the teaching method, pairs an advanced user with a novice user. The advanced user guides the novice through a number of structured tasks, and both users are instructed to talk aloud to each other throughout the test about what they are doing and thinking. The tester can analyze both the advanced and the novice users' mental models of the system (Nielsen, 1994). The method also reduces the likelihood that the users will try to interact with the testers, which can detract from the validity of the data. We believe the interplay that occurs between the advanced and novice users as they think aloud in the teaching method can give us insight into the mental models of the users.

The Study

Our goal for this study was to determine:

1. What are the differences between novice and advanced users' mental models of VSS software?
2. Does the teaching method of usability testing provide sufficient information to reveal novice and advanced users' mental models of the software, and the concepts represented by this software?

The teaching method of usability testing pairs an advanced and novice user together for each usability test. The advanced users for this study were selected from the students currently enrolled in the introductory astronomy lab course that one of the researchers was teaching. The three students who agreed to participate in this study were among the most competent users of the VSS by the end of the course. Additionally, they all received an *A* in the course, indicating a strong understanding of the astronomy concepts.

Three novice participants were selected from among graduate students working in the Learning and Performance Support Laboratory (LPSL) at the University of Georgia who had no familiarity with the VSS. They all had low to average computer experience, and no background in astronomy.

Data Collection and Analysis

Each pair of users was given a list of four common tasks to perform using the VSS. The tasks ranged from the most basic (e.g., constructing a model of a basic Sun-Earth-only solar system) to moderately complex tasks (e.g., investigating the eccentricity of planetary orbits and the timing of planetary orbits). Each of the advanced users had completed these tasks at least once during the astronomy lab course. Users were discouraged from asking the testers questions about the software or the test itself during the test.

Data consisted of audio and video recordings of the users' interactions with the software, video recording of the users' computer screen, researcher entries into usability data-logging software and researcher field notes. The data logs and field notes were analyzed for instances of user talk or action that revealed evidence of the user's mental model of either the tool or the astronomy content. Each instance was further coded to indicate whether it related to the mental model of a novice user or an advanced user, and whether that instance was a representation of the modeling environment (tool) or of the astronomy content (real world). The findings from each individual were then grouped together by common themes.

Results and Discussion

We found that users have difficulties in building mental models of the tool and the represented world. Four major themes emerged from the data: (a) conflict with existing interface mental models, (b) difficulties in building and integrating mental models of interface functionality, (c) difficulties in building and integrating mental models of space, and (d) difficulties in building and integrating mental models of space and time.

Conflict with existing interface mental models: Novice users found aspects of the VSS interface to be confusing, particularly the menus and shortcut keys, which are not consistent with Windows software conventions. This did not match the novice users' existing mental models of how an interface is laid out and how it should work. In tests 1 and 2, even though the advanced users spent considerable time explaining the functions of keys and menus in the program, novice users were still confused. The VSS also relies on keyboards commands for navigating through the space and selecting planets and stars in the space. Novice users expected to use the mouse as their primary navigation tool and often clicked on the screen to navigate through space or to edit parameters of planets and stars.

All of the advanced users were able to articulate clearly the functionality of the interface and were able to accomplish tasks efficiently and effectively. This highlights how users can modify their existing mental model of an interface to adapt to different interfaces. The control needs of a 4-D environment differ so greatly from, and are so much more demanding than, a normal 2-D Windows program that additional documentation and help features need to be incorporated into the software to help new users accelerate their learning and understanding of the controls (see Figure 1).

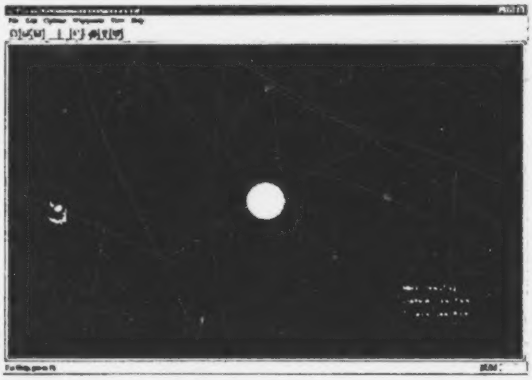

Figure 1. VSS Basic Screen Controls

Difficulties in building and integrating mental models of interface functionality: The main phenomenon of interest is generally located in the center of the VSS screen, but there is also ancillary information in each corner of the screen at all times. Novice users were unsure of which aspect of the interface to attend to first and which elements of the screen were the most important. A task such as timing the orbital period of a planet required them to use both hands on the keyboard while simultaneously watching three different portions of the screen.

Advanced users built their mental models to accommodate these demands. On many occasions, however, they were using the tools without fully understanding the concept behind it (e.g., negative number for rotation rate, increase or decrease in speed by a factor of ten). Both novice and advanced users suggested that a more simplified method of timing objects, such as a built-in stopwatch, would allow them to conceptually understand the elements involved in determining time in space without distracting their focus from watching the phenomenon occur.

Difficulties in building and integrating mental models of space: All users had difficulty comprehending the vastness of space that is represented in the software, the relatively small size of objects, and the challenges of navigating to other locations. For example, when a student creates an Earth and then observes it from the Sun, the Earth appears as little as a pixel or two of light on the screen. Novice users expected to see larger objects, similar in size to traditional textbook drawings of solar system objects. Their current mental models of the worlds represented by the software did not include the concept that most of space is, in fact, space.

The vastness of space created another problem for novice users when they tried to travel between planets. The *A* and *Z* keys controlled the forward and backward movement of the user's viewpoint. All of the novices consistently overshot their target by accelerating to a high speed, then not decelerating rapidly enough as they

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approached another planet. Advanced users were consistently proficient at maneuvering their viewpoint by using the keyboard keys.

Difficulties in building and integrating mental models of space and time: Time is the fourth dimension of the VSS. The difficulties in this section arise from the naïve mental models of both novice and advanced users that do not incorporate time as a key element of the modeling environment. VSS has a functionality called waypoints that allows users to create customized views of the solar system by attaching a viewpoint to any object and looking towards any other object. Novice and advanced users' mental models of a waypoint were based on an incorrect or naïve idea of returning to a specific location at any time, with the expectation that the view would be the same. Even though we do not expect to see stars at the same spot looking into a telescope pointing to a certain part of the sky when we return after a while, the novice users could not integrate the time factor into their mental model at first.

The passage of time is an integral feature of solar system modeling. A view from any one point at any one instant will never be the same as that same view at a different instant. Novice users also expected that VSS would have an "undo" feature of some sort that would enable them to return to a prior position (and time) with the click of the mouse. Time in many ways is the most important dimension in this environment, because without it the solar system model would not run, that is, all of the planetary movement that occurs in the model does so because of the passage of time. More thought should be given to how the user is informed of time on the screen, and how it is controlled by the user.

Conclusions

The teaching method of usability testing revealed information about the advanced and novice users' mental models of the software interface and of the astronomy content. Recommendations from this form of usability testing can help the developers make changes to the interface that would not have been revealed through an expert review, heuristic evaluation, or other forms of usability testing that focus primarily on finding errors with a program. If the interface is too challenging (non-intuitive or counter-intuitive), users may be developing a more complex mental model of the tool but not of the world represented by that tool. An ideal interface would not require significant mental model shifts on the part of novice users, allowing them to focus on the use of the tool for learning the new content.

Further research should be conducted on the users' understanding of the spatial and temporal world represented by the VSS. The time aspect (the fourth dimension) of the VSS is an important issue, because it enables the users to understand the motion of planetary bodies (by allowing the 3-D spatial movement to occur). The spatial dimension is also critical considering that the user in a computer-based 3-D (or 4-D) environment is forced to interact with this environment through a 2-D interface. More research can uncover the tension that must exist between the mental models of a 2-D interface and the mental models of a 3-D (or 4-D) environment.

References

Bibby, P. A. (1992). Mental models, instructions, and internalization. In Y. Rogers, A. Rutherford, & P. A. Bibby (Eds.), *Models in the mind: Theory, perspective, and application* (pp. 153–172). San Diego, CA: Academic Press.

Bower, G. H., & Morrow, D. G. (1990). Mental models in narrative comprehension. *Science, 247*, 44.
Calvin, W. H. (1996). *How brains think: Evolving intelligence, then and now.* New York: Basic Books.

Carroll, J. M., & Olsen, J. (1988). Mental models and human-computer interaction. In M. Helander (Ed.), *Handbook of human-computer interaction* (pp. 46–65). Amsterdam: Elsevier.

Collins, A. (1991). Cognitive apprenticeship and instructional technology. In L. Idol & B. F. Jones (Eds.), *Educational values and cognitive instruction: Implications for reform* (pp. 121–138). Hillsdale, NJ: Erlbaum.

Confrey, J., & Doerr, H. M. (1994). Student modelers. *Interactive Learning Environments, 4*, 199–217.

Haury, D. L. (1993). *Teaching science through inquiry.* Columbus, OH: ERIC Clearinghouse for Science Mathematics and Environmental Education.

Hay, K. E., & Barab, S. A. (1998, April). *Building worlds: Tools of virtual practice.* Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Jackson, S. L., Stratford, S. J., Krajcik, J., & Soloway, E. (1994). Making dynamic modeling accessible to precollege science students. *Interactive Learning Environments, 4,* 233–257.

Jih, H. J., & Reeves, T. C. (1992). Mental models: A research focus for interactive learning systems. *Educational Technology Research and Development, 40* (3), 39–50.

Johnson-Laird, P. N. (1989). Mental models. In M. Posner (Ed.), *Foundations of cognitive science.* Cambridge, MA: Massachusetts Institute of Technology Press.

Jonassen, D. H. (1996). *Computers in the classroom: Mindtools for critical thinking.* Columbus, OH: Prentice Hall.

Kearney, A. R., & Kaplan, S. (1997). Toward a methodology for the measurement of knowledge structures of ordinary people: The conceptual content cognitive map (3CM). *Environment and Behaviour, 29,* 579.

Kelly, J. J. (1995). *What do they think they're doing? Mental models of online catalog users in an academic library.* Unpublished Dissertation, The University of Georgia, Athens, GA.

Lehrer, R., Horvath, J., & Schauble, L. (1994). Developing model-based reasoning. *Interactive Learning Environments, 4,* 219–231.

O'Malley, C., & Draper, S. (1992). Representation and interaction: Are mental models all in the mind? In Y. Rogers, A. Rutherford, & P. A. Bibby (Eds.), *Models in the mind: Theory, perspective, and application* (pp. 73–91). San Diego, CA: Academic Press.

Nielsen, J. (1994). *Usability engineering.* New York: AP Professional.

Papert, S. (1993). *The children's machine.* New York: Basic Books.

Payne, S. J. (1992). On mental models and cognitive artifacts. In Y. Rogers, A. Rutherford, & P. A. Bibby (Eds.), *Models in the mind: Theory, perspective, and application* (pp. 103–118). San Diego, CA: Academic Press.

Roschelle, J., Kaput, J. J., & Stroup, W. (2000). SimCalc: Accelerating students' engagement with the mathematics of change. In M. J. Jacobson & R. B. Kozma (Eds.), *Innovations in science and mathematics education: Advanced designs for technologies of learning* (pp. 47–75). Mahwah, NJ: Erlbaum.

Roth, W.-M. (1996). Knowledge diffusion in a grade 4–5 classroom during a unit of civil engineering: An analysis of a classroom community in terms of its changing resources and practices. *Cognition and Instruction, 14,* 170–220.

Rouse, W. B., & Morris, N. M. (1986). On looking into the black box: Prospects and limits in the search for mental models. *Psychological Bulletin, 100,* 349–363.

Rutherford, A., & Wilson, J. R. (1992). Searching for mental models in human-machine systems. In Y. Rogers, A. Rutherford, & P. A. Bibby (Eds.), *Models in the mind: Theory, perspective, and application.* San Diego, CA: Academic Press.

Welch, W. W., Klopfer, L. E., Aikenhead, G. S., & Robinson, J. T. (1981). The role of inquiry in science education: Analysis and recommendations. *Science Education, 65,* 33–50.

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Educational Application of Dialogue System to Support e-Learning

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Abstract
This study is on the design and implementation of an educational dialogue system to support e-Learning. The learning domain to apply the dialogue system used the subject of the geometry. The knowledge in dialogue-based system for learning the geometry was created and represented by XML-based AIML. Implemented system in this study can understand the student's context of the dialogue. Moreover the dialogue system can answer the student's question by referring and saving the previous knowledge while having a conversation with a student. To refer and save a student's stat e of knowledge, we used an overlay student model in this system. Finally, we evaluated an educational dialogue system to test the efficiency of the designed and implemented system with geometry learning.

1. Introduction

The existing web-based learning systems have provided the learner the contents with a simple feedback. The learner interacts to the system through an interface screen simply. These methods do not support an intelligent and efficient learning. The interaction between the learner and the learning system advances on automation by an intelligent dialogue agent.

Established intelligent dialogue systems were used the Natural Language Processing system based on the Expert systems. Because these systems interact with a guided question and restricted answer in system, the system and the learner do not carry on a free dialogue concerning the related learning[8]. Therefore, we design and implement a natural language-based learning system using an intelligent dialogue agent. In order to implement the learning system, we used an engine that is a so-called Tutor-bot using the Pattern Matching(PM) method. We selected the learning domain about the geometry learning and extracted the knowledge base of the Plane Euclidean geometry.

Chapter 2 would introduce the basic concept behind the PM method, and introduce the readers to AIML. Chapter 3 discusses about the design of an intelligent dialogue e-learning system. Chapter 4 talks about the study an implementation with the use of tags. A sample code from *geo.aiml* is included in this chapter to allow the reader to fully understand the customization process. Then this study ends with Chapter 5, which talks about the future implementation of dialogue-based learning system.

2. Dialogues System for Tutoring

Pattern Matching and AIML

The Pattern Matching(PM) method is usually driven by fairly simple mechanisms. There is several in an existence. The first one was ELIZA created by Joseph Weizenbaum[13], which mimicked a psychotherapist. It made quite a name for itself because it succeeded in fooling some people it was a person. For the most part, they are implemented by rules that map simple pattern matches on the left-hand side to canned responses on right-hand side. Alice is a chatter-bot developed by Dr. Richard S. Wallace[12]. Alice is an acronym for Artificial Linguistic Internet Computer Entity. It's programmed using an XML DTD called AIML(Artificial Intelligence Markup Language). When the user enters statements at a prompt on WebPages, Alice fits that statement to the most 'specific' category it can find, and returns the response associated with that category. It is capable of understanding natural language syntax. However, the natural language is extremely complex. A person is presumed to have implicit or meta-knowledge about the world when having conversation. In human-to-human conversations, implicit and meta-knowledge is always used. This in someway poses as a huge challenge when customizing the Tutor-bot for e-learning system.

The Tutorbot was implemented by AIML(Artificial Intelligence Markup Language), which is a non-standard evolving markup language to create the chat robots. The primary design feature of AIML is minimalism. Compared with other chat robot languages, AIML is perhaps the simplest. The pattern matching language is very simple, for example permitting only one wild-card ('*') match character per pattern. AIML is an XML language, implying that it obeys certain grammatical meta-rules. The choice of XML syntax permits integration with other tools such as XML editors. Another motivation for XML is its familiar look and feel, especially to people with HTML experience. An AIML tutor agent begins and ends with the <alice> and </alice> tags respectively. Typical Alice category tags have two component tags.

*-A pattern, eg: <pattern> I HAVE A * <pattern>*

-A template, eg:<template>Where did you get it?<template>

The pattern matching used by Tutor-bot starts with analyzing the words in the phrase entered by the learner[9]. These words are in natural language, separated by spaces and converted to uppercase to enable case independent matching. If a matching category is found, it is possible that the category is a recursive category. If this is the case, the target phrase will be altered and evaluated again by the pattern matcher. This adds the wildcard symbols … and ' ' to the pattern language. Many AIML patterns start with the same words:

{WHAT IS A CIRCLE…, WHAT IS A … , WHAT IS … , WHAT OVAL…, WHAT…}

All these patterns overlap in one or more words. This fact suggests the use of a tree to store the patterns in. Alice uses a rooted, directed tree. Each node in the tree contains a hash table, which is used to store its successor nodes. This way, the pattern matching time is almost constant independent of the number of categories. It only depends on the length of the sentence; the longer the sentence, the longer the time to find a matching pattern. Yet, this relation is linear. All patterns are stored in alphabetical order.

Related Works

Numerous experiments have been performed with natural language interfaces. Several domains have been tested with varying success. Here, a few projects are discussed to determine which domains are suitable and which are not. Biermann [3] conducted an experiment to test the feasibility of natural language for programming environments. Subjects had to solve linear equations and calculate averages on a natural language system, which allowed them to manipulate tables and matrices. About 80% of the users' sentences were processed correctly. These results were compared with a similar experiment using a formal programming language called PL/C. Even though the subjects who used the natural language system used up to 50% more characters, they completed the problems using less time than the subjects who used the PL/C. This result can be explained in two ways: either natural language is easier to use and understand, or it is more verbose. As discussed before, verbosity is not a mayor problem and it must be said PL/C is more suitable for these kinds of problems than natural language because of the tables and matrices. If a domain had been chosen that was not obviously better suited for a mathematical notation, shorter lengths of the natural languages sentences should be expected.

Hauptman and Green [6] compared three interface styles; a command line language, a natural language and a menu-based interface. Each subject was given three hand-sketched diagrams of graphs that they were supposed to reproduce using the interface. It appeared that the natural language mode was not more difficult than any of the other two. It must be said though that this task as well as the previous one are good examples of tasks that are inappropriate for natural language interaction. Domains involving musical notations, algebra and graphical content are other unsuitable domains. Kelley [7] investigated the use of natural language for retrieving information from a calendar. He found that between 86% and 90% of the questions asked by the users were answered correctly. This result may look promising, but it must be noted that the domain is very simple and fairly limited.

3. Intelligent Dialogue Learning System

Overview of Dialogue-based Tutoring System

Figure 1 shows the overview of the intelligent dialogue-based e-learning system architecture. Dialogue-based Tutoring System is composed of 3 parts, learner interface by dialogue system, intelligent dialogue tutoring engine and intelligent tutoring system with learner base. The interface module is the part that learner proceed learning through the web. Dialogue module is embedded in learning content for communication between system and learner. The dialogue module consists of client and server. Moreover, this module is the core of this study. Server of this module contains the pattern matching engine and the knowledge base. Learner's knowledge level has diagnosed through learner profiles and dialogue among learning. The knowledge base saves domain knowledge on geometry information. The intelligent tutoring module is typical

Intelligent Tutoring System. ITS is consisted of student module, tutor module, and expert module. The student model was designed the overlay model, bug model, hybrid model[5].

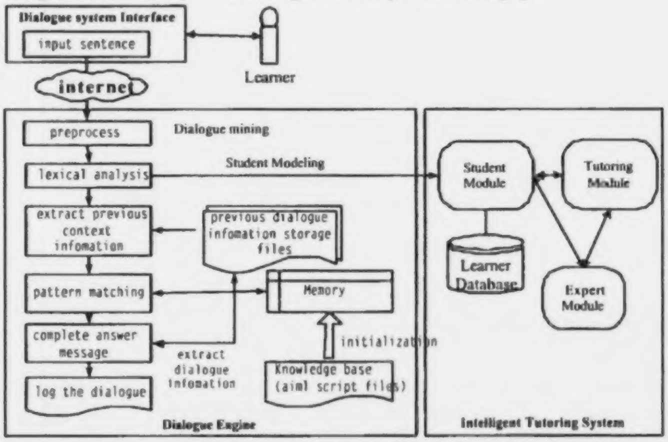
Dialogue system Interface
input sentence
Learner
internet
preprocess
Dialogue mining
lexical analysis
Student Modeling
extract previous context infomation
previous dialogue infomation storage files
pattern matching
Memory
complete answer message
initialization
extract dialogue infomation
Knowledge base (aiml script files)
log the dialogue
Dialogue Engine
Student Module
Tutoring Module
Learner Database
Expert Module
Intelligent Tutoring System

Figure 1. Overview of Dialogue-based Tutoring System

If learner inputs question, Tutorbot makes an analysis context through preprocessing. At this time, a learner's knowledge and a mistake are stored in learner database. For reasoning a whether last question is related former questions, the pattern matching engine extracts stored former contexts at temporary space. Passing through pattern matching processing, dialogue-based system understands learner's question and shows a suitable reply to learner. Finally, the system stores the result in learner database and repeats.

The reason of former question among the rules of the pattern matching uses recursive method and temporary space tag. This reasoning method is necessary for constructing student model. AIML(Artificial Intelligence Markup Language) contains a simple yet powerful XML markup tag called <srai>. The <srai> tag is the symbolic reduction tag. This allows minimalism. <srai>X</srai> is simple: The <srai> tag always appears in the *response* template, but the tutorbot treats X just like an *input* to the tutorbot. The tutorbot scans through its memory and finds the best response for X. The only tricky part is, the response to X may itself contain more <srai> tags.The best way to understand the recursive action of the AIML <srai> tag is by example.

Student: You may say that again Tutorbot
Tutorbot: Once more? "that"

The Tutorbot has no specific response to the pattern "You may say that again Tutorbot." Instead, the Tutorbot builds its response to the learner input in four steps. This simple sentence activated a sequence of four categories linked by <srai> tags. The tutorbot constructed the reply "Once more? "that" recursively as each sub sentence triggered the next matching pattern. <srai> allows the translation of Natural Language to keywords. On the other hand, the tag "that" in Tutorbot refers to whatever the tutorbot said before a user input. Conceptually the choice of "that" comes from the observation of the role of the word "that" in dialogue fragments like:

Tutorbot: Today is yesterday.
Student: That makes no sense.
Tutorbot: The answer is 3.14159
Student: That is cool.

In AIML the syntax <that>...</that> permits an optional "ThatPattern" to match the tutorbot's "that" expression.

Representation of Geometry learning knowledge for AIML Modeling

We should need that analyzes the scheme of geometry knowledge for performing geometry learning. Because the dialogues on the knowledge of the geometry learning are to teach knowledge of geometry domain, the domain knowledge of geometry is represented with a definite rule or context. Geometry object is core that is diagram information. The diagram information is divided the quantity and quality information. The quantity information contains presented independence information in learning spaces as an absolute coordinates, number of pixel, an inclined degrees etc. The quality information represents the ontology of

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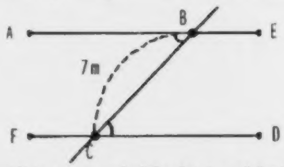
geometry objects like dot, line, triangle, circle, as well as the proposition alike a connected relation among each geometry objects, and various knowledge for the form of a proposition. Such information gets to be main content for constructing learning and presents problem to learner as well as a tutor system. Consequently, this diagram information determines an efficiency of dialogue-based tutoring system.

The quality information of geometry mainly is divided the structural information and the geometric information as followed figure 2. The structural information represents knowledge about relation among the objects and the features of geometry object. The geometric information is an added proposition on the basic structure. This information is reasoned by the geometric or algebraic knowledge. Efficient dialogue-based tutoring system needs suitable knowledge representation about the quality information of geometry. Main knowledge constructed with AIML is represented by structural information; on the other hand, the used knowledge by answer of dialogue is presented by the geometric information.



Structural information: *The line AB is composed of the dot A and dot B*
The line FD is composed of the dot F and dot D
The line BC is composed of the dot B and dot C
The dot B locates on the line AE ...
Geometry information: *Lines A E and FD are parallel*
The distance between the dot and the dot C is 7m
Alternate interior angles ABC and BCD is same ...

Figure 2. Classification of Geometry information

Student Model and Dialogue Representation

The geometric knowledge is constructed variously by the learner's knowledge state and learning process for using intelligent dialogue. Intelligent dialogue method is different complexity by who take the hegemony of dialogue. The hegemony of dialogue classifies by a case of system-initiative, case of learner-initiative and hybrid case. A case of system-initiative, system asks to a learner a question and a learner answer mostly. This method is same the one of an expert system and system reason the learner's knowledge in the course of a conversation.

On the other hand, a case of learner-initiative doesn't use planed dialogue but system replies the most suitable answer by learner's question. Because this method doesn't exist a constructed knowledge base previously, the number of answer is increase exponentially. As a result, system processes dialogue with restriction the band-with of learner's question.

Hybrid case, if the learner has a mistake or does not understand the learning content, the dialogue method executes with a system-initiative mode, if learner has understanding or tries review learning, learner-initiative drives. A learner's knowledge through dialogue is stored by student model and diagnoses a learner' level. The system-initiated method uses overlay model and fixes up a learner's knowledge and the pre-made dialogue path. While the learner-initiated method uses bug model to find learner's mistakes. Hybrid method uses a bug library model namely machine learning for storing new bug.

AIML Design for Geometry Learning

Tutorbot is able to understand the flow of conversations by capturing the questions and going into a particular topic. <topic> allows Tutorbot to prefer responses that deal with the topic currently being discussed. This creates topical conversation, yet still has the ability to move from one subject to another. For example, if the questions were asked in relation to Plane Euclidean Geometry, the file *Geo.aiml* is that will be put into use.

Example: *<Student> Hi!*
<Tutorbot> Hi! there [general category]
<Student> Can you please tell me more about a quadrangle ?
<Tutorbot> Lets move on the geometry section [geometry category]
<Student> How many lines do a quadrangle have?
<Tutorbot> Four.
<Student> How many dots do a quadrangle have?
<Tutorbot> Four, too.

<Student> What is an angle?
<Tutorbot> That is the degree of an angle formed where two lines cross each other.
<Student> Thanks you.
<Tutorbot> You're welcome. [general category]

Tutorbot is capable of throwing in random responses along with the proper response. This in a way is like a freebie guide that may assist students. This type of random responses tied with logical responses is feasible in this type of a setting. This gives some form of personality to Tutorbot. It would be like dialogue with an intelligent tutor and from past experience, an intelligent tutor always throws in additional hints to assist students when making decisions about their future.

```
<category>
<pattern>CIRCLES</pattern><template>
<random>
<li>You will have fun in geometry learning.</li>
<li>Circle is very interesting figure. </li>
<li>What is difference a circle and an oval? </li>
<li>Ask me anything you want about circle</li>
<li>Did you know that circles' features for Geometry?</li>
</random>
</template>
</category>
```

4. Implementation and Experience

Implementation of intelligent dialogue system

Figure 3 shows the prototype of a dialogue-based e-learning system. This system was designed to learn the plane Euclidean geometry learning with intelligent dialogue method. A learner can learn geometry learning through screen interface and can ask the toturbot a question by using dialogue interface. For reducing the bandwidth of learner's question, the context of question is limited in related learning contents.

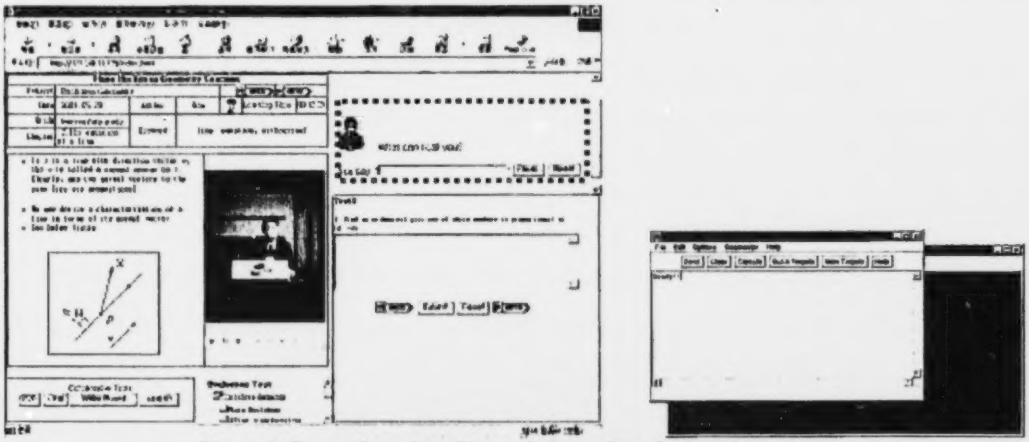


Figure 3. Screenshot of intelligent dialogue-based e-learning system

The dialogue-based engine used JDK 1.3 program and dialogue server executes by servlet. When server drives by servlet, the dialogue engine loads category items of geo.aiml file in memory. Moreover, server creates log file for grasping the learner's information. Right in figure 3 shows server screenshot of Tutorbot. H/W by using research is Windows 2000server. If a Tutorbot server executes, dialogue port is used the 2001 port with HTTP and all learner can communicate with system. Tutor-bot server in figure 3 can see that geo.aiml was loaded in memory by driving server

Sample of Conversation with Tutor-bot

The category on geometry learning was made with 23000-domain knowledge and knowledge was stored in geo.aiml file. A learner can communicate with a special knowledge in geo.aiml file and a general

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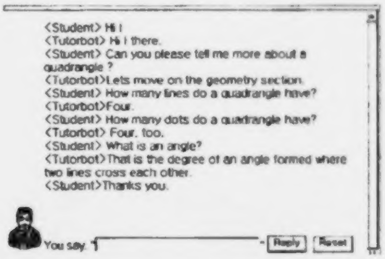
knowledge in general.aiml file The following Figure 4 was recorded between Tutorbot and a learner. A learner asks a system a question about the quadrangle and we can see that a tutorbot replies a suitable answer. When learner uses an approximated question or an illegal grammar, a tutorbot introduces to change a direction of dialogue.



```
<Student> Hi !
<Tutorbot> Hi ! there.
<Student> Can you please tell me more about a
quadrangle ?
<Tutorbot>Lets move on the geometry section.
<Student> How many lines do a quadrangle have?
<Tutorbot>Four.
<Student> How many dots do a quadrangle have?
<Tutorbot> Four, too.
<Student> What is an angle?
<Tutorbot>That is the degree of an angle formed where
two lines cross each other.
<Student>Thanks you.
```

Figure 4. Conversation with Tutor-bot

5. Conclusion and future work

Dialogue systems are becoming very common in many web sites today. They serve to give personality and intelligent information to web sites. Specially, a dialogue system approves a merit in e-learning system. Typical technique of intelligent tutoring system is intelligent dialogue based student model. We discussed on dialogue technique for such intelligent tutoring system in this paper. Moreover we extracted the domain knowledge of geometry learning and geometry analyzed structural information and geometric information. This information and knowledge could use effectual for intelligent dialogue system. We hope for developing intelligent dialogue-based tutoring system by our study.

Futures works need that study on temporal reasoning method by changing a learner's knowledge as well as research on virtual interface by using 3D and virtual reality. Furthermore, for improving the accuracy of dialogue, we will study on the reasoning method of an ambiguity and uncertain knowledge.

References

[1] Anderson, J. (1983) Acquisition of proof skills in geometry, Morgan Kauffman.

[2] Bates, J. (1994). The Role of Emotion in Believable Agents, Technical Report CMU-CS-94-136, School of Computer Science, Carnegie Mellon University, April 1994. Also to appear in Communications of the ACM, Special Issue on Agents, July 1994.

[3] Biermann, A. W. et al. (1983). An experimental study of natural language, International Journal of Man-Machine Studies 18, 71–87.

[4] Boyce, S. J. (2000). Natural Spoken Dialogue Systems for Telephony Applications, Communications of the ACM, Vol. 43, No. 9, 29–34.

[5] Burns, H. Parlett, J. Redfield, C.(1991) Intelligent tutoring System: Evolution in design, Lawrence Erlbaum.

[6] Hauptman, A. G. and Green, B. F. (1981). A comparison of command, menu selection and natural language computer programs, Behaviour and Information Technology, Vol. 2, No. 2, 163–178.

[7] Kelley, J. F. (1983). An empirical methodology for writing user-friendly natural-language computer applications, Proceedings of the CHI '83 Conference on Human Factors in Computing Systems, ACM, New York, 193–196.

[8] Mandl, H. Lesgold, A.(1988) Learning issues for intelligent tutoring systems, Springer-Verlag.

[9] Mykowiecka, A. (1991). Natural language generation – an overview, International Journal of Man-Machine Studies 34, 497–511.

[10] Patrick J. Ryan, (1986) Euclidean and non-Euclidean geometry, Cambridge university press.

[11] Turing, A. M. (1950). Computing machinery and intelligence, Mind, Vol. 59, No. 236, 433–460.

[12] Wallace, R. S. (2000). Don't read me - A.L.I.C.E. and AIML documentation, available online 4 .

[13] Weizenbaum, J. (1965). Eliza - a computer program for the study of natural language communication between man and machine, Communication of the Association for Computing Machinery 9: 36–45.

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An Authoring Tool for Variable Relationship Capturing: VRCapture

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Abstract: The need of authoring tool inspired the creation of VRCapture, which is a module in the Configurable, Incremental and Re-structurable Contributive Learning Environments (CIRCLE) and is capable of providing a tool to capture the authoring teacher's expertise. To ensure the expandability, object-oriented analysis and design methodology is employed, and reusability guides the development process. VRCapture with its environment CIRCLEs assemble a computer-based learning environment that overcomes many traditional CAI systems' deficiencies such as, high development/modification cost, non-modularity/ non-reusability, and commonly low acceptances of end-user teachers.

Introduction

The primary function of the teaching process is to achieve the transfer of knowledge from someone who is richer in terms of these commodities (knowledge) to those who own less. In order to secure the knowledge transfer process, some channels (or mediums) of communication must link the parties involved. Possible channels include:

1. schools/ learning and training institutions
2. home
3. work places
4. social and leisure centres

Channel (1) and (2) are very important in our early life, whereas channels (2) to (4) become of increasing value in our later life. Barker & Yeates (1985) noted that "Home and work environments are two of the most effective ways of disseminating educational information". Computers have been increasingly used to facilitate or even used as the communication channel due to the difficulties for a human teacher to fulfil all requirements, which Barker & Yeates (1985) argued as the necessities of a good teacher:

1. An agent for the dissemination of information and knowledge.
2. A motivator for the development of learning skills.
3. A means of measuring the effectiveness of 1, and 2.
4. Adaptable and patient.
5. Able to modify teaching strategies to the needs of individual students.
6. Always available when needed.

Computer Assisted Learning (CAL) System

High availability is the most obvious contrast between a computer assisted learning system and a real human teacher. And if intelligence is built into the learning systems, they can even provide an adaptable learning environment, which can be tailored to the student's individual needs. For example, CAPIT (Mayo et al., 2000) is an intelligent system that teaches 10-11 years old school children the capitalisation and punctuation rules in English grammar. It can provide selectively appropriate levels (brief to detailed) of feedback to a student, when he/she makes a mistake, based on the individual student's performance.

As explained in the 'Situated Learning' section later, expertise is achieved by continually repetitive practices. Computers are excellent tools for doing repetitive tasks (as they will never complain!) such as to teach a child how to punctuate English sentences or to provide exercises on an accounting topic. Teachers' time can be spent more on the creativity or strategies of the curriculum design rather than on the repetitive tasks that many of computerised systems are aimed for. "*Computers can make good teachers*", said Barker & Yeates (1985), whereas our interpretation is that "computers make it easier for a teacher to be a good one".

Issues in Computer Assisted Learning Systems

The CAL systems are generally built by computer programmers who may have only little or no understanding of the theories of education. As a result, those systems created could be excellent in terms of program design, computer resource utilisation and performance optimisation, but useless in real classrooms.

When a traditional CAL system is built, the author has to specify its screen design, instructional content, and instructional flow. Any change has to be preformed explicitly in terms of the design layout, sequences of instructions and the content materials. In other words, the system is non-modular, difficult to reuse and any modification can be very time consuming and costly.

Another issue for traditional CAL systems is that the systems have to be accepted by the teachers who are actually part of the end users. The NDH (Not Developed Here) syndrome psychologically creates the hindrance to the acceptance and leads to a mistrust from teachers to the system. It is already hard to develop a system that could suit two mathematical teachers' flavour let alone a system that could be accepted internationally.

Next in this paper, we shall talk about how VRCapture and the Configurable, Incremental and Re-structurable Contributive Learning Environments (CIRCLE) address those problems mentioned above. We shall then discuss how object-orientation facilitates the achievement of reusability and modularity in the system and how the employment of situated learning theory provides the benefit of more complete and accurate knowledge acquisition. In the last two sections, we shall describe the VRCapture system architecture and future possibilities.

Contribution from VRCapture

By using the VRCapture, the authoring task is shifted from the traditional programmers of traditional CAL to the teachers who use the material and know the students. The teachers create what they want the students to learn from the system by themselves. Thus, the teachers would feel more in control of the teaching process and naturally they are motivated to encourage the students to use 'their' systems. In addition, the knowledge repository can be improved directly based on the teachers' teaching experiences and students' feedback.

The knowledge or the rules are stored separately in CIRCLE (see figure 1). Any modification in the knowledge repository immediately brings its effect to the system in front of the students. While the knowledge is not hard-coded into the program, it is an inspectable repository and can be queried. Future expansion could possibly introduce an additional module that could make the knowledge repository runnable. By runnable, we could imagine a portrayal of a system that behaves like an expert system and answering queries by induction or reduction of the rules stored in the repository. Furthermore, the knowledge repository and the program code can be either maintained or even reused for different subject areas independently.

Teachers or instructors do not need to worry about the design of the screen layouts and the construction of instructional sequence. They only need to input appropriate parameters by which the system will determine how to layout and sequence each topic when students come to use them. The simple-to-use and easy-to-learn characteristics provide a friendly environment for the teachers who have less experiences, or who do not wish to spend too much time on the meta-learning of the system.

VRCapture in a Larger System

Inside the CIRCLE (see figure 1), VRCapture is responsible for providing an authoring tool to capture the teachers' expertise into the knowledge repository. The knowledge repository contains all the rules and relationships of domain concepts. The data inside the knowledge repository is then fed to the Intelligent Tutor on the demand of students. The main purpose of Intelligent Tutor is for the students to utilise those knowledge stored in the repository. It provides a user-friendly and adaptive interface from that the students can learn, do exercises, and test them-selves.

Benefit of CIRCLEs Architecture

Each of the CIRCLEs' components can be developed independently by providing their interface specifications to the developers of the other components. Its modular structure enhances greatly its expandability and maintainability. By this modular architecture, new modules or functions can be just plugged in, or existing modules can be re-structured or disposed without causing any vital effect to the overall system.

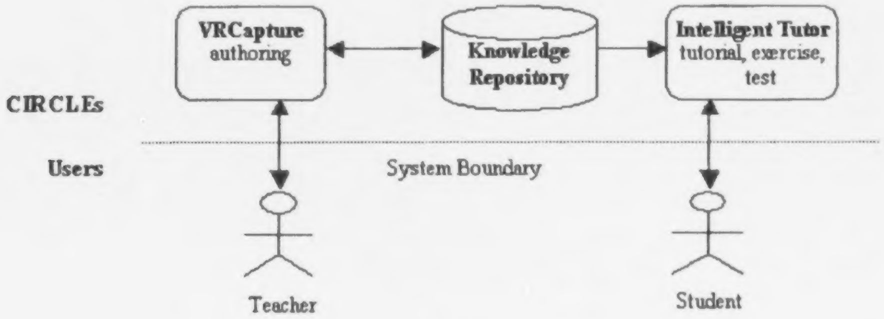


Figure 1 – The CIRCLEs Architecture

The users of CIRCLEs can also enjoy the benefits from its light-weightiness. The students only need the part of the system to perform their tasks, so do the teachers. No matter how much the system will expand in the future, the users can still use the version they have processed or just require a small incremental patch.

Openness is a highly valued criteria when the underlying technology is selected. The underlying Java technology ensures the system is portable over platforms. The portable and concise characteristics of CIRCLEs components open to us the possibility and ambition for migrate CIRCLEs on-line and hopefully, in the near future, more distant learner can be benefited from it.

Object-Orientation and Reuse

There are primary two divisions of reuse in terms of the development style; Development-for-Reuse, and Development-with-Reuse. Development-for-Reuse, by Hallsteinsen and Paci's definition, "*is the process of developing and preparing components such that they can be reused in future applications and contexts*." Therefore, during the design or implementation stage the developer understands that the artefacts under development will be reused. Whereas, Development-with-Reuse is the construction of software by utilising existing reusable components. It is an activity that involves the analysing, organizing, cataloguing, and evaluating of software artefacts which can be placed in reuse library.

VRCapture adopts the Development-For-Reuse guideline and use OO techniques to achieve least coupling of objects and maximum cohesion by clearly and logically separating different concepts into different implementation classes. Now let's look at how the Object-Orientation helps the reusability by its two distinguishing concepts: encapsulation, and inheritance.

Encapsulation provides independence to an object, which can be deployed with other objects to form a functional component. Object independence is an important characteristic in terms of reusability. Object-Orientation facilitates high cohesion, since every object stands for an explicit concept in the problem domain whereas, low coupling and high modularity are the 'should-be' of Object-Orientation. Encapsulation also provides a mean to achieve **information hiding** by which the details that is likely to change over the time are concealed. Very possibly the components that communicate to hardware need a replacement when the system's hardware is upgraded or the system migrates from one platform to another. Database selection can be replaced just by modifying the 'DBManager' (see figure 2) in VRCapture. Only those that are unlikely to change should be selected as the external interfaces of components.

Class inheritance defines class relationships by reusing the methods and data defined in another class. By doing this, redundancy is removed and tested code can be reused to achieve both quality control and cost saving.

Situated Learning

In the VRCapture system, the main focus is to store the teacher's knowledge electronically, so the knowledge can be accessed without the limitation of time and, may be in the future, even without the limitation of spaces, if a web-based interface is set up for students. The system aims at capturing the domain's knowledge effectively, and this aim is achieved by not applying the theory of situated learning to the students but to the teachers. We will first look at the general theory of situated learning and then we will talk about the application of the theory in the VRCapture.

Situated learning, also called problem-based learning, proposed that the contextual attribute of knowledge makes it not effective to teach conceptual knowledge without defining its application situations. "*Real world learning has a backbone of problem solving, production of work-authentic products, and investigation and research, in which all knowledge, processes and techniques connect and are used*" (Glasgow, 1997).

What Glasgow (1997) also describes in a traditional school nowadays, is that the teachers hope that the curriculum design and their teaching style will meet the need of the majority of their students, but in fact "*Much of today's curriculum is based on teacher's past experience in schools, input from textbook manufactures, discipline frameworks, standards, and information from peers*".

However, learning in a real-world situation is usually contextual, continual, and repetitive. For learning to be able to be packed into the long-term memory, continual repetition is a method being employed traditionally and it proves itself successfully (Shou, 1998).

For learning to being contextual, we are able to link pieces of conceptual knowledge with real life situations, which in term helps the validation or incurs more inspirations and associations on the conceptual knowledge. Additionally, real world learning usually happens while there is a need – a problem we encounter in the workplace or a question we want to solve.

It is more difficult initially for the students to grasp the big picture of how to apply the given conceptual knowledge. Brown (1989) gave an analogical links of knowledge to tools, "*we should abandon any notion that they (idea and concepts) are abstract, self-contained entities. It may be more useful to consider conceptual knowledge as, in some way, similar to a set of tools*". Knowing the description of the tool or the functions of this tool doesn't make a person expert or even capable of using this tool. To master a tool, the apprentice (student) observes, mimics what the master (teacher) does, and then repeats, and explore. The process to master a conceptual knowledge can be similar as well.

Application of situated learning in the VRCapture

Situated learning is applied in this project in the creation of the knowledge that is inputted by the teachers and can be stored in the repository. Experienced teachers, who are in charge of inputting the relationships of the domain concepts, can more completely and more precisely identify the relationships between the concepts. However, for someone who has less experience on both the domain practice and the system, he/she may need some assistance on inputting what he/she knows about the domain concepts. A question is therefore asked, "How can we facilitate the knowledge capturing process and make sure the knowledge is completely and correctly inputted, as far as in the teacher's personal understanding"?

An optional mechanism is created, by which the teacher can refine the stored knowledge by doing exercises. This is optional for more adaptability of power users. This mechanism situates the teacher in the student's point of view in order to provide a different perspective, which is aimed to reverse the tradition of teacher-centred education to a student-centred one. Questions are posed to the teacher randomly and he/she answers the questions like every student would do. By doing the exercise, the teacher has to examine what he/she has inputted into the database, and what he/she will do as a student in response to those questions. The teacher is actually learning the student's learning process, and hopefully the resulted knowledge capture can be more robust and more suitable for deploying.

Additional knowledge can be found by comparing the teacher's answer to the existing knowledge in database. Mis-concepts or conflicts in existing captured relationship can also be identified and corrected accordingly. Though this is an optional step but it ensures the completeness of the captured knowledge before the students actually start to work on these knowledge. Therefore, even for experienced users, this mechanism is still highly recommended.

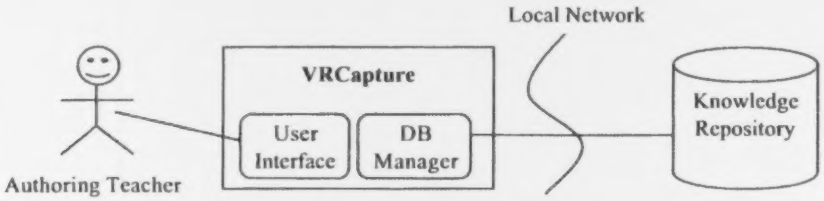
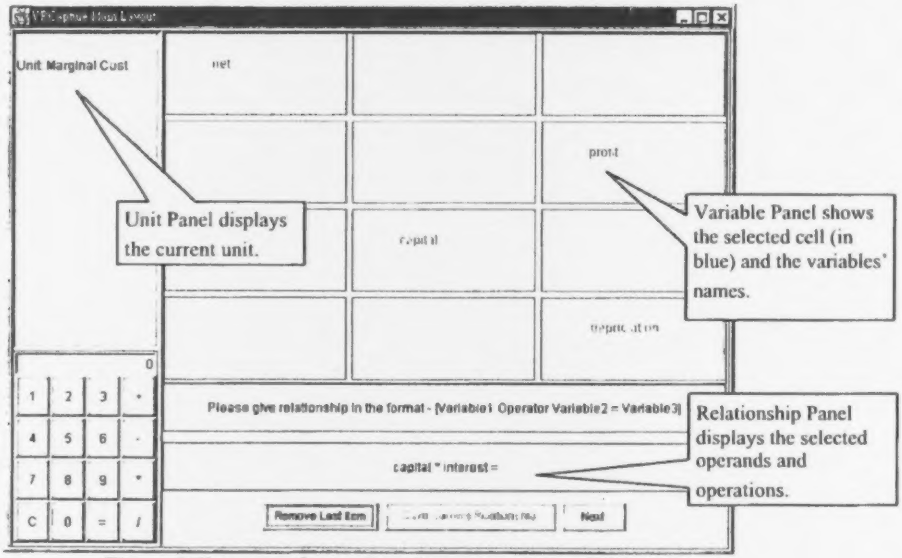


Figure 2: VRCapture system architecture

The VRCapture system is basically a two-layered system (see figure 2). It uses a database as the knowledge repository to store the captured relationships. A database interface called 'DBManager' is built to interface the transactions with knowledge repository. The implementation details which could change over time or requirements are all placed in 'DBManager'. Thus, the rest of the program can be database independent. This is the implementation of information hiding mentioned above. Figure 3 shows an interface for formulating and recording relationships/rules.



Please give relationship in the format - [Variable1 Operator Variable2 = Variable3]

capital * interest =

Unit Panel displays the current unit.

Variable Panel shows the selected cell (in blue) and the variables' names.

Relationship Panel displays the selected operands and operations.

Figure 3 The screen for teachers formulate relationships

Development Process

The development started by trying to understand the problem or the requirement statements. The initial general requirement statement was expanded into a list of sub statements. Confirmation of those sub statements with the supervisor also confirms my understanding of the problem.

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In the next step, the selection of methodology was performed. Object-oriented methodology was selected due to the following reasons:

- The implementation tool, Java, is itself object-oriented.
- Object-oriented system encourages explorative development by which a object can be created, experimented and then kept or discarded.
- Object-oriented system has more flexibility to expand.
- Object-oriented system provides an easier maintenance and debugging environment.
- Object-oriented development facilitates reusability.

In the analysis phase, use cases are used to document and identify required functions. Use cases provide insights of how the system interacts with the outside world and they can be collected into the user manual for a step-by-step guidance. The creation of class diagrams provides a direct mapping from design artefacts to program code. Each class in class diagram represents an implementation class in the VRCapture. The links between classes may be association, relationship or mapping (see Odell and Martin, 1998 for more details about object relationships).

Duplication check is the mechanism to check whether two relationship in conflict;
$(x + y = 3)$ and $(x + y = 5)$ are in conflict. When system detects any potential conflict, it will rise a diabg asking the teacher whether this conflict is intentionally allowed or not.

Conclusion and Future Development

The need of authoring tools for computer assisted learning system has inspired the creation of VRCapture. CIRCLEs serve as architecture that d ifferent tools can be integrated to perform intelligent tutoring. However, in the near future, we would like to overcome some of the limitations of CIRCLEs to expand the usable coverage to a wider range.

The current system has already the support for use in a local network. The CIRCLEs system can also be expanded to embrace the popularity of Internet. Through the Internet, the system can be within reach of a wider range of audience. The underlying Java technology makes it very easy to have an interface using Internet browsers. Browser interface modules can be created and plugged in to current architecture.

The current system can only takes in rules that have three elements (e.g. element1 + element2 = element3) and only certain operations (+,-,*,/,-). This limitation can be overcome by employing *operation stack* and *operator procedure parsing* (Weiss, 1998), which could interpret formulae with no length limitation and can identify operation precedence. And with additional operations, the system can also be used for complex mathematical formulae or other numerical disciplines. Finally, the question of whether computerised system such as CIRCLEs can be used for other non-numerical subjects like philosophy or psychology has to be left open and requires more future corroboration and investigation.

Reference

Barker, P. & Yeates, H. (1985). *Introudcing Computer Assisted Learning*, UK: Prentice Hall.

Brown, J. S., Collins, A. & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher, 18*, 32-42.

Glasgow, N. A. (1997). *New Curriculum for New Times*, USA: Corwin Press.

Mayo, M., Mitrovic, A. & McKenzie, J. (2000). CAPIT: An Intelligent Tutoring System for Capitalisation and Punctuation. In Kinshuk, C. Jesshope & T. Okamoto (Eds.) Proceedings of IEEE International Workshop on Advanced Learning Technologies, Los Alamitos: IEEE Computer Society Press, 151-154.

Shou, I. C. (1998). *Nurtured By Love*, Taiwan: Chinese Foundation of Musical and Cultural Education.

Weiss, M. A. (1998). *Data Structure & Problem Solving Using Java*, USA: Addison-Wesley.

Internet based learning and Knowledge Management

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Abstract: This paper presents the research and development of knowledge management system for Internet based intellectual assets to leverage the learning process for individual learners. The literature review reveals that corporate solutions of knowledge management are not directly applicable due to the lack of adaptivity needed to provide individualized feedback to the learner, and their localized nature that does not directly deal with authentication and verification of distributed information. Architecture has therefore been formulated for the knowledge management system that specifically supports web-based learning.

1. Introduction

Strategic concern for survival in the global information technology and information systems disciplines calls for constant upgrade of knowledge especially in computing related areas. The primary reason for this is the ever-changing technology, which compels employees to be up-to-date in their knowledge. The trend of increasing Internet based learning is evident from the increasing number of universities providing facilities to finish degrees and diplomas through Internet. In many instances it becomes pertinent, as otherwise it would mean loss of job. The implication is working population trying to upgrade their knowledge through Internet based learning.

2. Problems with the existing online education systems

Online education systems provide a great solution for working community. But they do not come with unmixed blessing. One of the primary considerations or constraint for both student and teachers is the time element. This necessitates a means by which the accurate and relevant knowledge can be accessed efficiently by the students without wasting much time. On the other hand, teachers should be able to save their precious time by reusability of knowledge. This warrants the use of a knowledge management system.

In a large distant learning class, it is very often not possible to answer individual queries due to low students to teacher ratio. It also lacks some important benefits of traditional classroom setting such as instructor-student and student-student interaction, collaborative work among peers, and so on. Although these factors can be translated into the Internet based learning by use of newsgroups or mailing lists and use of collaborative technology such as discussion forums, but there are several limitations. The first problem is the hesitation within students to post questions in a public arena such as discussion forum. Instead, they tend to post their queries to individual instructors asking for individual attention. The second problem is the information overload in the collaborative environment over time, and it becomes extremely difficult to mine the knowledge. The information exchange in such environments takes place in a haphazard manner due to different temporal and spatial conditions of individual students. This results in non-synchronization and repetition of information leading to even more tedious process of knowledge mining.

Another inherent problem for students who wants to have an in-depth knowledge on any subject through Internet is the overwhelming amount of information available on the Internet from all over the world. To quote Koniger (Koniger et al., 1995) in the article on "Drowning in information but thirsty for knowledge", "*Information is only valuable to the extent that it is structured. Because of a lack of structure in the creation, distribution and reception, information often does not arrive where it is needed and therefore, useless*". This disconcert becomes a serious barrier to potential learners. There are no formal mechanisms available to filter the information for the quality and authenticity verification. Added to this is that the information is not adapted to individual learners and therefore learning does not take any consideration of individual student attributes.

Another problem associated with gathering knowledge from the Internet is that the available information is not structured and not available in a uniform format. In other words, the available information is in heterogeneous formats varying even within a single source. This makes it extremely difficult to search and retrieve the information, posing one of the biggest challenges in making flexible and robust knowledge management systems.

3. Solution

In this background, the use of knowledge management in Internet based learning can provide an efficient solution for learners. The benefits of using knowledge management system in internet based learning would include increased efficiency in knowledge solicitation, avoid wasting time on repetitive queries, better use of resources etc.

In the following section we will look at the applicability of knowledge management systems to Internet based learning. The next section will look at the methodology to integrate knowledge management and Internet based systems to alleviate the problems common to Internet based learning. This is aimed to cater for both basic and advanced learners. The following section will look at the prototype showing various processes involved in the system. The next section will look at the benefits of the prototype system, followed by the conclusion.

4. Link between Internet based learning and knowledge management

The central theme of knowledge management perceived by many experts in the field is that it is an integrated and systematic process of acquiring, eliciting, organizing, representing and retrieval of information asset. The objective of the knowledge management in Internet based learning is to generate value in terms of knowledge from intelligent capital to enable faster and efficient learning. According to Liebowitz (1999), knowledge management deals with the conceptualization, review, consolidation, and action phase. Knowledge management in Internet based learning is about connecting learners with learners, and teachers and learners with information and knowledge (Corrall, 1999). It is about getting the right knowledge to the right person at the right time.

The phenomenon of overload of information to learners results in the learners' inability to cope with the processing of increased amount of available information. Internet based knowledge management systems can prove to be efficient solution to manage the problems associated with Internet based learning. They can improve the productivity through achieving reusability and enhancing educational services to the learners. Also, immediate clarification of doubts of the learners through on-line knowledge management system can enable them to correct the mistakes without waiting for the teachers or tutors to respond to learners. Features specific to learning institutions are knowledge intensive nature and extensive reusability of learning materials. These reasons call for the use of knowledge management system in learning. Synergy of Internet based learning and knowledge management systems would be ideal for saving time, avoiding reinventing wheel, increasing efficiency and so on.

5. Methodology

This paper proposes the use of knowledge management systems for both basic and advance learners. Basic learners are those who would like to just finish the course without any reference to any additional material. The advance learners are those who would like to enhance their knowledge in a given area beyond the requirements of the course curriculum.

Part 1: Catering for basic needs of the learner matching the curriculum

Catering for the basic learners by giving immediate and relevant access to the knowledge is a multi-step process. The first step is the collection of all basic material namely concepts, exercises, definitions, examples etc. and store them in the knowledge base. Additional material can be collected from various sources like the previous years archives (if available) of all questions including frequently asked questions and answers for them from various sources like newsgroups, discussion forums and mailing list etc. This archive can be used to compile a knowledge base and updated based on the new questions from the current students. Student profile parameters are also collected including extent of learning required, existing level of expertise, key interest, etc. The second step is to organize and transcribe the collected information in the knowledge base. The third step is to create a context-based search technology, which would enable the system for easy retrieval and to provide quick and accurate information to the learner. The search mechanism should allow the students to search by topic or index or by keyword as in common software help systems. The fourth step is the integration of user profile and knowledge base to give the best possible contextual resources related the search query. The fifth and final step is to create a user-friendly and intuitive interface for students to explore the knowledge content and ask queries.

Part 2: Catering for the advanced learner

Catering to advance learners requires quick acquisition, integration and presentation of relevant and correct knowledge from within the knowledge base and from websites distributed on the Internet and related to the context of the learner. The major concern in this process is the explosive growth of information, which lacks any quality checks, and integration of such information to make it useful knowledge in the context of learner's learning process. This requires meticulous evaluation of material available on the Internet and compiling and organizing the material to suit individual learning. Links to such evaluated material is maintained in the knowledge base for future use. This directory of these links is updated on a frequent basis. The rest of the steps involved in this part of the system are very similar to the first part and include information collection, evaluation for quality and authenticity, organization, creating proper retrieval mechanisms, integration of user profile and knowledge base and finally creation of user interface.

Figure 1 explains the processes involved in knowledge management systems in Internet based learning.

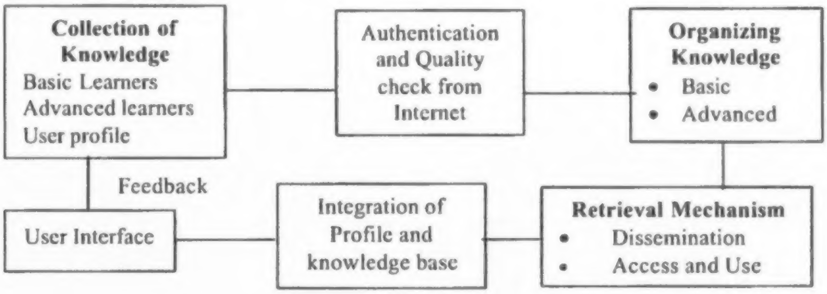

Figure 1: Knowledge Management Systems' Architecture

The results provided from the knowledge management system to any specific query are precise and concise. In other words students do not have to filter through abundance of information. Instead the knowledge management system does the job of sifting through the available information and gives appropriate and precise query results based on user profile.

6. Prototype

Based on the architecture, a prototype system is being developed which aims to guide the learners a guided discovery learning process. The guidance is individualized, based on the behavioural attributes of the learner. The components of the prototype are knowledge base, user profile database, knowledge engine, inference engine and interface. Knowledge base contains locally available information, references to Internet based distributed information, and cache of frequently accessed information. User profile database refers to the attributes of the learner gathered through user modeling mechanisms. Knowledge engine helps in manipulating the acquired information and effective indexing and storage. Inference engine enables retrieval of knowledge as per individual learner's attributes. Interface provide adaptive representation of the knowledge to the learner.

Figure 2 summarizes the sequence of actions as a result of the student's query and the mechanism used in the processes. Student's question on the interface triggers the following set of activities. Student identification is sent to the learner profile database and the details are integrated with the student query. The modified query is sent to the inference engine. The engine attempts to retrieve the information from the local knowledge database. If the context related information is not available, it fetches it from distributed Internet websites. The newly acquired information is then integrated with the existing information and converted into contextual knowledge before presenting it on the interface to the student.

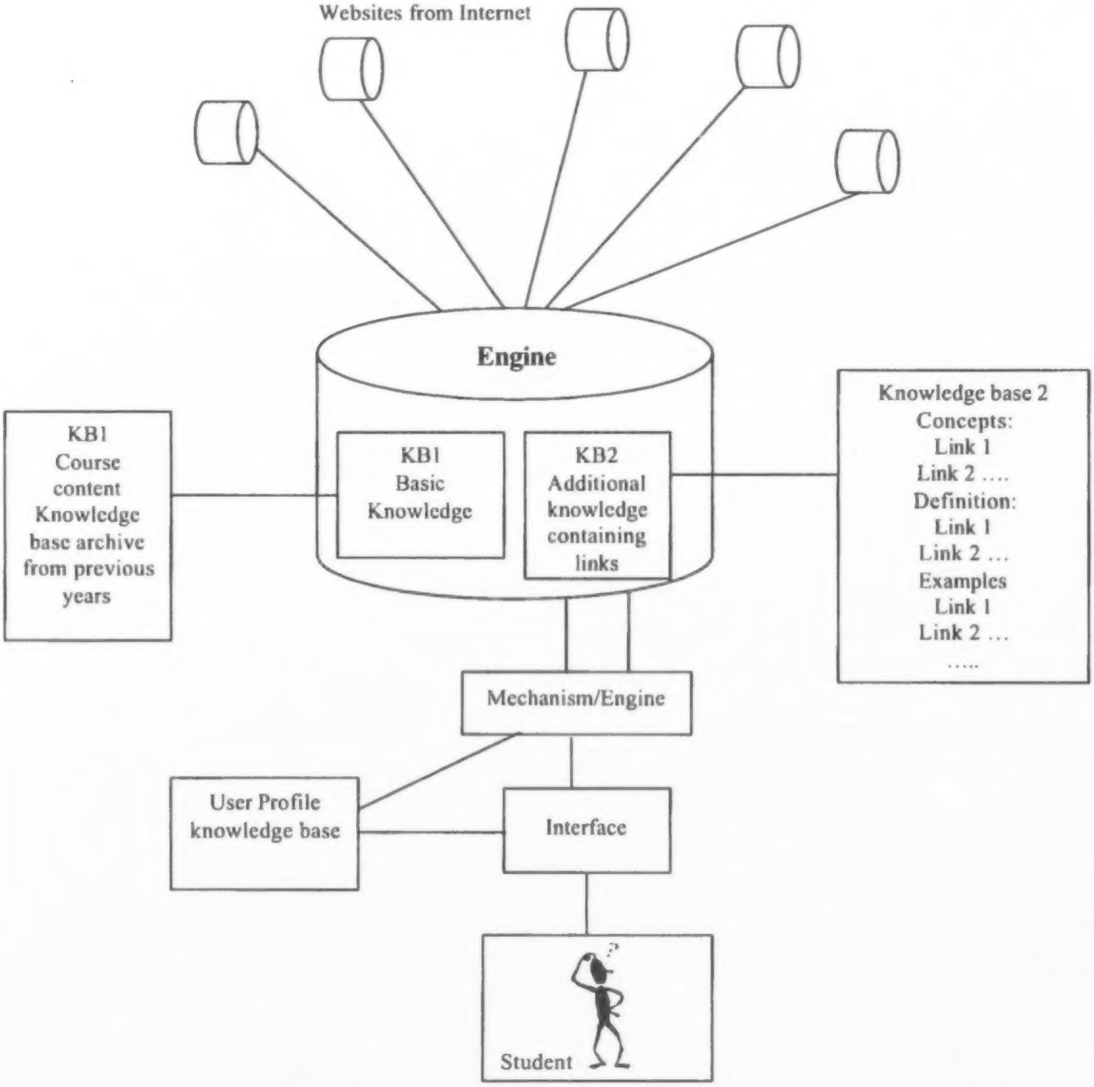
Websites from Internet
Engine
KB1
Course
content
Knowledge
base archive
from previous
years
KB1
Basic
Knowledge
KB2
Additional
knowledge
containing
links
Knowledge base 2
Concepts:
Link 1
Link 2 ....
Definition:
Link 1
Link 2 ...
Examples
Link 1
Link 2 ...
.....
Mechanism/Engine
User Profile
knowledge base
Interface
Student

Figure 2: Student query and knowledge retrieval process

7. Conclusion

Knowledge management systems combined with Internet based learning have a lot to offer to the teaching and learning community. They can save the precious time for both teachers and students through immediate retrieval of knowledge and information. This paper described the rationale behind the development of such a system and provided the details of functionality being developed in a prototype.

Even if the course material is structured very well, there is still a value addition to a system like this for a simple reason, that in distant education, students learning takes place in different points in time and such a system can provide right kind of material at right time, while still taking advantage of the information available on the Internet, and individualized it to a particular learner's needs. As the Internet grows, the strategic impact of knowledge management in Internet based system will be greatly felt. There is bright, exciting future for this area of research and knowledge management will play an important role in its evolution and integration.

8. References

Koniger, P. & Janowitz, K. (1995). Drowining in Information, But Thirsty for Knowledge. *International Journal of Information manamgement*, 15 (1), 5-16.

Liebowitz, J. (1999). *Building Organizational Intelligence: A Knowledge Primer*. London: CRC Press.

Corrall, S. (1999). Knowledge Management: Are we in the Knowledge Management Business? Retrieved on 17 March 2002 at http://www.ariadne.ac.uk/issue18/knowledge-mgt/

Mobile Agents in Web-based Student Modelling

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Abstract: This paper presents the application of "Bee-gent" mobile agents technology in designing web-based learning environments that provide adaptivity to the students by having two separate student models: Individual student model for each student; and Group student model for generalizing the attributes of a group of students. This combination enables adaptation in web-based learning environments at different granularity and in different environments, such as on-line mode, off-line mode or unreliable network connection.

Introduction

In recent years, educational information on the web has increased exponentially, and web-based learning is currently an important research and development area. An effective web-based learning environment should interact with the students and adapt to the needs of individual students. Despite previous research in this area, these systems have not yet exploited their full potential in facilitating adaptivity to the individual students. This paper presents the application of "Bee-gent" mobile agents technology in designing web-based learning environments that provide adaptivity to the students by having two separate student models: *Individual student model* for each student; and *Group student model* for generalizing the attributes of a group of students.

Design of Two-fold Student Modelling

Kinshuk et al. (1999) pointed out that dynamic adaptation requires consideration of following criteria:

(a) adaptation with respect to current domain competence level of the learner;
(b) suitability with respect to domain content;
(c) adaptation with respect to the context in which the information is being presented.

Based on the above criteria and the nature of web-based environment, we have developed a system, using mobile agents technology. The system uses two separate student models:

1. *Individual student model*, which serves an individual student and contains the detailed information about particular student's domain competence level, preferences, interaction information and other relevant details. A partial individual student model resides on the central server and another partial individual student model on the user's machine (local server).
2. *Group student model*, which generalises various attributes over a number of students and attempts to classify students in various categories (for various attributes), resides on the host base.

Design with Mobile Agent

In high-level view, a mobile agent interacts with client side inference engine to pick up the data, which in turn relies on individual student model at the client side. Then mobile agent moves to host (or server) side. At host side, mobile agent performs all the processes needed, such as updating the partial individual student model based on summary of client side student model brought by mobile agent, and interacting with group student model to be updated if required. After mobile agent finishes all the tasks at the host side, it gathers all information it needs, and returns to the client side. Then it updates the client side individual student model. In addition, mobile agent approach can work in intermittent connectivity between client and host because mobile agent can be dispatched and it can work autonomously even if the sender is not available any more.

The Bee-gent framework (http://www2.toshiba.co.jp/beegent/index.htm) is used to implement two types of mobile agents in the system (figure 1): agent wrappers and mediation agents.

- Agent Wrappers are used to agentify existing applications.

- Mediation Agents support inter-application co-ordination by moving from the site of an application to another where they interact with remote agent wrappers.

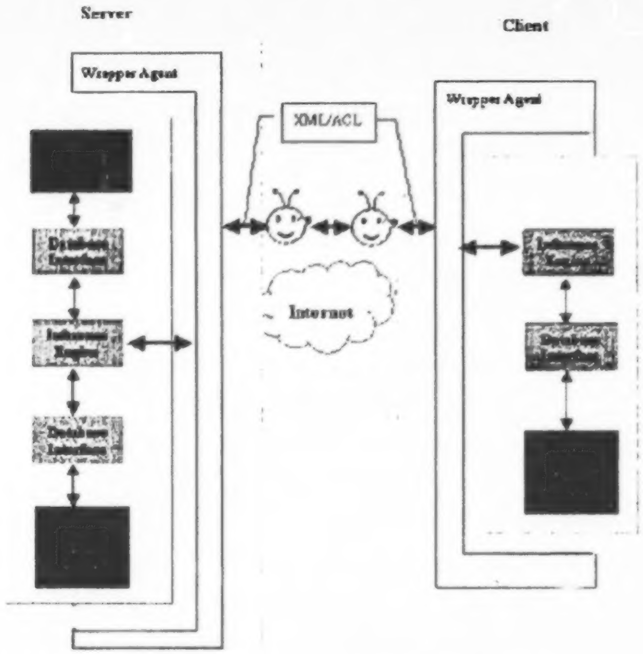

Figure 1: Architecture of adaptation mechanism using Bee-gent

Benefits of the Approach

The main benefits of the combination of mobile agents and two-fold student modeling are as follows:

A) Mobile agents can be used to pre-fetch the domain content that will be requested shortly by the student. Thus agents technology avoids unnecessary networking delays, cope the bandwidth limitation and adapt the representations to students, based on the student performance.

B) The distributed nature of mobile agents allows sharing of educational resources on heterogeneous systems and platforms.

C) Mobile agents' migrate-and-disconnect style of operation has lot of appeal for mobile phones, PDAs and other mobile devices that are now commonly used by the on-the-road learners.

Conclusion

In conclusion, the mechanism of the two-fold student modeling and using mobile agents technology provides an attractive alternative to implement and improve web-based learning environments.

References

Kinshuk, Oppermann R., Patel A. & Kashihara A. (1999). Multiple Representation Approach in Multimedia based Intelligent Educational Systems. *Artificial Intelligence in Education* (Eds. S. P. Lajoie & M. Vivet), IOS Press, Amsterdam, 259-266.

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Computer-Assisted Instruction and Multimedia for Students with Learning Disabilities at the Open University of Israel

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Abstract

The purpose of the project is to examine whether digitized speech-text synchronicity combined with other computerized assistive features supports students with learning disabilities who are enrolled in distance-learning programs in institutions of higher education. The technology enables students to follow a text that is presented on a computer screen as they listen to it being read aloud. In addition, for instance, users can navigate within the text, reread and listen again to material in topics that are difficult to understand and add written and voice notes. The preliminary results of a controlled study on the benefits of this technology for a group of distance-learning students with learning disabilities in the Open University of Israel will be presented.

Introduction

Learning disabilities are disturbances in the learning process that are caused by deficits in the functioning of the central nervous system. These disabilities can create discrepancies between learners' academic achievement and their intellectual and cognitive capabilities (Bigler, Lajiness-O'Neill & Howes, 1998). During the second half of the twentieth century, particularly the 1990s, special attention was devoted to research and treatment efforts surrounding learning disabilities. A body of evidence accumulated indicating that assistive technologies, primarily in the areas of computer hardware and software, can help students overcome various kinds and degrees of dyslexia and attention deficiencies and join the mainstream educational system (Raskind & Higgins, 1998; Lewis, 1998; Lewis, 2000). Indeed, according to a report published in 1992, the proportion of students with learning disabilities enrolled in institutions of higher education increased more than the proportion of students with other disabilities (American Council on Education, 1992).

However, research in this area has been limited in scope. For example, most investigations have been conducted on students in kindergarten through twelfth grade, as opposed to adults in either fice to face or distance-learning environments. Many questions remain unanswered: Which assistive technology should be used with each kind of learning disability? Does the use of assistive technologies in higher education affect the number of students who complete their studies and earn a degree, particularly in distance-learning programs? Which technology best suits each field of knowledge?

One reason that such issues are still unsolved is that the assistive technologies used by students with learning disabilities are produced primarily by commercial companies for the general population. In countries where English is not the native language, such as Israel, the situation is even more unclear, since most of the commercial programs in use were developed for English-speaking students. In the project described here, we examine whether a learning environment that provides assistive technologies—including the synchronization of digitized speech and text and additional features, might enhance learning in students with learning disabilities who are enrolled in a distance-learning program at the Open University of Israel (OUI).

Students with Learning Disabilities at the Open University of Israel

The number of students with learning disabilities in institutions of higher education is smaller than the number of people with learning disabilities in the general population. For example, the percentage of students with learning disabilities at the OUI is only 2%, whereas in the total population it is 4%. Also, we might assume that students who are enrolled in a distance-learning course face more difficulties than students with learning disabilities in universities where instruction is mainly face to face. At the OUI, the total number of students with learning disabilities who are enrolled each semester reaches about 1,000, and the predominant syndromes are attention deficit and attention deficit hyperactivity disorders (ADD/H), dyslexia, and dyscalculation. The OUI's Center for Students with Learning Disabilities (CSLD) provides the students with special examination conditions, individual instruction by trained tutors, and counseling. However, until now, the OUI has not used any assistive technologies to support these students in their academic studies.

Description of the Project

We developed a CD-ROM that contains speech synchronization for the text of a complete chapter of a textbook as well as other digitized features that are intended to help students with learning disabilities. The CD-ROM enables the user to carry out the following tasks:

- Read text that is displayed on the computer screen and simultaneously listen to it being read aloud
- Read and listen again to a self-selected audio reading of paragraphs that were difficult to understand the first time
- Navigate between topics without having to reread or to listen again to parts of the text that are irrelevant to the understanding of a specific subject
- Jump to a glossary with hyperlinks
- Use different colors to highlight paragraphs that are essential to an understanding of the topic, that need emphasizing, or that require a repeat reading
- Write notes and add them to a text while reading and listening to it
- Use a microphone to add voice notes to a text while reading and listening to it
- Compile the highlighted paragraphs and the notes in a separate file for further studying support
- Alter the way in which text is displayed on the screen; for example, change the size of the font or the amount of space between the lines

The advantage of speech-text synchronicity for school students with learning disabilities has already been described in the literature (Hebert & Murdock, 1994; Wise & Olson, 1995). The other digitized elements and functions were implemented upon the recommendation of specialists

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OUI, who have had considerable experience tutoring students at the OUI Center for Students with Learning Disabilities. We used the Acrobat Writer© software to create a learning environment that combines digitized speech and text and to provide the functionality described above. This developer software was convenient for our purposes because, unlike other software that has been developed to present electronic text, it enabled us to combine Hebrew text with digitized speech in the learning environment and to include features that are not present in the standard, widely used Acrobat Reader© and other software. To gain access to all the desired functions in the CDROM, the students installed the same software on their home computers.

The Benefits of the Project

The potential advantages of speech-text synchronicity have been investigated with dyslexic college students and others (Hebert & Murdock, 1994; Elkind, Black & Murray, 1996). The results of the college students' research showed that the assistive technology improved the reading rate and the understanding of most of the students who participated in the study. However, other studies suggest that speech-text synchronicity is beneficial only for students with severe disabilities, whereas for students with mild disorders the technology actually presents a disturbance (Raskind & Higgins, 1998). To the best of our knowledge, the influence of an assistive technology that includes all the computerized features described here has not been explored with adult distance-learning students. This pilot project will enable us to ascertain the kind of disorder that this technology best supports in a large group of students with various learning disabilities.

The Test Group and the Research

Each semester, between 200 and 300 students enroll in an introductory psychology course offered through distance-learning at the OUI, and of them, 10 to 15 usually request support from the CSLD. These students receive all of the course materials in print and have to fulfill the same requirements as their classmates. For our project, we have provided the students who requested aid from the CSLD with a digitized, speech-synchronized version of one chapter of the course's print textbook (a chapter on memory that is 50 pages long).

Through personal interviews, focus groups, and questionnaires, we are looking at the following issues:

- Does the synchronicity of digitized speech and text support the learning process of distance-learning students with learning disabilities and in what way?
- Did the technology help the students complete the assignments related to the chapter in question?
- Is there a difference between the students' grades on the assignments for the chapter in question and their grades on the assignments for the other chapters?
- Did the digitized speech-text synchronicity affect the time that the students invested in learning?
- Which of the digitized features of the CDROM that are described above helped the most in the learning process?
- Did the speech-text synchronicity, along with the additional features, affect the students' need for a tutor?

The control group consists of students with learning disabilities who were assigned the same chapter in the same course during a different semester; these students were provided with the print version of the text without the digitized technology. The two groups of students' attitudes, grades, and achievements related to the chapter will be compared, as well as their success at answering the questions related to the chapter on the final exam.

The research is being conducted over two semesters. At the conference we will demonstrate an English version of the CD-ROM with the assistive technology and present the preliminary results regarding the effects of this approach for distance-learning students with learning disabilities.

References

American Council on Education (1992) *College freshman with disabilities: A stastistical profile* (cooperative agreement No. H030C0000-91). Washington, DC: American Council on Education, Heath Resource Center

Bigler, E.D., Lajiness-O'Neill, R. & Howes, N.L. (1998) Technology in the assessment of learning disability. *Journal of Learning Disabilities* 31, 67-82.

Elkind, J., Black, M.S., & Murray, C. (1996) Computer-based compensation of adult reading disabilities.. *Annals of Dyslexia*, 46, 159-186. Also [on-line] http://lexia.mgh.harvard.edu/publications/elkind.pdf Accessed April 2002.

Hebert, B. M. & Murdock, J.Y. (1994) Comparing three computer-aided instruction output modes to teach vocabulary words to students with learning disabilities. *Learning disabilities Research and Practice* 9 136-141.

Lewis, R. B. (1998) Assistive technology and learning disabilities: Today's realities and tomorrow promises. *Journal of Learning Disabilities*, 31, 16-26.

Lewis, R. B. (2000) Musing on technology and learning disabilities on the occasion of the new millennium. *Journal of Special Education and Technology*, 15, 5-12.

Raskind, M.H., & Higgins, E.L. (1998) Assistive technology for postsecondary students with learning disabilities: An overview. *Journal of Learning Disabilities*, 31, 27-40.

Wise, B. & Olson, R. (1995) Computer-based phonological awareness and reading instruction. *Annals of Dyslexia*, 45, 99-122.

Summarizing Links: Issues and Interfaces

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Abstract: At the center of hypertext is the *link*, an active connection from part of one document to another document (or part of that document). In the early days of the World Wide Web, it was easy for readers to identify the links on the page: the unvisited links appeared in blue and underlined, the visited links appeared in red or purple and underlined. With the advent of advanced formatting techniques, such as cascading style sheets, links appear in different ways on different pages. These changes may make pages appear more appealing, but they also make it harder for readers to engage in a key hypertext reading activity, identifying and selecting the most relevant links. At the same time, even easily identifiable links provide readers with very little accompanying information as to why the link is there and where it leads.

In this paper, we describe ongoing research in providing readers with additional access to links and information about those links. We revisit in more detail the need to provide links in a consistent and clear manner, consider ways to make links more useful to readers without affecting the design of a page, suggest techniques for adding information to links, and describe a tool we have built that permits readers to obtain a summary of the links available on each page they visit.

1 Introduction

Where can I go from here? That question forms the center of hypertextual reading. Unlike in traditional linear writing, in which readers simply follow the narrative from beginning to end, in hypertext readers regularly look for links and consider whether or not to follow them. To permit readers to select the links that are most applicable, a hypertext system should provide four key attributes for links, summarized in Table 1.

Attribute	**Summary**
Identifiability	The links on a page must be easily identifiable.
Link Text	The source of the link must be obvious to readers.
Link Type	The purpose of the link should be clear.
Link Destination	The destination of the each link should be easy to determine.

Table 1: Key Attributes of Hypertext Links

1. ***Identifiability:*** **The links on a page must be easily identifiable.** That is, readers should be able to quickly tell what on a page is a link and what on a page is not a link. If readers cannot easily identify the links on the page, they will not follow the links. While some experimental hyperfictions may make the problem of finding the links part of the reading experience, most hypertexts should reveal, rather than obscure the links.
2. ***Link Text:*** **The source of the link should be obvious.** Most links do not go from page to page. Rather, they go from part of a page to another page (or part of another page). In a page with many links, readers should be able to clearly identify which part of the page the link is associated with. Typically, the source is a word, phrase, or image (the "anchor text" in HTML).
3. ***Link Type:*** **The purpose of each link should be clear.** A reader should know why the link is there. Does it provide a definition of the linked text? Some examples? A related page? A counter-argument to an argument on the page? The next page in a sequence? Without some additional information, readers are unlikely to know what the link is there for. It is this aspect of links that is perhaps least well supported on the Web.
4. ***Link Destination:*** **The destination of each link should be easy to determine.** Where does the link go? Is it elsewhere on the page, on the same site, or on another site? What kind of page does it

link to? While many browsers will put a URL in the status bar, a URL only says a little about the destination.

These attributes are particularly desirable for educational hypertexts, since we put links in pages so that students can explore further as their desires or needs for further information guide them. By making links easily identifiable, we let students find information more quickly. By telling them why we put the link there, we help them decide whether it's a kind of link they need to follow. And, by telling them what kind of information they will receive, we help them decide whether or not that information is appropriate before they spend their time following and exploring a link. Note that the last two goals, while similar, are different. For example, we might provide a link for students who do not understand a short reading and need more information (that is, the purpose of the link). But a "need more information" link might lead to another reading, to a problem set, or even to a set of dictionary entries. By providing both kinds of information, we further guide the student.

Unfortunately, as we suggest in Section 2, Web pages are often incomplete in their support of these four key aspects. Designers are making links harder to identify. Page authors too often use "Click here" as their source text. Browsers provide little support for link types. And the primary information most readers get on the destination of a link is little more than the URL for the link. Even if the designer of an educational hypertext is careful to clarify links, choose good link text, type links, and provide information on destinations, students may not be able to access all this information and, in any case, lose these benefits as soon as they leave the site.

So, what can be done? In this paper, we propose a partial solution. *We have developed a prototype system that provides a link summary at the end of each page that readers view, no matter where on the Web those pages are located.* For each link on the page, the summary includes the source text, the full URL of the destination, the link type (if available), and additional information about the link or destination (if available). In the near future, we expect to add summary information about the destination page (its title, its size, etc.). Because the links appear at the end of the page, they are easy to identify. In pages that provide the appropriate accompanying information, the type of the link and basic information on the destination are available. Hence, the summary helps meet most of the criteria required for the links without affecting the design of the page.

In Section 2 of this paper, we revisit the current status of links on the World Wide Web and describe some deficiencies of current practices. In Section 3, we discuss reasons to provide link summaries on pages. In Section 4, we suggest key aspects that any link summary system should provide. In Section 5, we describe the architecture of our link summary system. In Section 6, we revisit the need to summarize and clarify links. Finally, in Section 7, we describe planned updates to our system.

2 Links and the World Wide Web

The World Wide Web (Berners-Lee et al. 1994) is the leading hypertext system. How good is its support for links? Unfortunately, the answer is "it depends", particularly on the page designer. In the early days of the Web, readers found it easy to identify links: Blue underlined text represented unvisited links, red or purple underlined text represented recently visited links. However, as the Web has evolved to provide authors with more control over the appearance of the page, each page designer has chosen new ways to show links. Readers can no longer easily identify the links on many pages by simply scanning for blue, red, and purple underlined texts.

Jakob Nielsen, one of the leaders in Web design, has emphasized the need for easily identifiable links in a number of his Alertbox columns. He first warned of the problem in 1996.

> Links to pages that have not been seen by the user are blue; links to previously seen pages are purple or red. Don't mess with these colors since the ability to understand what links have been followed is one of the few navigational aides that is standard in most web browsers. Consistency is key to teaching users what the link colors mean. (Nielsen 1996, Item 8).

Nielsen returned to this issue in a 1999 column. As new designs were becoming standard for Web sites, he repeated his warning. He also noted the importance of the underline as a way of identifying links.

> [Non-standard link colors continue] to be a problem since users rely on the link colors to understand what parts of the site they have visited. I often see users bounce repeatedly among a small set of pages, not knowing that they are going back to the same page again and again. (Also, because non-standard link colors are unpleasantly frequent, users are now getting confused by any underlining of text that is not a link.) (Nielsen 1999)

Designers can, of course, continue to use these standards, but fewer and fewer seem to. Readers must now spend more effort determining whether a word or phrase on a page serves as a link, often by considering the placement of a word or by waving the mouse over the word to see if anything happens.

So, the clarity and text of links were originally quite good on the Web, but have been weakened by the advent of careless design. What about the two other desired characteristics of links: their types and their destinations? Once again, the answer is "it depends". In part, it depends on the page author. In particular, the current HTML specification (Raggett et al., 1999) provides at least four attributes for every links: `title`, `rel` (relationship), `rev` (reverse relationship, from linked page to current page), and `class`. The title is a generic form of additional information that may be displayed by the browser. It can provide information about the destination. The relation and reverse relation tags allow authors to specify a link type. Unfortunately, the standard link types (Raggett et al. 1999, Section 6.12) are relatively basic, reflecting simple relationships like "table of contents" or "next element of a sequence" rather than more complex elements like those suggested in (Trigg 1983), such as "abstraction", "refutation", "continuation", "data". Particularly for educational texts, which will need types like "example", "exercises", "simplification", the basic set does not suffice. Finally, the `class` attribute exists primarily for formatting, but could also be used to indicate type.

Even more importantly, support for types and destinations depends not only on author, but also on browsers. For example, not all browsers support the important title attribute (e.g., Netscape 4.7 does not) and those that do often require readers to perform specific actions (e.g., pause the cursor for at least a few seconds) to obtain the title text. Few browsers seem to do anything useful with `rel` and `rev` attributes. And, while, many browsers support the `class` attribute, they do so for formatting rather than logical typing.

So, what should page authors do? They can eschew complicated site designs that obscure the links. They can choose careful texts for their links. They can use the `title`, `rel`, and `rev` attributes. But they still need to hope that browsers will support all that they do and that their readers will choose to use those browsers. Is that enough? We think not. By providing link summaries for all pages, we can support careful authors without affecting their careful designs.

3 Why Summarize Links?

In the introduction, we suggested that a link summary system provides one key characteristic that one hopes for in a hypertext system: it makes the links clear (they all appear the same way on every page and in the same place on every page). Since many pages obscure their links, we hope that provides reason enough for link summaries. However, the link summary system provides additional characteristics that readers benefit from: it automatically provides information about the destination of the link and, if the page author has included that information, can include the link type and other comments.

But there are still other reasons to summarize links at the end of a page. One of the benefits we first observed when using the system is that it aids readers in dealing with mistyped links in Web pages. Since the URL appears in the summary, it is possible to look at the URL and identify potentially incorrect parts of the URL. While this is a minor benefit, it is one that many users have found useful.

More importantly, a link summary system can permit readers to organize links. For example, on a page that presents an argument, one might want to follow all the links to counter-arguments. By arranging the link summary by link type, readers can quickly find all the counter-arguments. Similarly, a student reading a long reference piece might want to be able to quickly identify all the examples. Both cases require that authors classify their links, but we hope that as the types of links are made available through tools like ours, authors will be more inclined to classify their links. A reader might also arrange links by destination (e.g., to see whether there is a site or page that is linked to particularly often).

Should these summarized links replace the links on the page? Certainly not. Many links are best understood within a broader context. The link summary system simply provides a way for readers to get additional information on the links available in the page.

4 Design of a Link Summary System

Given the benefits derived from summarizing the links in a page at the end of a page, one would hope to see a number of systems designed to provide such summaries. In considering such systems, we should look for systems that meet a number of key goals that are summarized in Table 2.

Goal	Summary
Universality	Works with any page on the Web.
Browser Independence	Works with any reasonable browser.
Design Preservation	Maintains the original design of the page as much as possible.
Author Support	Takes advantage of information the author provides.
Customizability	Allows readers to set appropriate preferences.

Table 2: Primary Goals of a Link Summary System

1. Universality. The link summary system should allow readers to obtain summaries of any page on the World Wide Web without requiring modifications to that page. While we could hope that authors would provide their own summaries or use server-side software to provide summaries, not all authors will do so. A client-side system that works with any reasonable Web page provides a more universal system. Since a number of pages do not meet HTML standards, the system should do its best even with incorrect HTML.

2. Browser Independence. The link summary system should work with any browser, past, present, or future. Since different readers clearly prefer to use different browsers, the system should support as many browsers as possible. This requirement suggests that a browser plugin is an inappropriate implementation, since each browser will require a different kind of plugin.

3. Design Preservation. While many of the problems described earlier are caused by designers who ignore standards for link appearance, it is also true that many good designs may require links to appear differently. Hence, the link summary system should not modify the original page, except to add the links at the end (or in a separate window).

4. Author Support Given that the HTML standard provides a number of attributes for tags that can provide link type and destination information, the system should support those standards. Hence, it should take link types from the rel, rev, and class attributes and additional information from the title attribute.

5. Customizability. As the previous section suggests, different readers will wish to organize their links in different ways. The system should give readers appropriate control over the link summaries. Aspects of summaries that readers may wish to control include: the order of links within the summary (do they appear in the same order as on the page, or ordered by some other characteristics), the information associated with each link (just the source text and URL, or with additional information), and even how they appear (font, etc.).

5 Technical Details

We have developed a prototype system that supports the design goals suggested in the previous section. To provide a relatively universal system that is independent of browser, we rely on the Web Raveler architecture (Kensler and Rebelsky 2000). Web Raveler is a collection of systems that mediate the conversation between browsers and servers. The classic implementation of Web Raveler is as a proxy server. Proxy servers receive each request and response that is sent between client and server. Proxy servers are used for a variety of reasons, including caching of pages, limiting access to certain pages, and logging information about Web use.

Web Raveler provides an infrastructure in which authors can write small "plugins" (to Web Raveler) that receive each page before it goes to the browser and may modify the page as they choose. The Link Summary plugin in our prototype system quickly scans the page for links, extracts information, and adds a table of links at the end of the page.

Web Raveler also provides additional facilities useful for the link summary system. In particular, it provides account information which permits us to store and access user preferences on the appearance of the link summary. In addition, the Web Raveler team is currently developing a Web cache that will make it easy for us to quickly obtain the titles associated with many URLs. While it would possible to obtain the title of a Web page by sending an HTTP request, if there are many links on a page, it would be overly time consuming to send an HTTP request for each of them. The Web Raveler cache would provide quicker access and user preferences could determine what the system does if the URL is not in the cache.

Our prototype system does a fairly simple search for links on a page. In particular, it looks for all the anchor (A) tags in the page. While this strategy works for most pages, it does not work for pages in which the links are generated on the client by Javascript or other scripting language. We are currently considering mechanisms for extracting such links and debating the tradeoffs (for example, interpreting a script will take additional time, making the system slower).

6 Conclusions

While links make hypertext hypertext, they are increasingly difficult to identify in many modern Web designs. In addition, the HTML standards that permit richer links are insufficiently supported by browsers. In this paper, we have suggested that a relatively simple mechanism, a link summary automatically generated for each page viewed, can increase the usability of modern Web pages and better support both readers and authors.

7 Future Work

As we suggest above, we hope to extend the system for provide additional information about the destination of each link. In its simplest form, this additional information can include the title of the page and the size of the destination page. However, it might also be useful to provide additional information about the destination, such as the author (if available) and even a summary.

Our prototype system was built as a basic proof of concept. In the near future we plan to begin some more careful user testing to see whether readers take advantage of link summaries and whether there are ways to make them more useful. We also hope to investigate what aspects of link summaries readers want to customize.

Because our link summary system appears to modify pages, we are also working to consider the intellectual property ramifications of the system. We are hoping to build on the work of the Web Raveler team in this direction.

References

Berners-Lee, T., Cailliau, R., Luotonen, A., Nielsen, H.F., and Secret, A. (1994). The World-Wide Web Communications of the ACM August 1994 Vol. 37, No. 8, pp. 76-82.

Fuller, G., Simonson, J., Tiwari, A., and Rebelsky, S. A. (2002). Clio's Assistants: A Tool Suite for Exploring Student Web Usage. Accepted to the EdMedia 2002 World Conference on Educational Multimedia, Hypermedia, and Telecommunications (June 24-29, Denver, Colorado).

Kensler, A. and Rebelsky, S. A. (2000). Web Raveler: An Infrastructure for Transforming Hypermedia. In J. Bourdeau and S. Heller (Eds.) *Proceedings of the EdMedia 2000 World Conference on Educational Multimedia, Hypermedia, and Telecommunications* (June 26-July 1, 2000, Montreal, Quebec, Canada), pp. 479-484. Charlottesville, VA: AACE, 2000.

Landow, George P. (1997). *Hypertext 2.0: The Convergence of Contemporary Critical Theory and Technology*. Baltimore, Maryland: The Johns Hopkins University Press.

Nielsen, J. (1996). Top Ten Mistakes of Web Design. Alertbox (monthly column), May 1996. Online document at <http://www.useit.com/alertbox/9605.html> (Visited 19 December 2001, Last modified 18 November 2001).

Nielsen, J. (1999). Using Link Titles to Help Users Predict Where They Are Going. Alertbox (monthly column), January 11, 1998. Online document at <http://www.useit.com/alertbox/980111.html> (Visited 19 December 2001, Last modified 25 August 2001).

Nielsen, J. (1999). "Top Ten Mistakes" Revisted Three Years Laters. Alertbox (monthly column), May 2, 1999. Online document at <http://www.useit.com/alertbox/990502.html> (Visited 19 December 2001, Last modified 25 August 2001).

Raggett, D., Le Hors, A., and Jacobs, I. (Eds.) (1999). HTML 4.01 Specification. Online document at <http://www.w3.org/TR/1999/REC-html401-19991224/> (Visited 19 December 2001, Last Modified 13 March 2000). World Wide Web Consortium (W3C) 24 December 1999.

Trigg, R. (1983). A Network-Based Approach to Text Handling for the Online Scientific Community. Ph.D. Thesis, University of Maryland. Chapter 4 available online at <http://www.workpractice.com/trigg/thesis-chap4.html> (Visited 19 December 2001, Last modified 13 July 2001).

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Internet as an Ideal Technological Tool for Multicultural Education

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Abstract: This brief paper will report the process and results of a website for multicultural education being developed by international graduate students from MU. The resources on this web site have important implications for educational technologists who wish to make instruction more responsive and effective for learners with diverse backgrounds. The web site includes four components: a discussion forum, opportunities to meet Korean children and read their stories, literacy lesson plans using tri-lingual multimedia stories, and research papers.

Multicultural Education and the Internet

As the United States continues to become more ethnically diverse, the composition of the U.S. classroom is changing. Teachers are encountering students from other cultures whose worldviews, motivational levels, and learning styles are substantially different from those of most teachers and native-born students. Teachers should be prepared to meet the educational needs of ethnically and culturally diverse students (Gay, 1997). Experts in the field of multicultural education recommend specific competencies that will empower teachers to create a learning environment that encourages and supports the academic achievement of students from diverse racial and ethnic groups. In addition to developing positive attitudes and behaviors toward culturally different children, teachers are expected to be able to:

- Understand the learner characteristics that children from different cultural backgrounds bring to the teaching/learning situation which may affect the quality of learning; and
- Create, select, and use appropriate instructional strategies, pedagogical techniques, and materials to accommodate the learner characteristics (Sheffield, 1997).

As educational technologists, we believe that these expectations can be reached through the application of educational technology. The Internet can be an ideal technological tool for multicultural education. In addition to the enormous amount of information available on the Internet, the Internet has the potential to network and interact with people (Gorski, 1996). The Internet can support several educational ideals consistent with multicultural education: Inclusive education, Collaborative education, and Interactive education (Gorski, 1996)

Designing a Website for Multicultural Education

The web site being developed is an example that models multicultural ideals. It is a sample of interactive, inclusive, and collaborative media for multicultural education. The web site consists of four parts: discussion forum, meet the children, literacy lesson plans, and research reviews.

Discussion Forum

This web site offers a discussion forum, for students to email teachers or other students to ask for more information or clarification on a particular topic. A vast of network of teachers and students around the world and across myriad cultures could share questions and exchange resources on a given topic. According to Garnsey and Garton (1992), the discussion forum, as a form of CMC (Computer-Mediated Communication), solves the constraints of time and space to those geographically dispersed organizations that are looking forward to communicating with each other. It also allows teachers to share resources and discuss their teaching successes and failure, which is an excellent model of collaborative media for multicultural education. This is a sample of the interactive learning environment made possible by the Web. Another use of the discussion forum is to provide an authentic use of language through for communication. Some educational theorists suggest that authentic tasks are very important for students, as they enable students to learn meaningfully and purposefully (Brown, Collins & Duguid, 1989).

Meet the Children

Inclusivity is another important notion in multicultural curriculum transformation (Gorski, 1996). If education is truly to be student-centered, then the experiences, perspectives, and ideas of the students themselves must be brought to the fore. To be "included" in the educational process, students must be given opportunities to have their voices heard and to hear each other's voices, which are prerequisite to student-student interaction and cooperative learning. The Internet can facilitate this kind of Inclusivity by encouraging teachers and students to participate in virtual global communities with other teachers and students who may be either very culturally similar or different. This web site offers the opportunity to meet Korean children who want to share their experience and writing with other students around the world. Writing samples by the children are included.

Literacy Lesson Plans

The web site describes an innovative multimedia story-writing project with elementary children in an ESL classroom. The children wrote and illustrated multicultural stories and then worked with international graduate students to transform the stories into interactive multimedia stories in three languages. A sample story is included and a variety of lesson plans for literacy development in ESL are provided.

Research Reviews

The web has the potential to greatly expand the breadth and depth of collaborative possibilities of educators (Gorski, 1996). Five research papers are being provided: multicultural education, globalization, literacy development, technology-writing and publishing on the web, and TESOL. In this web site, research findings will be compiled to share resources on multicultural education and tips for teachers on how to make a learning environment effective based on research.

Importance of the Work

The resources on this web site have important implications for educational technologists who wish to make instruction more responsive and effective for learners with diverse backgrounds. The web site should have positive implications for training pre-service and in-service teachers in multiculturalism and provide a resource site for teachers and children.

References

Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Research, 18*(1), 32-42.

Garnsey, R., & Garton, A. (1992, September). *Pactok: Asia Pacific electro-media gets earthed*. Paper presented via the Adult Open Learning Information Network Conference, Australia.

Gay, G. (1997). Multicultural infusion in teacher education: Foundations and applications. *Peabody Journal of Education, 72*(1), 150-177.

Gorski, P. (1996). Multicultural pavilion. *Multicultural education and the internet: Tools resources, and commentary.* Retrieved March 22, 2002, from http://curry.edschool.virginia.edu/go/multicultural/net/guide.htm

Sheffield, C.J. (1997). Instructional technology for teachers: Preparation for classroom diversity. *Educational Technology, 17*(2), 16-18.

Knowing Who We Are – Supporting Companion Awareness In Discussion Forums

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Abstract: In this paper we describe how learners need awareness information about co-learners in computer-supported collaborative learning systems. Awareness is essential for working collaboratively and for building a learning community. If the learner doesn't know anything about his/hers co-learners, there can't be any community, which means that there can't be any real collaboration either. In this paper we first describe a theoretical background for our research after which we introduce one possible solution to solve the demands for awareness in a Web-based conferencing systems. We also present our initial implementation of awareness support and report experiences from a course using the system.

Introduction

In many cases Web-based learning environments are used asynchronously, which obviously gives freedom of time and place for learners. But when a learner logs into the system, it is very hard for him/her to know if there is someone else present at the same time or even ever have been. Most of these asynchronously used Web-based learning environments include some kind of discussion forum. In these discussions a learner can find co-learners who have made comments and make conclusions that he/she is not alone, but especially co-learners who are only reading comments are quite invisible. Thus learners come visible only through their contributions, which can lead to wrong conclusions about the state of the discussion. Ongoing discussion might even look like a dead discussion because learners are only reading. That is why it is reasonable to give information about their visits to other learners. This information can enhance learner's awareness of co-learners and their interactions, which are essential especially for collaborative learning (Dillenbourg 1999). It even can be argued that otherwise there will not be any chances to collaborate. This awareness can inform learner that co-learners are interested in each other's contributions and can be in important role in community building. A learner must receive information, which could include who the other learners are, what they have done and what they are doing now. If learners are aware of who are the ones to collaborate with then it is possible to start building a community for learning. In this paper we consider how the technology can support collaborative learning by providing awareness information (see also Jermann et al. 2001).

First in this paper we describe a theoretical background for the research and after that we introduce one possible solution to solve these demands for awareness in Web-based conferencing systems. We present our implementation and report experiences from our experiment. Finally we make conclusions of the work we have done.

Collaborative learning and community building

Learners' work and learning in online learning environments can be seen at its best as collaborative learning. Learners are working together and building new knowledge by reflecting their thoughts with others. However, collaborative learning is a difficult concept in practice. According to Dillenbourg (1999), the words 'collaborative learning' describe a situation where particular forms of interaction among people are expected to occur. This interaction can trigger specific learning mechanisms and finally lead the participants to learn.

Dillenbourg (1999) classifies four categories in which there are different ways to increase the probability that some type of collaborative interactions will occur. These categories are:

- to set up initial conditions,
- to over-specify the 'collaboration' contract with a scenario based on roles,
- to scaffold productive interactions by encompassing interaction rules in the medium, and
- to monitor and regulate the interactions.

With reference to this categorization our work emphasizes the fourth category. Also, as an alternative to the tools for the teacher to monitor the learners, we provide tools for the learners themselves for self-regulation of their interactions. These tools offer information about community's members and their interactions, which can be used by the learner to maintain the awareness of the state of the community. In collaborative processes this information about other learners could really help. Especially in asynchronous learning environments this kind of awareness information would be helpful for interacting with other learners.

Because learners are, in most cases, inside the environment at different times this awareness information would help to keep discussions alive. A learner can check from awareness information if other learners have been inside the system and read their comments. In this way a learner can have more clearly expectations when the discussion is going to continue.

For working collaboratively is also necessary to build some kind of community. Or more clearly, if group of people are working, or in this case learning, collaboratively there is a community. That's why, because communities are everywhere (Wenger 1998). It's important to realize that these communities don't have to agree in issues, which they are dealing. Arguing, as well as discussions, agreeing and so on, is common for the communities.

Informal information about others is also good for community building. It supports especially the social aspect of the community. Nardi et al. (1998) were surprised how well a chat facility supported community building. It was especially its informal and social features that are valuable for community building.

Companion Awareness

Like collaborative learning, awareness is also a notion, which is hard to define precisely. It has lot of different aspects and it can be classified by many different ways (Liechti 2000). Definition of the awareness is depending of the context of the use and also of the characteristics of the system. In this paper we are exploring new opportunities, which the awareness can provide for asynchronous discussion forums.

Gutwin, Stark & Greenberg (1995) have defined a framework of awareness. In this framework they distinguish social, task concept and workspace awareness. Especially they focused on workspace awareness, which is essential for students to learn and work together effectively. Workspace awareness is information, which describes who is participating to the work, where are they, what have they done and what are they doing. Their focus was on the synchronous learning environments but their conclusions about awareness are valid also in the asynchronous environments.

Jermann et al. (2001) have defined another framework, which describes capabilities of tools to support collaborative interaction. In this framework they set awareness features in learners locus of processing. This means that awareness support gives information to the learner, but it depends on the learner how the information is interpreted or understood. Because of that awareness features should be quite simple and the given information should be easy to understand.

Awareness information can help collaborative learning especially in the community building. When a learner knows which other persons belong to the group, he/she can have a feeling of belonging to the community. This belonging strengthens the community and makes interactions easier. The benefits of awareness are more obvious in synchronous systems, but we believe that these benefits are important in asynchronous learning, too. Our focus is to support learners' collaborative work with awareness of their co-learners. In asynchronous collaborative learning systems this awareness information should include the following:

- information which helps to identify co-learners,
- information which supports social aspects of the community, and
- information which shows the usage of the system.

We use the notion, *companion awareness*, to describe this kind of awareness information.

Dyn3W – Learning environment

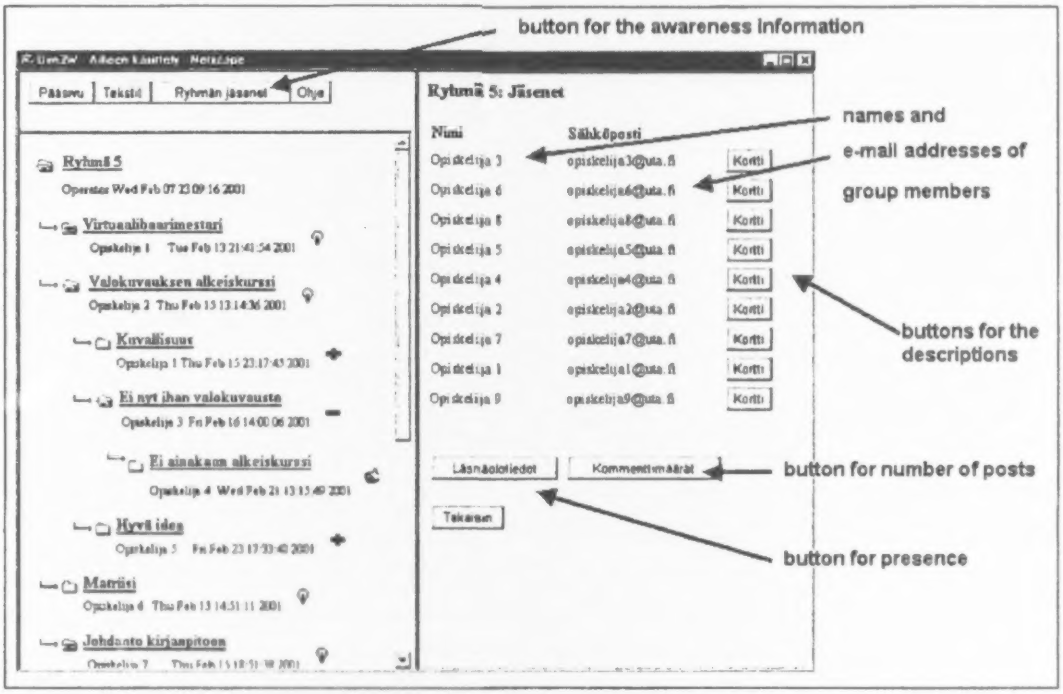
In our courses at the University of Tampere we are using Dyn3W learning environment. It is a product of project called CoWoGLe (Conferencing on the Web for Group learning), which have been going since 1996. (Hietala et al.

1997). The system has been in use on several courses and more than 1000 students have been using it over the years.

The main part of our Dyn3W system is a discussion forum. The discussions are threaded (figure 1) and because the system is using frames, it is possible write a comment and read old comments concurrently. The system keeps record of each user's usage. It also counts comments. Students are divided in groups and they working in these groups with same assignment.

New awareness features

In our system the learners are working together in small groups and they have to make a decision, which they present to the other groups. Without any awareness about the other group members this group work is difficult, especially the decision-making is hard. That's why we implemented awareness support for learners. These new awareness features include information about who group members are, what they have done and when they have been inside the system. For learners it is also possible to give an informal description of themselves. This was designed for supporting the informal aspect of communication. It is also one way to support group's community building, which is important in learning relationships (Wenger 1998).



Ryhmä 5
Operator Wed Feb 07 23:09:16 2001

Virtuaalibaarimestari
Opiskelija 1 Tue Feb 13 21:41:54 2001

Valokuvauksen alkeiskurssi
Opiskelija 2 Thu Feb 15 13:14:36 2001

Kuvallisuus
Opiskelija 1 Thu Feb 15 23:17:43 2001

Ei nyt ihan valokuvausta
Opiskelija 3 Fri Feb 16 14:00:06 2001

Ei ainakaan alkeiskurssi
Opiskelija 4 Wed Feb 21 13:15:49 2001

Hyvä idea
Opiskelija 5 Fri Feb 23 17:33:42 2001

Matriisi
Opiskelija 6 Thu Feb 15 14:51:11 2001

Johdanto kirjanpitoon
Opiskelija 7 Thu Feb 15 18:51:38 2001

Ryhmä 5: Jäsenet

Nimi	Sähköposti	
Opiskelija 3	opiskelija3@uta.fi	Kortti
Opiskelija 6	opiskelija6@uta.fi	Kortti
Opiskelija 8	opiskelija8@uta.fi	Kortti
Opiskelija 5	opiskelija5@uta.fi	Kortti
Opiskelija 4	opiskelija4@uta.fi	Kortti
Opiskelija 2	opiskelija2@uta.fi	Kortti
Opiskelija 7	opiskelija7@uta.fi	Kortti
Opiskelija 1	opiskelija1@uta.fi	Kortti
Opiskelija 9	opiskelija9@uta.fi	Kortti

Figure 1: View from small group working area

A view from the small group's working area is shown in figure 1. In the left frame discussion tree is shown. Above that there is the button bar, which includes a button for the awareness information. This awareness information is shown in the right frame, which normally is used for reading comments from the discussion and writing new comments to the discussion.

In our implementation the learner can see him/herself as one of the members on the list of the group. Another way in the implementation could be that he/she is removed form lists and information is only about other group members. In this case it is more difficult to learner compare him/herself to others. Showing the current user also in those group listings makes it clearer that the user is a member of the group. He/she can see that he/she is in the same position with others. Also comparing oneself to others comes very easy (on right in figure 2).

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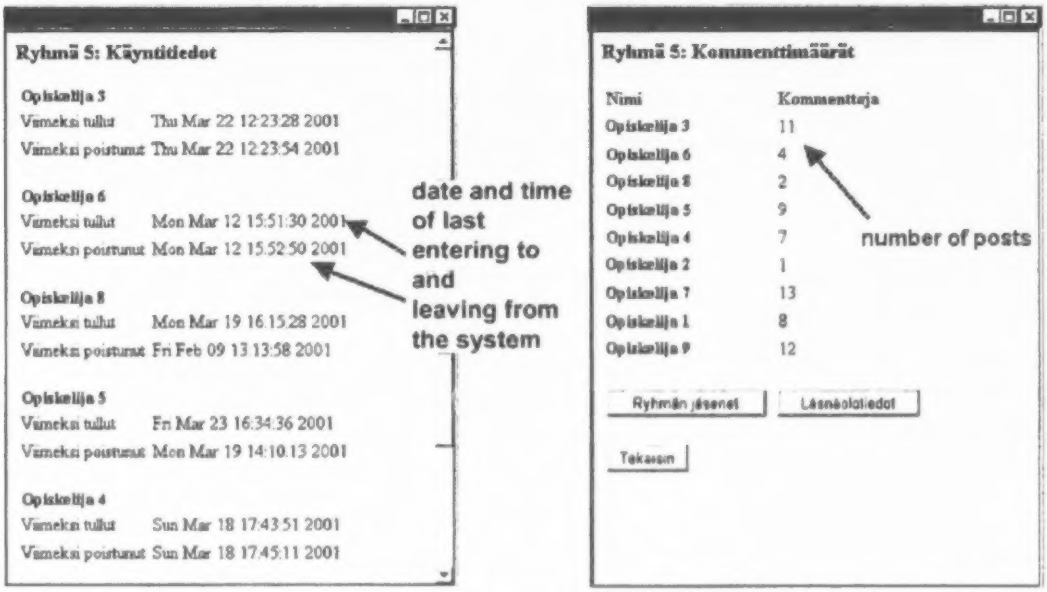

Ryhmä 5: Käyntitiedot

Opiskelija 3
Viimeksi tullut Thu Mar 22 12:23:28 2001
Viimeksi poistunut Thu Mar 22 12:23:54 2001

Opiskelija 6
Viimeksi tullut Mon Mar 12 15:51:30 2001
Viimeksi poistunut Mon Mar 12 15:52:50 2001

Opiskelija 8
Viimeksi tullut Mon Mar 19 16:15:28 2001
Viimeksi poistunut Fri Feb 09 13:13:58 2001

Opiskelija 5
Viimeksi tullut Fri Mar 23 16:34:36 2001
Viimeksi poistunut Mon Mar 19 14:10:13 2001

Opiskelija 4
Viimeksi tullut Sun Mar 18 17:43:51 2001
Viimeksi poistunut Sun Mar 18 17:45:11 2001

date and time of last entering to and leaving from the system

Ryhmä 5: Kommenttimäärät

Nimi	Kommentteja
Opiskelija 3	11
Opiskelija 6	4
Opiskelija 8	2
Opiskelija 5	9
Opiskelija 4	7
Opiskelija 2	1
Opiskelija 7	13
Opiskelija 1	8
Opiskelija 9	12

number of posts

Figure 2: Views of awareness features. Presence information (on left) and number of posts (on right)

We hope that this would encourage learners to work harder. Because they can easily see how much work other group members have done, they might want to do likewise. Of course this can also lead learner to be lazy, because he/she is not only one. This problem could be solved with forced requirements, which seem to be good way to get discussion going (Sorenssen & Takle 2001).

The awareness features included also information about group members' presence in the system. This is implemented by telling which time each group member has logged in and out of the system (on left in figure 2). It could be implemented also so that system just tells who is inside and who is outside the system. But we wanted to show learners more detailed information about each group member's visits to the system.

Experiment and results

Dyn3W- system with the new features was in use on Computer-Aided Instruction course at Spring 2001. The course had 74 participants. In this course, which includes also lectures, exercises and two group projects, the assignment for working in Dyn3W- system was to collaboratively produce a short description for a good online course. For that students were randomly divided into eight groups. Four of these groups had the awareness support and four did not have this support in the conferencing system. This means there were 36 learners with support and 38 without. Because of that, we can find out different groups' usage of the system and compare if there is any difference e.g. in discussion activity. Participants used the system for a quite short period, which lasted only 4 weeks.

These new awareness features weren't introduced or explained to the learners during lectures or exercises. We did this because we wanted to find out if the users could find these tools by themselves and how they would be using those tools. In this way we can explore if learners find ways to use them and how many times they are using them. Introducing these tools just for part of participants would also be quite difficult. Introduction would also lead learners to use tools in a particular way that the teacher is thinking to use it.

As we can see in Table 1, the new awareness did not encourage our students to produce more comments than in the groups without the features ($6.8 < 8.2$). However, if we look a little bit closer to the data, we can find an interesting issue. It was compulsory for all participants to produce at least one comment (new course suggestion) in the group. If we consider those who produced more than only this one compulsory comment, we find that there were more students who stayed and participated in the discussions in the awareness support groups than in those without the support ($29 > 28$). In groups without the awareness features 26,3 % of learners made just that required comment, but in groups with the awareness features the same percentage was only 19,4. This gives a weak evidence for the

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usefulness of the awareness tools. Learners with the features also had more sessions than learners without the features.

	The awareness features	
	With	Without
Participants	36	38
Sessions by average	16,5	14,7
Comments by average	6,8	8,2
Participants working more than compulsory	29	28

Table 1: Comparing the two learner groups

Most of the learners used the new awareness features at least once (Table 2). This means that most of the learners found these features easily. Most of them were using all of the features. Many learners liked to read other learners self-descriptions but they didn't give a description of themselves. As we see in Table 1, learners using the awareness features had 16,5 sessions by average and they used awareness support during 4 different sessions (Table 2).

Used the awareness features at least once	33 learners
Read other users descriptions of themselves	25
Wrote description of themselves	5
Were interested in the "presence" information	29
Were interested in the number of posts	29
Sessions where using awareness by average	4 sessions

Table 2: Usage of the awareness features

Conclusions

According to the preliminary results we got from experiment it's quite fair to say that learners were at least very interested in getting companion awareness information. The fact that learners did use awareness features quite often but not in every session, supports that conclusion.

Participants took part in the discussions as much as it has been common in this course in earlier years. So the awareness features didn't have effect for participation in way we were expecting. Duration of the online exercise might also have effects. Four weeks period is quite short, which makes the learners focusing to the task and leaving social aspects to background. On our course learners could also meet other learners at the lectures twice a week, on the campus site and so on, which probably effected also to the need of awareness information. The awareness features can be more valuable for an online course where learners are physically distributed.

Typically on every course, traditional or online, there are learners that don't want to do more than they have to. We got weak evidence that with the awareness support for the learners we can downsize the number of this kind of behavior of learners. Somehow the awareness features seemed to get more learners to be involved to the work of community. This might mean that learners are more motivated for the course and therefore are working harder, which would hopefully lead to the better grades and learning.

We also found out that learners are interested in all kind of awareness information, but they are not ready to take extra effort for making others aware about themselves. This can be seen from the interest of other learners' descriptions. Somehow it's surprising that the learners didn't make a self-description after they have read other learners self-descriptions. Nardi et al. (1998) have made same kind of observation with personal Web pages in an online course.

Future work

In the near future we are going to rearrange the experiment we have discussed in this paper. Especially we want to get more evidence for the finding that those learners with the awareness features were more active than was compulsory. We are also going to make some improvements to our system. We are going to highlight buttons for learner self-descriptions after the description have been done. We hope that this way the learners will not get tired with this feature, because now they can know from the button if their co-learners have made their self-description. We are also considering ways to encourage learners to writing their own descriptions.

It is also possible to give learners more or even better awareness information. One possible way to do that would be information about the reading times and the readers of each posting (along the lines of the BSCW system (Appelt & Mambrey 1999)). This means that learners should be able to see who have read their postings. So if learner makes a new posting, he/she can check later who has read it or hasn't read it. In this way learner can be more aware about ongoing discussion. In this case questions about privacy have to be considered too. Is it fair to the learners to provide so detailed information about their usage of the system for their co-learners? If it is done openly, it might also encourage learners to use the system more and hopefully in the meantime learn more in collaboration with others. We are planning to include these awareness features into our discussion forum.

In our experiment there were also peer groups without awareness support. If we in the future compare more carefully these groups with those with awareness support, we can maybe find out more detailed knowledge of usefulness of supporting awareness. A problem with that kind of analysis is the short time of usage of Dyn3W system on that specific course. The awareness features are probably more useful in longer lasting usage of online learning environment. One possible way to get analysis little bit further is to evaluate the quality of different groups' proposals and find out if there is any difference and what might be the reasons for them. This is one of the issues that we are planning to focus in our future research.

References

Appelt, W. & Mambrey, P. (1999). Experiences with the BSCW Shared Workspace System as the Backbone of a Virtual Learning Environment for Students. Proceedings of the World Conference on Educational Multimedia, Hypermedia and Telecommunications ED-MEDIA 99, Seattle, June 1999.

Dillenbourg P. (1999) What do you mean by collaborative learning?. In P. Dillenbourg (Ed.), *Collaborative learning: Cognitive and Computational Approaches.* (pp.1-19). Oxford: Elsevier.

Hietala, P., Niemirepo, T. & Ovaska, S. (1997), Using the World Wide Web to promote educational discussion on university level courses. Proceedings of IFIP 3.3 and 3.6 Joint Working Conference "The Virtual Campus: Trends for Higher Education and Training", Madrid, Spain. Chapman & Hall, 169-183.

Jermann, P., Soller, A. & Muehlenbrock, M. (2001). From Mirroring to Guiding: A Review of State of the Art Technology for Supporting Collaborative Learning. In proceedings of first European Conference on Computer-Supported Collaborative Learning, Euro-CSCL 2001. Maastricht, The Netherlands.

Gutwin, C., Stark, G. & Greenberg, S. (1995). Support for Workspace Awareness in Educational Groupware. Proceedings of the CSCL 1995, Indiana University, Bloomington, IN.

Liechti, O. (2000). Awareness and the WWW: an Overview. *ACM SIGGROUP Bulletin,* December 2000, vol. 21, 3, 3-12.

Nardi, B., Reilly, B., Steinbeck, R. (1998). An online digital photography course for high school teachers. Proceedings of the ED-MEDIA 1998 conference, Freiburg, Germany. AACE.

Sorensen, E. K. & Takle, E. S. (2001). Collaborative Knowledge Building in Web-based Learning: Assessing the Quality of Dialogue. Proceedings of the ED-MEDIA 2001-World Conference on Educational Multimedia, Hypermedia & Telecommunications. Tampere, Finland, AACE.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning and Identity.* Cambridge: Cambridge University Press.

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Design and Development of a Flexible Online Course for Making Accessible Online Courses

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Abstract: The design rationale for the development of an exemplary, flexible online course for making accessible online courses is described. We developed the course by adopting the roles of content expert and instructional designer. The course has a dual purpose; the assessment for postgraduate students provides a guide to learning for academic staff development. The design and development process included the formulation of learning outcomes, assessment criteria and strategies, learning methods, and the alignment of these. The learning strategies included a variation of the cognitive apprenticeship model that was refined following feedback from prototype face-to-face workshops. Learner-centred design is fundamental and includes: high contrast text and background; no unnecessary graphics or icons; tips for people using assistive technology; avoiding the use of PDF; direct links to other course areas; text transcript for online videos; and easy access to resources for learning activities.

Project Initiation and Rationale

The production of guidelines for making online courses accessible (Pearson and Koppi, 2001), lead to considerations of developing an online course for making accessible online courses. Because the authors are at different universities, in different fields with different 'clients', the nature of the course had to be negotiated. Pearson (at the University of Teesside, UK) teaches postgraduate students and the desired accessibility module would be part of an MSc in Multimedia Design. Koppi (at the University of New South Wales, Australia) is involved with academic staff development and the course would have to help teaching staff to produce their own accessible online courses (using WebCT at UNSW).

The project development proposal had to include a rationale stating that the intended course would have the dual purpose of an MSc component and a staff development purpose. This was to prove problematic, particularly where assessment was concerned. The project proposal was based on constructivist learning principles and was structured to include learning activities, dialogue and collaboration, and student support. We decided to adopt the roles of content expert (Pearson) and instructional designer (Koppi) to help us include the essential perspectives in courseware development. The structure of this paper describing the design and development of the course is based on an instructional design plan.

We realised that the course itself would have to be an exemplar of accessible course design. We would have to ensure that it would be accessible to people with disabilities. We intended to employ the services of an experienced student who is blind, and is a regular Internet user, to assist us with identifying the capabilities of assistive technologies, and with checking the accessibility of the course. We also intended to use the checking tools provided by Bobby (CAST, 2001), DreamWeaver 4, and our own Guidelines (Pearson and Koppi, 2001) to check for accessibility.

Formulation of Learning Outcomes

Following instructional design principles (Biggs, 1999a and b), the aims, objectives and learning outcomes were formulated first, and the learning outcomes, which are concerned with what the student will be able do, are given as follows.

"On successful completion of this module the student will be able to:

1. Discuss the issues relevant to access for people with disabilities to online learning.
2. Demonstrate skills in the use of relevant guidelines and accessibility checking mechanisms.
3. Describe the use and application of assistive technologies.
4. Describe the needs of the learner in the design of accessible online courseware.
5. Demonstrate skills in the design and development of accessible and inclusive online courseware.
6. Analyse barriers to accessibility in existing web sites and online courses."

Assessment Criteria

The assessment criteria are concerned with measuring how well the students have achieved the learning outcomes; they were formulated for each learning activity designed to produce the desired learning outcomes. For example, for the learning outcome concerned with the task investigating the guidelines based on those developed by the Web Accessibility Initiative (WAI), part of the World Wide Web Consortium (W3C), the assessment criteria together with relevant information are given as:

"If you are being assessed for this course, your portfolio contribution for this activity will be assessed according to the following criteria. If you are carrying out this task out of interest or for your personal development, the criteria can be used as a checklist for your own learning.

1. The extent to which you have considered the purpose and the extent of the activities of W3C and WAI.
2. Your analysis if the applicability of W3C guidelines for accessible web site design to the average non-technical academic developer.
3. Evidence of research and understanding of the nature of other guidelines.
4. Quality of the overall presentation and coherence of the posting and additional links.
5. The quality and coherence of your contribution to the discussion of this topic.
   Marked out of 100% with 20% for each element."

As indicated above, this online course has a dual purpose (part of a postgraduate degree and for staff development), and so the assessment criteria can be used in different ways. The criteria can be used for summative assessment (portfolio) in the case of the students, and as a learning guide in the case of teaching staff learning about accessibility. The students can also use them as a learning guide because the assessment criteria are provided with each learning task.

Assessment Strategy

Types of Assessment

The assessment strategy is concerned with the methods of assessment that are best suited to the students demonstrating that they have achieved the learning outcomes. There are many ways of assessing learning and McLoughlin and Luca (2001) note that there are three types of assessment:

- **Cognitive** : thinking, knowledge, application and understanding of principles, concepts
- **Performance**: demonstration of skills and abilities, complex task performance
- **Portfolios**: evidence of complete student record, tasks, achievement, examples of work etc.

Of course, these three types are not exclusive, e.g., a portfolio would include evidence of cognitive and performance attainment. For academic staff undergoing staff development in inclusive courseware design, and for postgraduate students learning about courseware design, the most appropriate types of assessment would be performance and portfolios since we would want to see practical examples of work as evidence of learning and application of inclusive and accessible principles.

The portfolio is used as half of the assessment and is described as follows.

"You should develop a portfolio by posting to the Student Presentations area or your personal topic area in the discussion forum, to demonstrate understanding of issues related to disability, including:

1. The Disability Discrimination Acts and their effect on education and online learning.
2. Review of current guidelines and their usefulness for academic developers.
3. Review of assistive technologies.
4. Accessibility checking tools, their use and application, reviews of good/bad examples of websites.
5. Design methods and tools for creating accessible documents and courses.

This assessment will take place throughout the module and will be directly linked to the activities you undertake through the course."

The other half of the assessment is concerned with the students or staff either (a) creating or modifying an accessible and inclusive course based on their own subject expertise, or (b) redesigning a given course (especially prepared from common practices) which does not meet accessibility requirements. Participants have the option of working in groups or as individuals in carrying out the tasks.

Authentic Assessment

In addition to the learning outcomes, assessment criteria and assessment strategies being aligned, the assessment tasks should also be authentic. Herrington and Herrington (1998) in their review of authentic assessment provide descriptors such as: situated, practical, realistic, performance-based, real-world, and ill-structured. The use of real-world learning environments enables the same activity to be used for learning and assessment (Herrington and Oliver, 2000). For example, the assessment of how well teachers are able to design and develop an accessible online environment is their production of an accessible online course or their redesign of an inaccessible course, as described above.

In the real world, work is often collaborative in nature and authentic tasks should include collaborative activities wherever possible (as in this course). If well designed, collaborative work can enhance the learning experience and the social negotiation that promotes higher order thinking (Herrington and Oliver, 1999). In the course, discussion topics are used to facilitate collaboration and the presentation of alternative viewpoints.

Learning and Teaching Strategy

The learning and teaching strategy is concerned with the methods will best help students achieve the learning outcomes. Having formulated the learning outcomes and assessment strategy and criteria, it follows that the learning tasks should be considered and that they should all be in alignment. This section presents a rationale for the learning tasks employed.

Cognitive apprenticeship model

The cognitive apprenticeship approach (Brandt *et al.*, 1993), when coupled with participation in the community of practice (Lave and Wenger, 1991) and authentic problem-based learning (Savery and Duffy, 1995; Grabinger and Dunlap, 2000), can provide an authentic situated learning experience that bridges the gap between abstract theory and effective practice (Herrington and Oliver, 2000). With respect to designing accessible learning environments, the intention is for the teachers to apply the theory in their everyday practice and not to treat it only in the abstract. Learning, online or otherwise, can be facilitated by the use of scaffolding (support) in a social constructivist setting (Roehler and Cantlon, 1997).

We decided to adapt the five stages of the cognitive apprenticeship model (Brandt *et al.*, 1993) as follows.

Phase 1 We elected to present the expert perspective through an interview (Koppi interviewed Pearson) which was filmed and converted to streaming video. The five major issues (as identified in the learning outcomes) and expert considerations were discussed (Pearson and Koppi, 2002). The video sets the scene for the five learning tasks corresponding to the first five learning outcomes.

Phase 2 Working in groups, the participants carry out the learning activities and discuss their findings and conclusions.

Phase 3 As an authentic activity, the participants apply what they have learned to the design and construction of their own online learning environment (e.g., using WebCT) or to the redesign of an existing problematic one already prepared by us.

Phase 4 The learners continue developing their websites in their own time and check that their sites conform to acceptable standards (e.g. by using the Bobby and DreamWeaver software). Postgraduate students carry out the assessment already detailed – redesign of inaccessible course or design/re-design a proposal for their own course or web site.

Phase 5 The learners may each reflect on what they have learned and describe general principles for developing accessible online learning environments. Students illustrate their learning by creating a portfolio of their accessible designs and implementations that contribute to their assessment. Academic staff could organise and facilitate a workshop in their own department or school.

Face-to-Face Workshop Prototypes

We developed face-to-face workshops on accessibility for academic staff, with the intention of using the workshop tasks as prototypes for the online tasks. The workshops enabled us to see how the learning tasks worked, how long they took, what the problems were, and to obtain feedback from the participants. We modelled the workshop along the lines of the online course: orientation introduction, activities, reporting back, with support from the workshop facilitator. We were in effect doing evaluation of the intended online tasks in advance.

The results of the workshop experience enabled us to refine activities for the online course, mainly by adding more support and tasks to provide a background and orientation to the issues of learner-centred design. We also realised how much more valuable an online course can be than an ephemeral face-to-face workshop which disappears without visible trace. The online course can be revisited and re-examined after further learning or application of learning has occurred. Fleeting ideas in a workshop, too soon gone because of the pace, can be explored in the online course. The advantages of face-to-face though cannot be denied – the time commitment is made and colleagues are there on hand for immediate discussion, however brief. It seems that commitment to an online course can be problematic for busy people because it is too easy not to set the time aside (Forsyth, 2001).

We also utilised the services of Darren Fittler, a law student who is blind, and an experienced Internet user. This proved to be a highly engaging time for the workshop participants. Darren was a first-time user of WebCT and went through his allotted tasks (of which he had no prior information), speaking his thoughts out loud, and that gave a powerful message with respect to learner-centred design. We felt we had to capture that and incorporate it into the online course. He was later videoed going through it all again in a studio setting. If we had not had the experience of the face-to-face workshop with Darren we would probably not have thought of including him online.

Multipurpose Course Design

The issue of the dual purpose of the online course (part of a postgraduate degree, and staff development), and its effect on the inclusion of assessment strategies, was resolved essentially by giving the assessment criteria different purposes. For academic staff, doing the course out of interest or personal development, the assessment criteria can be used simply as a guide to learning. This obviated having to develop two separate courses, one with and one without assessment. Extra instructions and clarification had to be repeated for every activity page on the website because the course can be dipped into at any place by staff and being confronted with unexpected assessment may prove a barrier to engagement.

Design Features of the Online Course

Since learner-centred design is a core concern of the online course, some of those design features are noted here.

- The Home page has text and icon (with alt-tags) links to all the important elements of the course.
- High contrast text and background are used throughout, and no unnecessary graphics or icons are used.
- On the Home page there are tips for accessibility, e.g., for people using a screen reader to hide the left navigation bar which adds unnecessary complexity to the page.
- The tip also includes a link to downloading the Adobe Acrobat Reader 5 to enable suitably formatted PDF documents to be read by a screen reader.
- The use of PDF has been avoided wherever possible, or alternative formats have been provided.
- The Welcome page provides tutor contact details, describes the course, its rationale, the activities, assessment portfolio, and invites constant feedback/evaluation of the course.
- The aims, objectives and learning outcomes are visible from the Home page.
- A link to other parts of the course is provided wherever they are mentioned, and that link opens in a new window to enable easy return (closing the window).
- Links are provided directly to any particular discussion topic rather than just to the discussion area which would require further searching to find the specific relevant topic.
- A schedule is provided of tasks, their content, deliverables (particularly if the course is assessable) and an indication of how much time should be allocated to each task. This time allocation is a suggestion only in that personal interests and different learning styles will result in different times being spent on the tasks.
- An orientation activity is provided for easing new online learners into the environment, and to enable course participants to meet each other and to comment on each other's interests. Practice is also provided in uploading a file to the student presentation area, with tutor contact details immediately to hand in case of difficulties.
- Each of the activities is developed as self-contained (to minimise searching other documents for relevant information) with introduction, task, reporting, discussing, assessment criteria (for those being assessed), and resources being provided.
- A direct link to assessment is also provided on the Home page.
- A link to resources, including links to relevant free software downloads, is available from the Home page.
- The videos include either subtitles or a text transcript.

References

Biggs, J. (1999a). What the student does: teaching for enhanced learning. *Higher Education Research and Development*, 18, 57–75.

Biggs, J. (1999b) Formulating and Clarifying Curriculum Objectives. In *Teaching for Quality Learning at University: What the Student Does*, Society for Research into Higher Education & Open University Press.

Brandt, B. L., Farmer, J.A. and Buckmaster, A. (1993) Cognitive apprenticeship approach to helping adults learn. In *Applying cognitive learning theory to adult learning* (ed. D. D. Flannery), pp 69–78. New directions for adult and continuing education, Jossey-Bass, San Francisco.

CAST, 2001, http://www.cast.org/bobby, updated 16 December 2001, accessed 17 December 2001

Forsyth, R. (2001) Participation in online staff development: why is there a mismatch between intention and practice. Paper presented at the Open and Distance Learning Association of Australia 15th Biennial Forum, 24–27 September, Sydney, Australia, pp 57–58.

Grabinger, R.S. and Dunlap, J. C. (2000) Rich environments for active learning: a definition. In *The Changing Face of Learning Technology* (eds D. Squires, G. Conole, G. Jacobs), pp 8–38. University of Wales Press, Cardiff.

Herrington, J., & Herrington, A. (1998) Authentic Assessment and Multimedia: how university students respond to a model of authentic assessment. *Higher Education Research and Development,* 17, 305–322.

Herrington, J. and Oliver, R. (1999) Using situated learning and multimedia to investigate higher-order thinking, *Journal of Educational Multimedia and Hypermedia* 8:4. 401–421

Herrington, J. and Oliver, R. (2000) An instructional design framework for authentic learning environments. *Educational Technology Research and Development*, 48 (3), 23–48.

Lave, J. and Wenger, E. (1991) *Situated learning: legitimate peripheral participation*. Cambridge University Press.

McLoughlin, C. and Luca, J. (2001) Computer-assisted assessment: developing skills in both qualitative and quantitative assessment online. Workshop at ED-MEDIA, Tampere, Finland, June 25–30.

Pearson, E. J. and Koppi, A. J. (2001) Guidelines for Accessible Online Courses, Internal publication University of New South Wales, http://www.edtec.unsw.edu.au

Pearson, E. J. and Koppi, A. J. (2002) Essential Elements in the Design and Development of Inclusive Online Courses. Paper submitted to ED-MEDIA, Denver, June

Roehler, L. R. and Cantlon, D. J. (1997) Scaffolding: a powerful tool in social constructivist classrooms. In *Scaffolding student learning, instructional approaches and issues* (eds K. Hogan and M. Pressley), pp 6-42. Brookline Books, Cambridge Massachusetts.

Savery, J. R. and Duffy, T.M. (1995) Problem-based learning: an instructional model and its constructivist framework. *Educational Technology*, 35 (5): 31–38.

Web Accessibility Initiative (WAI) http://www.w3.org/WAI/

The Influence of Discussion Groups in The Computer Supported Collaborative Learning

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1. Introduction

There is a growing tendency to strive for integration of individual and social dimensions in the new learning environment settings where technology is used as a tool for organising learning. Computer Support for Collaborative Learning (CSCL) is an emerging area of research when using Web-based learning environments in education. It represents a departure from previous work in instructional technology where learning was seen as an individual phenomenon. Many current learning theories connected to CSCL embrace a view of learning as a largely social phenomenon. Social interaction is seen to be a paramount site for the development and practice of cognition. One might expect the group to perform better than individuals on various challenging tasks like learning, knowledge creation, creativity, and problem solving. (Solomon 1993; Levine et.al. 1993; Scardamalia & Bereiter 1994; Kirschner & Whitson 1997). Collaborative learning can here be defined as a process through which a group of learners construct knowledge for its members and for itself as a learning community. It is typical of collaborative learning that learners have an inherent and spontaneous motive for collaborate, that learners determine and plan their own learning process, and learning contents are tailored in that learning community. Learning is co-operative and based on interaction with others, and it is evaluated on a self-evaluation basis. (see Korhonen 2001.) Learners thus have the possibility to study and apply issues closely related to their life situations and contexts flexibly (cf. Brown, Collins & Duguid 1989; Lave 1988) Structured and formal teaching and learning is replaced with a learning environment constructed by group of learners, in where they are able to set their learning goals collectively and share their responsibility to follow the learning paths to meet these goals.

There are some couraging research findings of group discussions or problem-solving activities in collaborative learning settings which give a support on the use of asynchronous group discussions in CSCL environment. Benefits of group discussion actions brought to learning are e.g. increased motivation, deeper understanding of the concepts and an increased willingness to tackle difficult questions that learners cannot answer alone (Weir 1992). Participants who solved problems through computer supported group discussion were more satisfied with the learning process and virtual groups tend to be more task oriented than face-to-face groups. Computer conferencing is giving flexibility to the communication. (Jonassen & Il Kwon 2001.) Group discussions brought in a case-based learning environment showed also that students who worked in groups performed significantly better that those who worked alone on the analysis and alternatives tasks. Participants who worked in groups liked their method also significantly better than those who worked alone and felt they have learned more working in a group. (Flynn & Klein 2001). The primary disadvantage that has been identified in recent research is the lack of nonverbal cues and the fact that in a virtual group discussion it is more difficult to reach group concensus. Some of the students might complain also about the extra time and effort needed for written argumentation. (see Jonassen & Kwon 2001.) Computer-mediated communication appears to support cognitive development of participants in many ways but educators need more information how to foster student student development in general, and to enhance teaching and learning in particular in CSCL environments.

Central to the implementation of group discussion settings mentioned above is the organization of learning. There is some evidence that the more students are coached and instructed in their systematic and reflective use of computer supported communication, the more varied and extensice the collaboration will be (Admiraal et.al. 1997). The strength of group discussion setting in the collaborative learning environment lies in its members' diversity, with each member should contribute his or her knowledge and competence into the collective action (Sharan & Sharan 1994; Korhonen 2001). The purpose of this presentation is to analyse two different kind of cases where the discussion groups have been brought into CSCL setting. The analysis and interpretations of the discussion groups are intended to imply how group investigation based or on the other hand freely organized discussion group influence of group interaction in CSCL environment.

2. Two Cases under Examination

The group discussion cases evaluated here are carried through a WebCT-based network learning environment. The CSCL environment is serving as a basis for sharing material and information, discussions and publishing written documents in Web. In these cases learning is not only virtual; it also involves contact teaching as orientation or group work under a teacher's supervision.

In the first case the use of the Web discussion group is based on certain co-operative group method brought into CSCL environment. The group method chosen is the Group Investigation method developed by Sharan & Sharan (1992; 1994). Group discussion is based upon research-like learning process and consensus building through cooperation by group members. The group of students attending this integrated Web-based course is consisting of 28 Finnish education science and adult education students in University of Tampere. The Group Investigation period in Web-based learning environment is bringing an interesting addition to the traditional seminar work, which is carried out in face-to-face meetings. The character of Group Investigation lies in the integration of four features: investigation, interaction, interpretation, and intrinsic motivation. Investigating in groups calls for students to use their interpersonal communication and planning skills, reflect and integrate their findings collectively and present their findings to others as well. (Sharan & Sharan 1992). These basic co-operative features of the group method are combined in the six stages of the model (Sharan & Sharan 1994):

- Stage 1: Students determine subtopics and organize into research groups.
- Stage 2: Groups plan their investigations.
- Stage 3: Groups carry out their investigations.
- Stage 4: Groups plan their presentations.
- Stage 5: Groups make their presentations.

- Stage 6: Teacher and students evaluate their projects.

Group Investigation method suits for small group of learners, who have complementary skills and have a common learning goal to reach for. The goal of the Group Investigation is to combine social interaction and communal problem solving to a research like process (Vahtivuori, Wager & Passi 1999). This method is quite simple and straightforward for implementation, so it doesn't require a long careful orientation. This kind of instructional co-operative method seems to work particularly well for Higher Education students of theoretical science study modules.

In the second case learning also involves contact teaching as orientation and small group work under a mentor's supervision. However, the network discussion group is organized much more freely. The organization of groups is based on certain theoretical discussion themes. The discussion groups are working as knowledge construction areas where the goal of the discussion is to share the knowledge with others and to reflect the findings. The group of students attending this network-based courses is consisting of 22 adult nursing science students in Open University in Institute of Extension Studies in Tampere. The requirements in this network courses is to do several written assignments: like analysis of network discussion themes and write a written home assignment. The role of the virtual discussion forum is to be a basis for all the written assignments in the study period.

The both of the research groups construct a personal learning diary. These authentic learning diaries of the learners are composing the central research data. So the situations are analyzed qualitatively. The main research question in this case is to try to find through these discussion group cases some evidence on how group's movement toward reaching a conclusion is carried out in different kind of group discussion settings. Is the group interaction and learners' experiences of interpersonal interactions different when there is certain cooperational method utilized and is the quality of outcome better or worse in that case?

The analysis of the research material is carried out during the winter 2001 -2002 and will be potentially reported in the coming ED-MEDIA 2002 conference in June, 2002.

References

Admiraal W.F.; Lockhorst D.; Wubbels T.; Korthage A.J. & Veen W. (1997) Computer-mediated Communication in Teacher Education: Computer Conferencing and the Supervision of Student Teachers. Paper presented on the biennal meeting of the European Association for Research on Learning and Instruction, August, 1997, Athens, Greece.

Brown, J.S.; Collins, A. & Duguid, P. (1989) Situated Cognition and the Culture of Learning. Educational Researcher 18, no. 1, 32-41.

Flynn A.E. & Klein J.D. (2001) The Influence of Discussion Groups in a Case-Based Learning Environment. Educational Technology Research and Development 49, no. 3, 71-86.

Jonassen D.H. & Il Kwon H. (2001) Communication Patterns in Computer Mediated Versus Face-to-Face Group Problem Solving. Educational Technology Research and Development 49, no. 1, 35-51.

Kirshner, D. & Whitson, J., eds. (1997) Situated Cognition: Social, Semiotic, and Psychological Perspectives. Mahwah, NJ: Lawrence Erlbaum Associates.

Korhonen V. (2001) Situated and Socially Shared Cognition in Practice: Designing a Collaborative Learning Experience for Adult Learners. Paper presented at the ED-MEDIA 2001 Confenrence, June, 2001, Tampere, Finland.

Lave, J. (1988) Cognition in practice : mind, mathematics and culture in everyday life. Cambridge: Cambridge University Press.

Levine, J.M., Resnick, L.B. & Higgins, T.E. (1993) Social Foundations of Cognition. Annu.Rev.Psychol. 1993. 44, 585-612.

Scardamalia, M. & Bereiter, C. (1994) Computer Support for Knowledge-building Communities. The Journal of the Learning Sciences, 3, 265-283.

Sharan, S. & Sharan, Y. (1992) Expanding Cooperative Learning through Group Investigation. New York: Teachers College Press.

Sharan, S. & Sharan, Y. (1994) Group Investigation in the Cooperative Classroom. In Handbook of Cooperative Learning Methods.

Salomon, G. (1993) No distribution without individuals' cognition: a dynamic interactional view. In Salomon, G. (ed.) Distributed Cognitions. Psychological and educational considerations (p. 111-138). Cambridge: Cambridge Univ.Press.

Vahtivuori, S.; Wager, P. & Passi, A. (1999) "Opettaja, opettaja, teletiimi Tellus kutsuu…" Kohti yhteisöllistä opiskelua virtuaalikoulussa. ("Teacher, teacher, tele-team Tellus calling…" - towards communal learning in a virtual school environment. Authors' translation). Kasvatus 3/1999, 265-278.

Weir, S. (1992). Electronic communities of learners: Fact or fiction. In R. Tinker & P. Kapisovsky (Eds.), Prospects for Educational Telecomputing: Selected Readings (p. 87-110). Cambridge, MA: Technology Education Research Center.

A Learner-Centered Media Production Process for Web-Based Learning Environments

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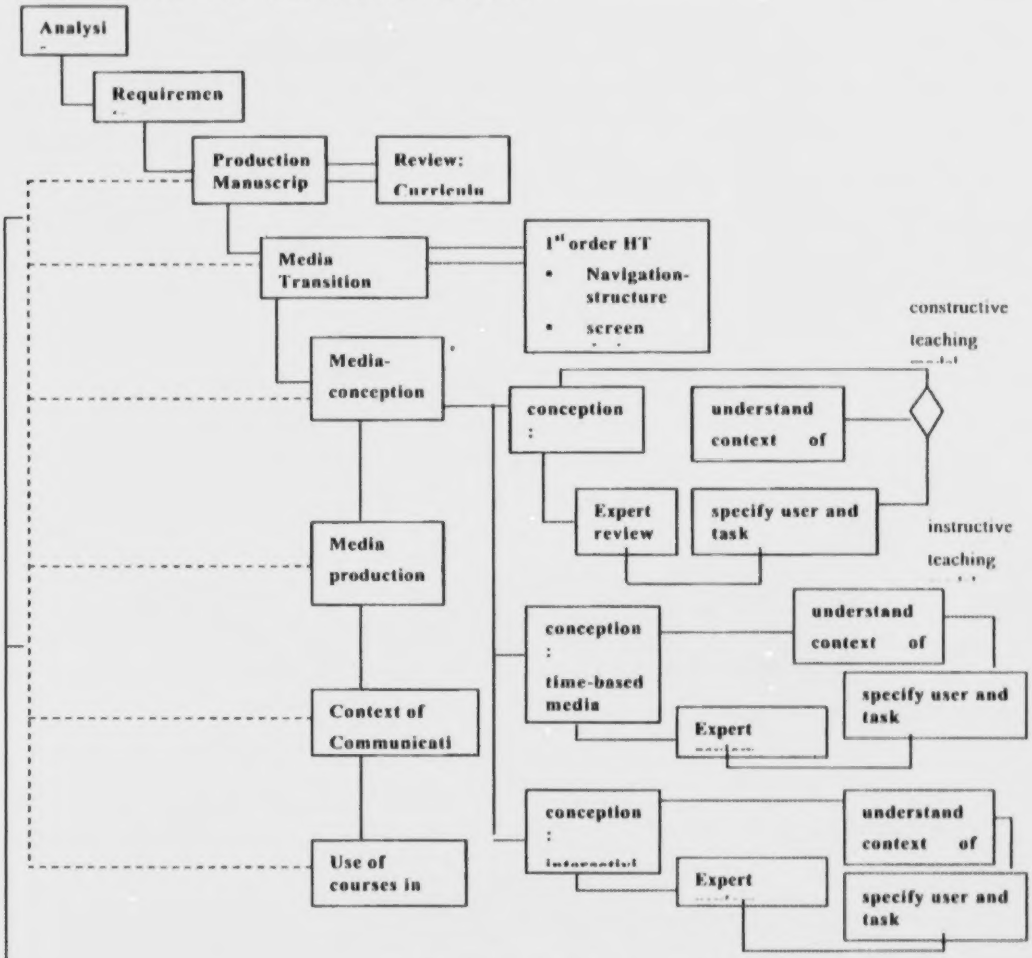
Abstract. The development of web-based courses for virtual universities very often starts from a paper-based tradition of teaching and learning. Web-based learning environments, however, have an added-value by the potential of hypermedia, multimedia, interactivity, cooperation and collaboration, mediated by digital media with different features distinguishing contexts for presentation of content. Currently, there exists no adequate model covering media as distinguishing contextual aspects for web-based learning environments. This paper presents a framework to deal with media features as varying contexts during the development of learning environments.

1 Introduction

The production of web-based courses often start from a paper-based tradition of teaching and learning with content authors writing a kind of book, which is subsequently the basis for a continuous media production process considering media features as distinguishing contexts. Therefore, the production of web-based learning material does not only mean the transfer of and adaptation from one medium to another one, but also an integration into an adequate media production process, where media features change contexts for design. As we see the development of web-based courses as equivalent in many aspects to software development processes we refer to ISO 13407 as a reference model for user centered design processes, which focus on understanding user contexts. The importance of contexts have already been recognized in many other areas (see for example Suchman 1987). This paper is based on experience of the authors in the production of web-based courses, in the design of user-adequate learning spaces and in the support of the design process. The IMIS is involved in a national project called "Distance Education in Medical Computer Science" (started in January 1999) which aims at providing a complete course of studies for the specialization of students in medical computer science offered at a virtual university (Hagen, Germany) (Kritzenberger/Hartwig/Herczeg 2001; Kritzenberger/Herczeg 2001).

2 Media Contexts in a User-Centered Production Process

The stages of media production (writing a book, transmission of the book into hypertext, hypertext functions, multimedia course, interactive computer-based training, cooperative learning) provide different contexts for thinking about media design for learning environments integrated in one process model of media production (figure 1), covering media features in cyclic sub-processes (similar to the spiral model for the user-centered software development processes as specified in ISO 13407). Furthermore, in the development of web-based courses we have to distinguish several problem areas for the media development process: Domain knowledge selection, teaching model, media features, interactivity, communication and collaboration. Most of the requirements come from the overriding demands of the teaching model. It is the main frame for specification of hypermedia, and has a secondary effect on framing the multimedia use and interactivity. For the pedagogic conception of interaction the main focus has to be on the learner's cognitive operations and information processing procedures. The decision is also the embedding of hypermedia, media use and interactivity in the overall learning environment. These requirements have to be made more concrete in the media design and is subject to discussion between content authors, media designers, pedagogic experts and several other specialists. That is, the case is not to enhance the hypertext with time-based multimedia like audio, video or animations etc.. The critical aspect of multimedia design is to use it for a more precise presentation of facts wherever it seems to be adequate, e.g. as a more concrete way of explaining processes, which otherwise would be too complicated to be explained properly and therefore could otherwise hardly be understood by the learners. For example, simulations can help to demonstrate how time-based actions follow each others in a complex process to be explained in the subject domain. In this stage of development it is helpful to analyze the kinds of knowledge involved in order to deduce consequences for presentation. Furthermore, there is a larger organizational context of teaching and learning, where communication and collaboration environments are applied. We have also to understand the use of the multimedia and interactive learning environments in this larger context of communication and collaboration processes of the virtual university or other institutions where the web-course will be offered.


Analysi
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Media production
conception : time-based media
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Figure 1: Contexts for Media Production Processes

Conclusions

The model proposed in figure 1 is capable to deal with different media features separately and reflect them as contexts of learning. The model also shows an integration of the interdependence of human-centered design activities as specified in ISO 13407. For further work, this model has to be refined as a generic model for dealing with media contexts in the development of web-based learning environments in order to improve their development process and by this also their usability.

Acknowledgement

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References

ISO 13407: International Standard - Human-Centered Design Processes for Interactive Systems (1999E).ISO

Kritzenberger, H.; Hartwig, R.; Herczeg, M.: Scenario-Based Design for Flexible Hypermedia Learning Environments. *Proceedings of ED-MEDIA 2001. International Conference on Educational Multimedia, Hypermedia and Telecommunications* Tampere, Finland 2001 AACE - Association for the Advancement of Computing in Education, pp. 1023-1028

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Kritzenberger, H.; Herczeg, M.: Approaches to Quality Management for Developing WBT Courses. *Proceedings of the 20th ICDE-World Conference on Open Learning and Distance Education.* Düsseldorf, Germany, 1.-5. April 2001. International Council for Open and Distance Education (ICDE). (Electronic Proceedings)

Suchman, L. (1987): Plans and situated actions. Cambridge University Press

Mixed Reality Environments as Collaborative and Constructive Learning Spaces for Elementary School Children

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Abstract. Learning is an active, constructive and collaborative process, where people construct knowledge from their experiences in the world. People construct new knowledge with particular effectiveness when they engage in constructing personally meaningful products, that is meaningful to themselves or to others around them. The construction of knowledge from experiences in the world seems to be especially important in childhood learning, as children need to learn through their senses and through physical activity. Unfortunately, for school children there are few learning situations where senses and physical activity is involved. This is partly due to the nature of the concepts to be learned and partly to the lack of manipulative learning material. This contribution introduces a mixed reality environment as a collaborative and constructive learning space for elementary school children. During recent teaching experiments in an elementary school the children created their own mixed reality environment which served from a scientific point of view for a semiotic-based understanding for the creation and usage of physical and digital media bringing together arts and computer science.

1 Introduction

Education in the media age means to develop media competence and a deeper understanding of media characteristics starting from kindergarten age to high school education. The learning goal is to understand the design as well as the use of the media and also to understand the essence and nature of specific media.

Starting from these learning goals the authors are involved in a project called ArtDeCom ("Theory and Practice of Integrating Education and Training in Arts and Computer Science"). We try bringing together education in the two usually separated disciplines of arts and computer science in school on several levels of education. Pupils should be given an opportunity to explore the relationships of the two disciplines with adequate tools and learning goals for their respective age and learner level. The project is funded by the German "Bund-Länder Commission for Educational Planning and Research Promotion" (BLK) within the general funding program "Culture in the Media Age". It aims at investigating teaching material and situation for a curriculum definition for integrating education in arts and computer science on all educational levels. The IMIS is cooperating with the Muthesius Academy of Arts, Design and Architecture and with the Institute of Art History of the Christian-Albrechts-University in Kiel (Germany) to develop curricular elements for an integrated education of arts and computer science.

This situation is the background for the integrated lessons of arts and computer science in an elementary school in Luebeck (Germany). The teaching attempt is in the 3rd class level of an elementary school for children with an age of 8-9. During several lessons the children work in design projects developing their own mixed reality environment, within which they later perform an interactive musical revue. The children themselves develop the scenes of the mixed reality environment working in groups and using adequate software tools as well as real world materials. Collaborative and constructive learning is practiced permanently during the design process as well as during interaction with the hybrid environments of the mixed reality scenery.

A key focus of our research refers to cross-settings of ways of thinking in arts and in computer science. We think that mixed reality environments are a perfect learning space that enables children to explore concepts from both disciplines in an intuitive way.

2 Collaborative and Constructive Learning

Constructive learning theory addresses learning as an active process, in which people actively construct knowledge from their experiences in the world. People construct new knowledge with particular effectiveness when they engage in constructing personally meaningful products, which are meaningful to themselves or to others around them. Furthermore, it is important that the learning environment is authentic and situated in a real-life situation. Learners must get an opportunity to build multiple contexts and perspectives in a social context. Numerous examples have been given in academic context.

The construction of knowledge from experiences in the world seems to be especially important in childhood learning, as children need to learn through their senses and through physical activity. Todays kindergartens and playgrounds are full of physical objects and physical activity. But as children move on through elementary school and into secondary school, they encounter fewer learning situations where senses and physical activity is involved. This is partly due to the nature of the concepts to be learned. They are very difficult to explore with the senses when manipulative learning material is not available. One reason is that many abstract concepts seem to be very difficult (if not impossible) to explore with physical media. For example, traditional physical media generally do not support children understanding the behavior of dynamic systems or how patterns arise through dynamic interactions among component parts. Such concepts are typically taught through more formal methods, involving abstract mathematical formalisms. Unfortunately, many students have severe problems with this approach, and thus never develop a deep understanding of these concepts (Resnick 1998).

With this background in mind Resnick (Resnick 1998) has created a new generation of computationally enhanced manipulative materials, called "digital manipulatives", developed at the MIT Media Lab. They expand the range of concepts that children (and adults) can explore through direct manipulation of physical objects. They aim to enable children to continue to learn concepts with "kindergarten approach" even as they grow older. As children build and experiment with these manipulative materials, they form mental models and develop deeper understanding of the concepts they enact with. Children continue to learn new concepts with a "kindergarten approach". Resnick assumes that children learn with digital manipulatives concepts that were previously considered "too advanced" for them.

There are several other approaches with physical and tangible (graspable and touchable objects) interaction, for example MIT's KidsRoom (Bobick et al. 2000), Triangles and 'strings' (Gorbet et al. 1998), Curlybot (Frei et al. 1999); StoryMat (Ryokai/Cassel 1999) in order to enhance collaboration among learners and enable constructive learning experiences for children.

Furthermore, several design projects with children have shown positive effects on learning and deep understanding (Alborzi et al. 2000; Druin/Perlin 1994; Stanton et al. 2001). In these projects children create external artifacts, like animate stories, video games, kinetic sculptures, models, simulations and so on, which they share and discuss with others. These artifacts provide rich opportunities for learning. As children are involved as active participants, they have a greater sense of control over the learning process. As they design artifacts in group work, they experience pluralistic thinking, multiple strategies and solutions. By the way they need to think about how other people will understand and use their constructions. Furthermore, design projects are mostly interdisciplinary and therefore bring together concepts from different disciplines.

3 Mixed Reality Environments as Learning Spaces

In our approach to constructive learning we use a mixed reality environment as a collaborative and constructive learning space for children. As we have discussed in the previous chapter, in early elementary classrooms children need manipulative material to initiate learning processes, as they allow exploration with the senses and therefore enable physical experience for the learner. They allow children to explore concepts by interaction and with their senses and therefore allow to build and to correct mental models and a deeper understanding of the underlying domain.

In mixed reality environments real world and virtual world objects are presented together on a single display. Mixed Reality techniques have proven valuable in single user applications. For example in other contexts single user mixed reality interfaces have been developed for computer aided instruction (Feiner/McIntyre/Seligmann 1993) and for medical visualization (Bajura/Fuchs/Ohbuchi 1992). These applications have shown that mixed reality interfaces can enable a person to interact with the real world in ways, which were never possible before. However, there has been less research on collaborative applications (Billinghurst/Kato 1999) or on interaction of children with mixed reality environments (www.animax.de) or even multi-user mixed reality environments and their use as learning spaces.

3.1 Design of Mixed Reality Environments

The mixed reality environments used in our lessons are designed by the children themselves in collaborative design projects. In the beginning the class is divided into groups, where each group works out a project development plan. It includes a story, the material to be used, the function of the computer and its connections and extensions to physical space. Afterwards there is a phase of creating, collecting and arranging objects for the mixed reality environment. These objects can either be of digital or of physical nature. Various materials for scenery creation are used, like wires and papier-maché (see figure 1). During the development process the pupils are acquainted with the hardware and software to be used.

Children collaboratively create their own mixed reality environment. During this working process the children get involved as active participants creating something meaningful to themselves and to others.

Figure 1: Children are creating the objects for the mixed reality scene

Furthermore, during the working process the children do not only create an animation for the digital world, but they also create the digital world. In our project they simply use a LEGO Cam for that task and LEGO MindStorms Vision Command to program the interactive sequences of certain picture recognition sequences (see figure 2).

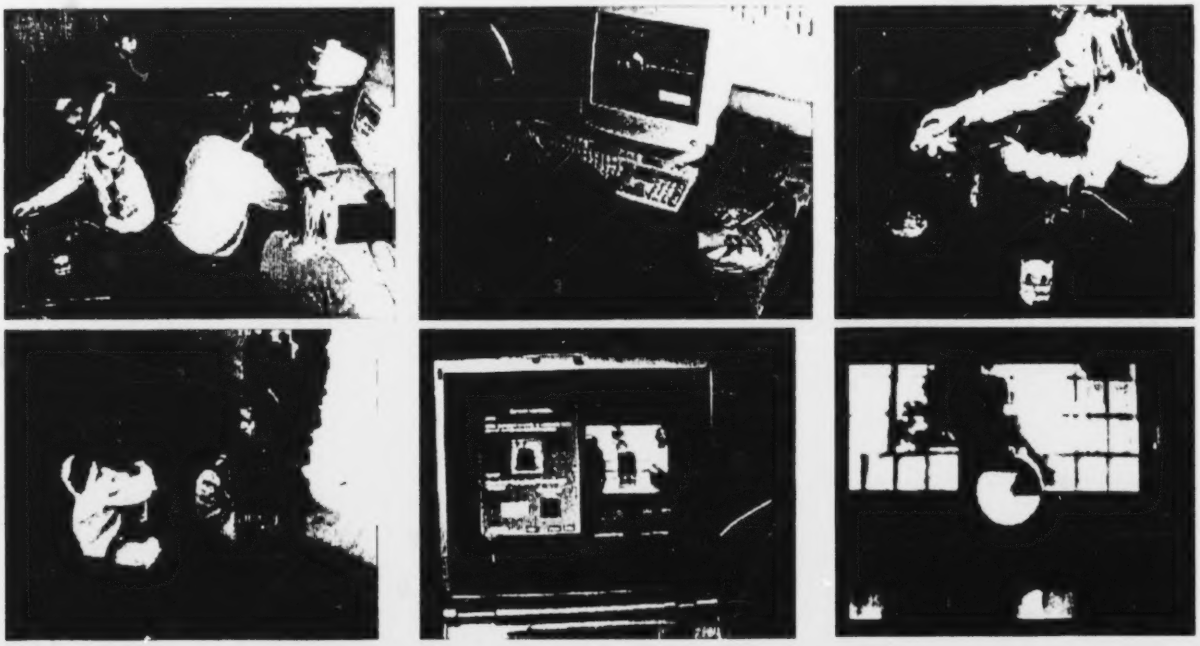

Figure 2: Children producing an animation with the LEGO Cam

3.2 Scenario: The "World of Dragons" music revue in a mixed reality environment

Figure 3 shows a sketch of the collaborative mixed reality environment, which was designed (as described in Chapter 3.1) by the children for a music revue "World of Dragons". It consists of an animation, which shows a wild landscape with mountains, trees, a watercourse, an active volcano, a cave and several moving dragons. On the stage within the physical world, there are several trees which have been made from the same material and look exactly like the trees in the animation. Between the projection wall and the video animation the children move and dance on the stage. They wear differently colored dragon costumes and dance to the music of Sergey Prokofjew ("Romeo and Juliet", "The Montagnes and Capulets"). The rhythm of the music as well as the narrative structures of the animation impose a certain timing of the acoustic and body expression.

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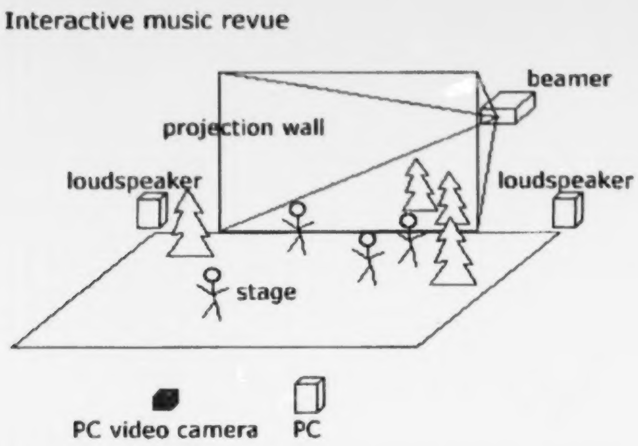
Interactive music revue
beamer
projection wall
loudspeaker
loudspeaker
stage
PC video camera
PC

Figure 3: Sketch of the collaborative mixed reality environment for the music revue

By their movements and by the colors of their costumes the children activate different sounds in the mixed reality environment. There are also other sounds coming from objects in the mixed reality environment, like the blowing of the wind, the rolling of thunder, the volcanic eruption, the sound of an avalanche, the shouting of dragons, as well as the recurring sound of a stumbling little dragon.

3.3 How children learn from mixed reality environments

The learning experience of the children can be interpreted on several levels. On a concrete level of interpretation, children learn about concepts and methods in both disciplines, in arts and in computer science (see figure 4).

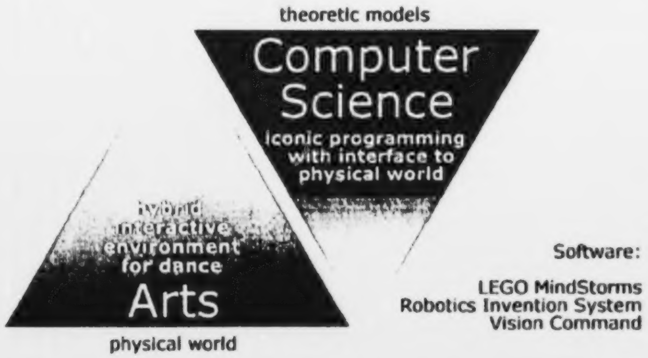
theoretic models
Computer Science
Iconic programming with interface to physical world
hybrid interactive environment for dance
Arts
physical world
Software:
LEGO MindStorms
Robotics Invention System
Vision Command

Figure 4: Connecting methods of arts and of computer science

In an active hybrid environment the activities of the children ground in a physical world. They are engaged in the manual development of the "landscape". They create and realize the objects, which are used for the animation. They act and dance on the stage and interact with the animation by their movements and they influence the behavior of the computer program with signs like the color of their costumes. With iconic programming the learners bridge the gap between the physical world with its multiple meanings and interpretations and the abstract world of models and algorithms in computer science. Furthermore, an adequate tool is needed to realize programming experience for children. For our purposes we found LEGO MindStorms, Robotic Invention System and Vision Command fitting perfectly as a programming environment for the purposes of our project.

The most interesting aspect of children´s learning experiences in mixed reality environments is of semiotic nature and can be explained with the "teridentity relation" (x=y=z) of Charles Sanders Peirce.

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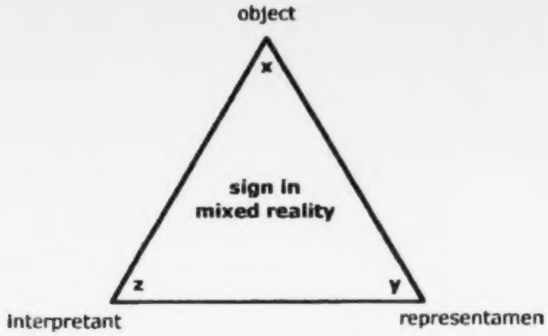

Figure 5: Teridentity relation for the interpretation of learning experiences in mixed reality environments (acccording to Peirce)

Whereas in traditional ways of teaching only separated areas are interpreted from a semiotic point of view, in our form of transdisciplinary teaching we try to relate all possible signs to each other. It does not matter, whether these signs are of iconic nature, or if they are indices, symbols, individual events and states, or habits of predictive / relational, propositional or argumentative nature.

If we interpret the learning experiences of the children in a more systematic and semiotic way, we get the following situation and interpretations. According to Peirce (Hartshorne/Weiss/Burks 1997) there are 10 possible kinds of signs, where Peirce endeavored to construct a theory of all possible natural and conventional signs, whether simple or complex. This theory is helpful to explain how different levels of interpretation and learning experience are related to each other. We do not want to classify the elements of the transdisciplinary learning environment according to these 10 classes of Pierce, because this conclusion would neglect a lot and shift the focus to the theory. Instead we would like to focus to very important practical aspects:

- experience in design and creation of the narrative story; the dragons mirror the fascination and the anger of the world of the dragons as well as the kind of relationships between the children and their appraisals
- experience of the relationship to the body, to corporeality and being touched by others, especially children of the other sex
- experience of elements of mimic and dancing expressions (which exists independently of verbal expressions)
- empathy in music and rhythm, with its attributes like loud and soft, fast and slow, pretty and grave
- experience of the quality of material during the creation of the landscape (which is either light or heavy, hard or soft, dry or slippery) and examination of the shaping of the three dimensions of the room
- experience of the pictorial nature and modelling process during the creation of the digital animation, when single picture sequences are constructed from gradually changing the real world models
- identification of characteristic sounds and their integration into the narrative and expressive dance story of the music revue
- experience in abstract information processing for conception and development of the picture recognition program with LEGO-RIS Vision Command
- reflection on the different relationships of boys and girls to dancing as well as to computer technology
- experience on how attribute of objects in the real world (like colour, movement, position in the real world space) cause reactions in the virtual world, that is on the states and effects of the computer program

4 Conclusions

In our teaching attempt we found that mixed reality environments are a very promising learning space for a constructive and collaborative learning of children. The mixed reality environment meets all requirements for a constructive learning space for children, like learning through senses and physical activity using digital manipulatives.

In designing and in working with a mixed reality environment, the children construct a configuration of the world instead of a describing knowledge. They do this by individually creating and constructing the world and by subsequently freely interpreting their self-created world. During the performance of the music revue the children experience a singular event. However, for every event numerous interpretations are possible. By interpreting the world the children do not create an analytical but an intuitive understanding. The children are engaged in the world of constructing the objects, in the world of programming and in the world of behavior. They write programs and they control the computer program with their behavior (dancing, movements, colors of their costumes etc.). By this the children become themselves variables in the computer program when acting in the world of the musical revue. They act themselves as signs with different states and effects on each other as well as on the elements of the real and the virtual world.

Further research will explore the use of other computer-based learning environments as tools and environments for trans-disciplinary teaching and understanding in the field of arts and computer sciences. The research will be done on different levels of education and age.

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References

1. Alborzi, Houman; Durin, Allison; Montemayor, Jaime; Platner, Michele; Porteous, Jessica; Sherman, Lisa; Boltman, Angela; Taxén, Gustav; Best, Jack; Hammer, Joe; Kruskal, Ablex; Lal, Abby; Plaisant Schwenn, Thomas; Sumida, Lauren; Wagner, Rebecca; Hendler, Jim (2000): Designing Story Rooms: Interactive Storytelling Spaces for Children. In: Symposium on Designing Interactive Systems. Conference Proceedings on Designing Interactive Systems: Processes, Practices, Methods, and Techniques. New York: ACM Press, pp. 95-104
2. Bajura, M.; Fuchs, H.; Ohbuchi, R. (1992): Merging Virtual Objects with the Real World: Seeing Ultrasound Imagery Within the Patient. In: Proceedings of SIGGRAPH 92. New York: ACM Press, pp. 130-145
3. Billinghurst, Mark; Kato, Hirokazu (1999): Collaborative Mixed Reality. In: Proceedings on the First International Symposium on Mixed Reality (IMSM 99). Mixed Reality - Merging Real and Virtual Worlds. Berlin: Springer, pp. 261-284
4. Bobick, A.; Intille, S.; Davis, J.; Baird, F.; Pinhanez, C.; Campbell, L; Ivanov, Y.; Schutte, A.; Wilson, A. (2000): KidsRoom: A perceptually-based interactive and immersive story environment. Presence Teleoperators and Virtual Environments 8 (4), pp. 367-391
5. Druin, A.; Perlin, K. (1994): Immersive environments: A physical approach to the computer interface. In: Companion of CHI 94. Boston, MA, April 1994, ACM Press, pp. 325-326
6. Feiner, S.; MacIntyre, B.; Seligmann, D. (1993): Knowledge-Based Augmented Reality. Communications of the ACM 36 (7), pp. 53-61
7. Frei, P; Su, V.; Mihak, B.; Ishii, H. (1999): Curlybot: International Conference on Computer Graphics and Interactive Techniques. Proceedings of the Conference in SIGGRAPH 99. Los Angeles, California. New York: ACM Press
8. Gorbet, M.; Orth, M.; Ishii, H. (1998): Triangles: Tangible Interfaces for manipulation and exploration of digital information topography. Proceedings of CHI 98, ACM, pp. 49-56
9. Patten, J.; Griffith, L.; Ishii, H. (2000): A tangible interface for controlling robotic toys. Proceedings of CHI 2000, ACM
10. Hartshorne, Charles; Weiss, Paul; Burks, Arthur (1997): Collected Papers of Charles Sanders Peirce. 1931-1958, Vol.1-8. Cambridge, Massachusetts: Harvard University Press.
11. Resnick, Mitchel (1998): Technologies for Lifelong Kindergarten. In: Educational Technology Research and Development 46 (4), pp. 1-16
12. Ryokai, K.; Cassel, J. (1999): Computer Support for Children's Collaborative Fantasy Play and Story Telling. Proceedings of CSCL 1999. Stanford, CA
13. Stanton, Danae; Bayon, Victor; Neale, Helen; Ghali, Ahmed; Benford, Steve; Cobb, Sue; Ingram, Rob; O'Malley, Claire; Wilson, John; Pridmore, Tony (2001): Classroom Collaboration in the Design of Tangible Interfaces for Storytelling. In: Proceedings of the Conference on Computer-Human Interaction CHI 2001, pp. 482-489

SCHEDULING AND MONITORING DYNAMIC LEARNING OBJECTS ON THE WEB

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NTP Information Solutions Ltd, University of Huddersfield

1. ABSTRACT

Next generation web Learning Management Systems (LMS) will deliver courses built from small re-usable learning objects and use systems to tailor curricula so that the learning needs of each individual student can be met in an automated and cost effective way. Web based Intelligent Tutoring Systems (ITS), aimed at compensating for the absence of a human tutor have to date mostly concentrated on providing assistance in a particular subject domain and not focussed on the problem of utilising content represented as learning objects across multiple subject domains. This paper describes the creation of a non-dictatorial tutoring system that employs a 'learning navigator' to help trainees visualise the best path through assignable units extracted from a learning repository. The system takes a unique approach to deliver personalised learning by taking advantage of the SCORM specification and storing content as Sharable Content Objects (SCOs), and therefore enabling the use of existing and third party content.

2 PARTNERS

This paper discusses a collaborative project between NTP Information Solutions (NTPIS) and the University of Huddersfield that has been set up to investigate different ways to enhance web based learning environments. NTP Group is one of the largest multi-occupational training providers in the UK Serving 25,000 trainees throughout the UK. Together with the four other companies in the NTP Group, NTPIS delivers a range of management, training and consultancy services for UK enterprises. A key part of the company's strategy is to provide e-training solutions directly to the work place across diverse sectors. At NTPIS creative designers use authoring tools such as Trivantis Lectora and Macromedia Flash to produce learning applications in the form of Sharable Content Objects (SCOs) that are then delivered as courses through a Learning Management System (LMS). This method follows the SCORM standard that facilitates interoperability of learning content between systems. The University of Huddersfield has a track history of research into the monitoring and scheduling of Computer Based Training (CBT) applications delivered over the Internet and delivers several of its MSc courses using the Blackboard LMS. Both organisations are aware of the low completion rates associated with e-Learning and are seeking ways to combat this by enhancing LMSs.

3. OVERALL VISION AND GOALS

NTPIS wish to develop a total Internet/intranet training solution for their customers. This includes developing the next generation of their LMS to include tutoring and guidance. Their vision is to provide a one-stop shop that will help their customers to grow, by the use of improved management information systems and by investing to it's most valuable capital; the employees and their knowledge. The next generation LMS will not just provide a training delivery platform but also act as the central point of access for getting help and advice. An agent will be integrated into the LMS that will contain a level of intelligence to answer trainee's questions and be able to direct trainees to the resources that they need. It will monitor activities and determine common learning and browsing patterns and suggest the best approach for each individual user based upon their profile .

This paper focuses on the problem of delivering personalised training for the individuals in a manner that matches the requirements of industry. It describes a system that uses a generic domain knowledge model and reusable-learning objects to provide cost-effective way to provide individualised learning experiences. The learning objects are authored to comply with the Sharable Content Object Reference Model (SCORM) specification to provide the interoperability across the LMS and content vendors. The system extends the SCORM by mapping the Sharable Content Objects (SCO) to the learning outcomes in the system's knowledge model. Small reusable SCOs are published in the data repository and combined dynamically, at runtime. The system provides guidance to trainees by suggesting appropriate learning paths through the content and gives information about the relevancy of SCOs depending on the profile of the trainee and their individual circumstances.

4. BACKGROUND

The use of e-learning has increased enormously during the last few years and even the most modest estimations predict huge growth in the future. The main reasons for this have been based on the Martini principle of delivering training anytime and anywhere, giving cost-savings on the reduced offsite time, travel and accommodation expenses and trainer costs. However, a disadvantage of this approach is that e-learning can often lead to an isolated experience and not deliver sufficient tutoring or guidance. This factor has often been linked to poor completion rates for online courses. In a traditional classroom scenario training tends to be pitched to the average level of the people attending the class. This level may not suit all and training individually can, sometimes, provide an advantage if training is tailored to an individual's specific needs. CBT and e-learning provides direct access to each individual being trained and should, in theory, be superior to the broadcasting methodology used in the traditional classroom if mechanisms can be put in place to provide an individualised experience. However, the benefits of this have not yet been exploited. Regardless of the fact that the training is done individually and at any time the trainee prefers, the delivered training content is still static for the trainee. The same limitation applies to the majority of hypermedia, as web content is often the same static information presented to each reader (Brusilovsky 2001). Academic research has delivered some pedagogically valid systems that pitch the level of training into the level of the trainee but they have been bespoke applications for a certain knowledge domain (Mullier et al. 2001). Also, the industry has developed several generic domain user modelling systems (Kobsa 2001) but nothing focussed purely on training and education. NTPIS require a system that can tailor content extracted from a repository of re-usable SCOs to a large diverse audience. To provide a cost effective solution for the enterprise the content has to be authored for the industry standards so that it can be reused and interchanged across the platforms.

The Advanced Distance Learning (ADL) is an initiative from the US Department of Defense (DoD), which is aimed for promoting the co-operation, between government, academia and business to develop elearning standardisation. This initiative has resulted in actions that have delivered the Sharable Content Object Reference Model (SCORM), which is currently on version 1.2. The SCORM defines a web-based learning "**Aggregation Model**" and "**Run-time Environment**" (RTE) for learning objects. The aggregation model specifies how to aggregate the resources into the structured learning content. The RTE defines the common language and data model for the communication between the LMS and the content. This enables the true interoperability between the content and LMSs developed by the different vendors. SCORM has been the specification that has brought together pieces of the learning specifications made by other organisations, like Aviation Industry CBT Committee (AICC), Alliance of Remote Instructional Authoring & Distribution Networks for Europe (ARIADNE) and the Institute of Electrical Electronics Engineering (IEEE) Learning Technology Standards Committee (LTSC). NTPIS has recognised the advantages offered by following official open standards, and developed it's infrastructure to implement the SCORM 1.2 specification. The ADL initiative envisions use of the training content to be developed as small reusable Sharable Content Objects (SCO), which could be stored in a repository used in various different courses. The first versions of the SCORM specification have already been well adopted by the industry and implemented in most of the leading LMSs. ADL takes the vision of interoperability and re-usability further, in it's long range vision; once the SCO are commonly available they can be assemble in the real time, on demand and then delivered to learners. (ADL SCORM 2001).

This research has developed the system that implements dynamic scheduling by associating SCOs with the data of its learning outcomes and by developing the dynamical routing engine that can suggest to the trainee the different learning paths that can be taken to achieve the same learning objectives.

5. SYSTEM ARCHITECTURE

NTPIS have developed a web based LMS that acts as the infrastructure for delivering, managing and monitoring training in the work place. The system contains various interfaces that allow course authors, tutors, managers and trainees to create a customisable training portal that displays the user with the menus and menu-items based on the given rights. When trainees access this system they are presented with a menu showing the courses that they are enrolled on, where they are up to and what they need to do next. Content is developed using authoring tools, such as Trivantis Lectora and Macromedia Flash, in the form of SCOs and submitted into a learning repository using the **Lesson Management Interface**. A training manager uses the **Course Management Interface** to create courses by defining paths between the SCOs that are present in the repository. Work completed so far has focussed on extending these interfaces and including a 3rd interface; the **Learning Navigator Interface**. The objective of the Learning Navigator is to provide a graphical way to visualise the contents of the learning repository and the structure of the course the student is following. The interface allows the trainee to not only see the SCOs that form part of the course that they are enrolled on, but also any other relevant SCOs. The trainee can also view several different paths through to SCOs ranging from how the course was originally authored to what the system considers is the best path for the user to take in their particular situation.

5.1 THE LESSON MANAGEMENT INTERFACE

The lesson management interface (Fig. 1) is an access point to the learning object repository and provides the tools necessary for editing and registering SCOs into the system. The SCORM Aggregation Model defines the basic SCO information, such as name, description and keywords. We have extended this information by assigning the SCO with weighted learning outcomes (skills). These learning outcomes are predefined in the system and have been related to each other in a hierarchy, which consists of skills categories in a tree type structure.

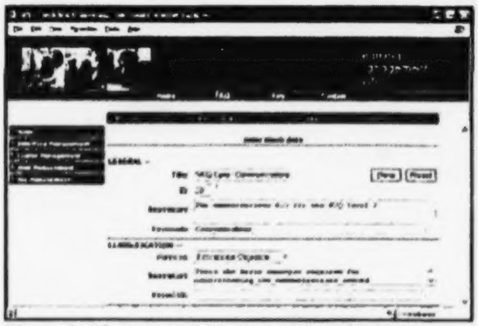


Figure 1: The lesson management interface

5.2 THE COURSE MANAGEMENT INTERFACE

The course management interface (Fig. 2) is used to create courses from SCOs in the repository. Courses are assigned with learning outcomes that are expected to be achieved by taking a course. Like the skills associated into the SCOs, these outcomes are mapped to the same skill hierarchy. Course tutor uses his expertise to use learning repository to combine linear series of SCOs that fulfil these learning outcomes.. This forms a basic course structure and is called a default Learning Path.

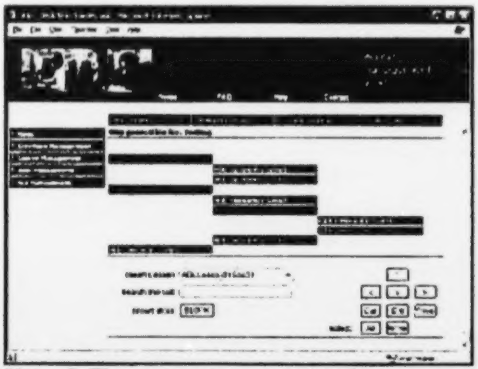
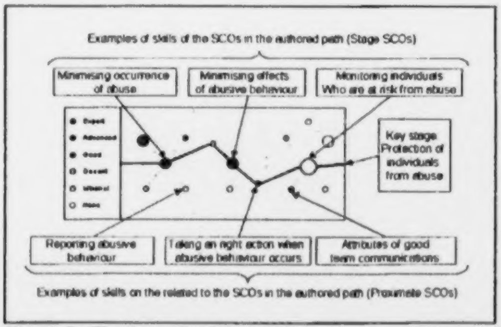


Figure 2: The course management Interface

5.3 LEARNING NAVIGATOR

The Learning Navigator (Fig. 3) is an interface that is used by the trainee when proceeding through the courseware. It presents the trainee with the course structure that consists of **Stage SCOs** and **Proximate SCOs.** The stage SCO is a learning object that has been authored to be part of the course. The Proximate SCOs are dynamically pulled out from the learning object repository and recommended for the trainee, based on the skill relations that are assigned to the Stage SCOs and what is the trainee's knowledge on the those skills. In addition, it presents the Learning Path recommendations made by the **Routing Engine**.


Examples of skills of the SCOs in the authored path (Stage SCOs)
Minimising occurrence of abuse
Minimising effects of abusive behaviour
Monitoring individuals Who are at risk from abuse
Expert
Advanced
Good
Key stage Protection of individuals from abuse
Reporting abusive behaviour
Taking an right action when abusive behaviour occurs
Attributes of good team communications
Examples of skills on the related to the SCOs in the authored path (Proximate SCOs)
Figure 3: The Learning Navigator

The example demonstrated above in figure 3 is part of a course on "*Protecting individuals form abusive behaviour*". There are three stage SCOs , from which each has been grouped together with the additional Proximate SCOs. If the path viewed had been the default path (original path authored by the training manager) the path would be a straight line. However, the path deviates from this and shows a path that has been chosen by the Routing Engine. The Learning Navigator is also a trainee's tool to get all the necessary information about the course structure and it's different entities. This information can be divided in to two parts, the visual data and the text-based data. The text-based data is mainly

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displayed in roll-over popup windows and contains detailed information about the SCOs, Skills, and course outcomes (e.g. Name, description etc). The visual data can be listed as:

- Stage SCOs
- Proximate SCOs
- Course learning outcomes
- Proximate SCO relations to Stage SCO
- Relevancy of the SCO (Which depends on the:)
  - Trainee level of the SCOs (Skills associated for the SCOs)
  - SCO relevancy towards learning outcomes (Mapped using skills hierarchy).
  - SCO relevancy towards the Stage SCO(Mapped using skills hierarchy)
- Different Paths with the order of the SCOs
- Current course position

5.4 ROUTING ENGINE

The decisions made by the Routing Engine follow loosely the framework used by Karagianidis et al. (2001a) . This defines the layered structure for the evaluation for adaptive and personalised learning services, which uses two distinct high level processes; *Interaction Assessment* and *Adaptation Decision Making*. The Interaction Assessment phase makes the high-level conclusions from the learner's interactions during their learning. These conclusions are analysed by the Adaptation Decision Making component, which personalises the content for the trainee. The NTP Routing Engine (Fig. 4) applies this framework in the manner that complies with the requirements of the SCORM specification. The Interaction assessment has been implemented in the **SCO Performance Assessment** (SPA) module. This component makes conclusions based on the communication interchange using the SCORM RTE, rather than monitoring low-level events such as keystrokes and mouse clicks. Conclusions such as "*The trainee 'Mike' has achieved 47% level on the 'Protecting individuals form abuse' –skill*", are based on trainee's prior knowledge and analysis of SCORM data model items *lesson_status, score and interactions collection*. The benefit of this approach is that the learning content can be authored to the SCORM standard and all objects in the repository, whatever their subject domain, can be scheduled by the system. Some limited extensions to the SCORM standard had to be made so that SCOs could be linked to specific skills. Karagianidis' Adaptation Decision Making component is implemented in the **Pathway Generator** (PG) module. This module passes the information about the Stage SCOs, Proximate SCOs and Pathways to the Learning Navigator. The possible paths could include:

- *Original*	One that was authored
- *Generic*	With SCOs that will generate widest range of knowledge
- *Fastest*	Based on time taken by the previous uses
- *Suggested*	Contains SCOs that best fit the users performance and entry profile
- *Popular*	Based on what paths have previous users selected

The PG recommends new paths by assessing how relevant SCOs are to the learning outcomes of the course and the Stage SCOs. These relevancies are counted by taking the sum of the linked skill elements, which are counted by dividing the amount of the skill association percentage (A) by the trainee's knowledge level on the skill (K). Each type of elements has a factor (f) that can be used to adjust the importance of the different type of relationships. Following formula is used to count the Proximate SCO relevancies. The Stage SCO relevancies ignore the last sum, which represents the Proximate SCO skills that are linked to a specific Stage SCO .

$$R_{ps} = \frac{\sum^{allskills}\left(f_a \frac{A_{ps}}{K}\right)}{n_{allskills}} + \frac{\sum^{linkedtogoals}\left(f_{lg} \frac{A_g}{K}\right)}{n_{linkedtogoals}} + \frac{\sum^{linkedtostagescos}\left(f_{lss} \frac{A_{ss}}{K}\right)}{n_{linkedtostagescos}}$$

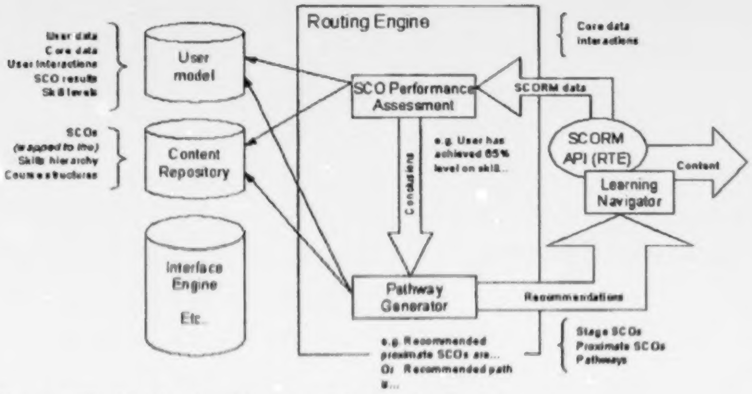
User data
Core data
User interactions
SCO results
Skill levels
SCOs
(mapped to the)
Skills hierarchy
Course structures
User model
Content Repository
Interface Engine
Etc..
Routing Engine
SCO Performance Assessment
Conclusions
e.g. User has achieved 65% level on skill...
Pathway Generator
e.g. Recommended proximate SCOs are... Or Recommended path is...
Core data
interactions
SCORM data
SCORM API (RTE)
Content
Learning Navigator
Recommendations
Stage SCOs
Proximate SCOs
Pathways

Figure 4: The high level architecture of the Routing Engine

5.5 IMPLEMENTATION ARCHITECTURE

The system has been implemented using a client side Java Applet as the SCORM API and the Learning Navigator, providing the graphical user interface and interactivity required by the Learning Navigator. The functionality of the Routing Engine and all database access was left on the server side Java Servlet, implementing a scalable distributed client-server framework (figure 5). Even though there are other technologies to implement the required system (Sherman 2000), this framework was chosen because of the following benefits:

- Java Applet can be used to implement high quality interactive graphical interface
- Faster response times compared to http-CGI architecture
- Logical functionality mainly in the server side minimises the download size of applet.
- Distributed architecture provides better scalability and maintainability

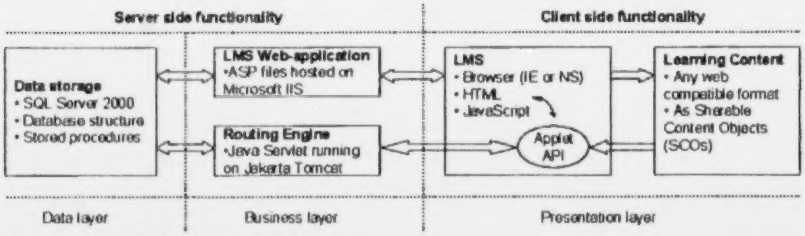
Server side functionality
Client side functionality
Data storage
• SQL Server 2000
• Database structure
• Stored procedures
LMS Web-application
•ASP files hosted on Microsoft IIS
Routing Engine
•Java Servlet running on Jakarta Tomcat
LMS
• Browser (IE or NS)
• HTML
• JavaScript
Applet API
Learning Content
• Any web compatible format
• As Shareable Content Objects (SCOs)
Data layer
Business layer
Presentation layer

Figure 5: The implementation architecture

6. VALIDATION

The proposed system will be validated and analysis will be made whether the pedagogical benefits match the estimations and if the logic of the system is suggesting better paths for the user. The intention is to follow the same validation process as Karagiannidis, Sampson and Brusilovsky (2001b). Validation will focus on three areas

- Overall success towards increased learning i.e. comparison with and without the Learning Navigator facility.
- Whether the SPA module can provide enough information to the pathway generator such that useful decisions can be made.
- Success of Proximate SCO and pathway recommendations of the Pathway generator

The granularity of the adaptation is dependent on the size of learning objects and the effect of this will need to be examined. In addition, we will need to measure how much users experience is affected when presented with SCOs that contain various different navigation panels and graphical user interfaces. This can be avoided by the use of standard template, but when SCOs from various sources are used, the outcome might be disturbing. ADL envisions including the templates to the scope of future versions of SCORM.

7. CONCLUSION

This paper has discussed how a LMS can be extended to provide individualised tuition. There is little doubt that a relevant individualised experience should lead to an enhanced training experience. E-learning is an ideal vehicle for deployment of individualised training because it provides direct access to each individual. We have demonstrated how courses can be represented as small discrete re-usable objects, stored in a learning repository, retrieved, and allocated dynamically at runtime. The e-Learning industry requires a cost effective solution of using existing/3rd party content and standard authoring tools to develop content. In addition, e-learning specifications, such as SCORM, should be used to provide interoperability between systems. At its current version SCORM requires slight extension to provide mechanism for delivering individualised training. Mapping the SCOs into a LMS skills architecture enables the PG to recommend learning objects outside the original linear course structure on the basis of their relevancy. Still, the analysis of the users interactions inside a SCO does not reflect towards a specific skill, but towards all skills associated in the SCO. The continued proliferation of e-learning solutions and the increasing number of trainees using LMSs means that the functions, which this project has provided could play an essential role in increasing learning effectiveness in the workplace

We have demonstrated how courses can be represented as small discrete re-usable SCOs, stored in a learning repository, retrieved, and allocated dynamically at runtime.

REFERENCES

Brusilovsky P. (2001) User Modeling and User-Adapted Interaction (UMUAI) - Adaptive Hypermedia, v.11, No 1-2, p. 129-158.

Mullier D.J., Hobbs D.J. and Moore D.J. (1998). A web based Intelligent Tutoring System, Proceedings of NETIES at Leeds Metropolitan University. An initial investigation into moving the ideas discussed in the previous papers into web environment. Available at the www: http://www.mullier.co.uk/NETIES.htm

Karagiannidis, C., Sampson, D. Brusilovsky, P., (2001a) Layered evaluation of adaptive and personalised educational applications and services Assessment methods workshop in AI-ED 2001

Karagiannidis, C., Sampson, D. Brusilovsky, P. (2001b). Empirical evaluation of User Models and User-Adapted Systems: A Layered Evaluation Review, 8th Panhellenic conference on Informatics, Workshop on software usability Nicosia, Cyprus, November 8 10th 2001

Kobsa, A. (2001) Generic User Modeling Systems. User Modeling and User-Adapted Interaction Vol. 11, 49-63, 2001 Kluwer Academic Publishers. Printed in Netherlands. http://www1.ics.uci.edu/~kobsa/papers/2001-UMUAI-kobsa.pdf

Sherman R. A., Singley, M.K., Fairweather, P.G. (2000). Porting a Standalone Intelligent Tutoring system to the web. Proceedings of the international workshop on Adaptive an Intelligent Web-Based Educational Systems held in conjunction with ITS2000.

ADL SCORM (2001). Sharable Content Object Reference Model Version 1.2 Specification, Advanced Distributed Learning, Available at www.adlnet.org

Writing-4-Sharing—A Web-based Writing Support System

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Introduction

This paper describes a web-based application that facilitates the meeting of pedagogical goals of process-oriented communicative writing. It supports the teaching strategies used in an EFL (English as a Foreign Language) writing class and allows the construction of electronic portfolios. The system allows uploading and exchange of electronic files through the World Wide Web and performs administrative tasks. It makes possible the smooth completion of collaborative writing, process writing and peer reviewing activities, all essential components of the curriculum of this writing course.

Rationale

The "Writing-4-Sharing" system was developed in response to a dire need to manage the sizeable numbers of papers in large writing classes efficiently. One of the difficulties encountered by teachers of writing in Asia is the large number of students in a class. It is not uncommon for an EFL teacher to be facing classes of 30 to 50 students. While collaborative writing, drafting and revising, and peer reviewing are techniques that are frequently used in writing classes, they require that the teacher keep track of all the papers and all the changing team members of each assignment, thus burdening the teacher with menial record-keeping tasks. A system that can track assignments, assign grades to all the members of a team and publish the students' work in an electronic space where all the students can view each other's work and the corrections made by the teacher can support the teaching strategies mentioned and reduce the number of administrative tasks that the teacher needs to perform.

Description of the System

"Writing-4-Sharing" was created at the Wenzao Ursuline College of Languages in Taiwan and is currently being used in a freshman level writing class of English majors. The system allows students to submit drafts and completed assignments through the World Wide Web and the teacher to download them, point out the locations of the errors and send the corrections back also by uploading the papers onto the Web. This cycle can be repeated as many times as drafts are required. The teacher can therefore electronically monitor individual or group writing processes from the brainstorming phase to the final draft. The system also enables students to see each other's papers, thus facilitating collaborative writing and peer editing as well as viewing of the comments offered by the teacher to all the papers. In addition, the program tracks the papers submitted by every student and keeps record of all the grades.

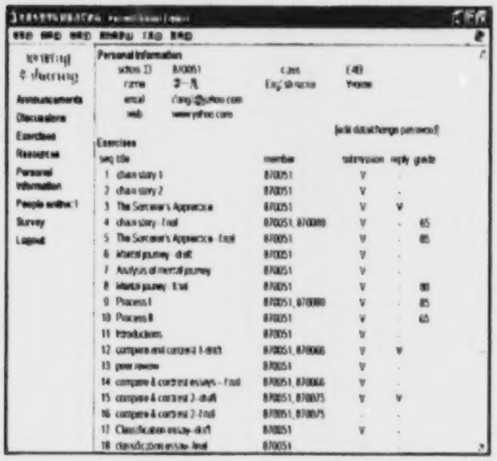
After logging in, students are shown a personalized screen from which they can choose to view announcements, participate in discussions, view their portfolios, consult online resources, upload or download assignments, or check feedback given by a peer reviewer or the teacher.

The teacher's interface allows her to post announcements or course materials. She can also start discussion threads or recommend valuable online resources.

The program allows the teacher to see groupings of papers submitted by student name or by project name. She can download the papers and use features of Microsoft Word such as underlining, commenting, or coloring to mark places in it where correction is needed. When the errors have been marked, she can upload the papers back onto the Web next to the original paper. The system automatically renames each file when it is uploaded or downloaded according to a numerical scheme so that there are no problems with multiple copies of the same file name.

"Writing 4 Sharing" also allows the teacher to assign students to work individually or as a team. She can assign students to different groups so that students can collaborate on different projects with different partners. When a grade is given, it gets posted to all the members of the team. The teacher can also assign students to peer review each other's papers or to view model papers without making additional paper copies.

2 sample screen shots


writing
4 sharing
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Exercises
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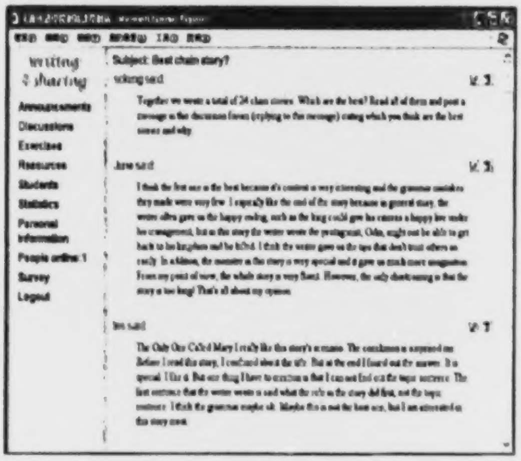
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Resources
Students
Statistics
Personal Information
People online: 1
Survey
Logout

Subject: Best chain story?

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Using Technology and Constructivism in Business Law: First Year Lessons

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Abstract: Converting to new teaching methods incorporating technology and constructivist principles can be a daunting challenge for professors and students alike. This paper will present the author's experiences in applying technology and constructivism to teach Legal Studies in Business. Students worked on realistic business problems that required them to conduct online legal research in an assigned U.S. state. The students used WebCT to post research results online; summarize and discuss the law, and collaborate with fellow students to reach solutions. The conversion to these new methods introduced several new layers of complexity to the teaching and learning process, including use of legal research techniques, bulletins boards, and new ways of evaluating student performance. Several strategies have been developed for easing the transition for new users of these technologies, and for enhancing the author's second year of teaching with this method.

Constructivist learning principles call for teaching methods that are problem-based, realistic, ill-structured, and invite consideration of solutions from multiple perspectives (Dunlap 1999). The emergence of substantial legal information online has created new opportunities for problem-based learning about real-life situations by using the Internet research tools available in the real world.

The most distinct feature of the Legal Studies in Business environment is that applicable legal rules vary widely from one jurisdiction to another (unlike laws of physics, chemistry or other disciplines). Thus, business law provides a unique context for using multiple perspectives to engage in problem-based learning.

To capitalize on this opportunity, the author assigned each student to a specific U.S. state, and required the students to conduct online legal research in the assigned state to solve a realistic business problem. The students also were assigned to a group of four fellow students. Using a WebCT bulletin board, the group was required to collaborate to reach a group solution the business problem, even though the legal rules varied in the students' assigned states. This process required students to analyze and synthesize the rules of law, and to deal with the complexity that is a part of the real world legal environment. Making the ransition to this teaching method presented several challenges for students and the instructor.

Complexity.

This method introduced a much higher degree of complexity for students compared to traditional lecture environments. Students were challenged to learn how to use the Internet tools for research, how to use the Lexis-Nexis legal research database, how find legal information online, how to read and analyze cases competently, how to reconcile conflicting rules of law in multiple states, how to use WebCT, and how to collaborate effectively online. For many students, dealing with the added complexity in one or more of these areas was a difficult obstacle that interfered with learning. During this inaugural course, insufficient support materials were provided to prepare students for this adjustment and to lessen complexity. In the future, significant explanatory materials (e.g. "How to Read a Case", "How to Handle Information in Lexis-Nexis") must be provided.

Ambiguity.

In our educational culture students expect and prefer specific information about course assignments and their weight in grading from the opening days of the course. In preparing the first attempt of this new teaching method, it was difficult to predict student performance on problem-based learning, and thus difficult to state a specific number or problems or their relative weight. Two choices were possible. Be specific and lose flexibility to make adjustments as needed based on student performance, or be ambiguous, thereby maximizing flexibility but increasing student uncertainty.

In this first effort, the number and weight of the assignments was left ambiguous. Students were asked to trust the instructor's judgment that the number of assignments would be reasonable based on their performance and that the relative weight of assignments would be adjusted at the end of the semester as fairness dictated. Many students struggled with this ambiguity regarding their workload and grading to a surprising degree. For some students it interfered with course performance.

To reduce ambiguity, instructors should be as specific as possible while retaining some flexibility. One approach would be to split the syllabus into two parts: a first part with specific numbers of assignments and grading, and a second part that will be pursued and adjusted if student performance permits.

Clarity of Instructions.

Constructivist principles hold that problems should be ill-structured and that learners' have a high degree of autonomy. Accordingly, few restrictions were placed on how students organized the work of their groups and the form their responses should take. Instructions were general and often given verbally in class.

Students and groups that struggled in their performance often cited the "lack of instructions" or "misunderstanding" of instructions as a reason for their poor performance. Students expect specifics on what, where, when and how to perform, and several groups had difficulty exercising their autonomy in this area. Confronted with the challenge of problem-based learning, some groups appeared to use lack of specific instructions as a "cop out" for poor performance. Specific and clear written instructions should be given early in the course to set patterns for performance, and learner autonomy can be increased as the semester progresses.

Workload and Feedback.

This approach requires the instructor to assess a large volume of messages and legal information posted in WebCT. The method requires good methods for evaluating student posting, keeping adequate records and posting feedback to students. Disciplined, consistent attention to the WebCT bulletin board is essential. Students found it difficult to move forward on further assignments until sufficient feedback was received. A lackof timely feedback was a strong source of student frustration. Consistent and timely assessment is an essential component of the method.

References

Jonassen. D., Mayes, T., and McAleese, R., (1993). *A Manifesto for a Constructivist Approach to Technology in Higher Education.* In T. Duffy, D. Jonassen, & J. Lowyck (Eds), Designing constructivist learning environments. Heidelberg, FRG: Springer-Verlag.

Strommen, E. and Lincoln, B. (1992). *Constructivism Technology and the Future of Classroom Learning.* http://www.ilt.columbia.edu/ilt/papers/construct.html

Dunlap, J. (1999). *Rich Environments for Active Learning on the Web: Guidelines and Examples, Proceedings,* WebNet '99: World Wide Conference on WWW and the Internet.

Warmkessel, M. M. & McCade, J. M. (1997). *Integrating information literacy into the curriculum.* Research Strategies, 15(2), 80-88.

Ritchie, D.C. and Hoffman, R. (1997). Incorporating instructional design principles with the World Wide Web, *Web-based instruction,* Kahn, B. (ed), New Jersey, Educational Technology Publication, Inc., pp. 149-158.

Interface Design, Functionality and Course Evaluation Quality Assurance for A General Education Course at the University of California, Davis

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Abstract

This paper discussed how a Mediaworks[2] online course was checked for quality assurance focusing on interface design, features, functionalities and performance. Recommendations to improve QA practice concluded the paper.

Interface Design Features with Implications to Learning

Moby course development[3] uses a familiar interface. The main LOGIN screen contains an embedded watermark of the UCDAVIS logo as a main background and two boxes where users input their username and password. The Main Page contains two main frames which divides the course's contents and the Home Page Menu. The entire course is organized with the Lecture Menu, My Personal Information, E-mail Your TA, Review My Notes, Course Management, Paper Interactions, Administration and Acknowledgment information on the left side. The right side merely contained directions to click on course links. The Lecture Menu contained all 24 lecture modules supplemented with information about the course organization on the right. The screen frame is divided into four movable frame sections. The upper left section is the graphics page. The lower left is the lecture page where all lecture files are displayed. The upper right contains the module number while the lower left contains the lecture titles, sublectures, slides and graphic titles.

The Moby course generator templates allows designing course content in a variety of combinations. For Anthropology 15, content was presented using a combination of highly text-based lecture presentation with simultaneous audio version of the text[4]. While this choice of mixing media method worked well for handicapped users, this arrangement is found (Hannafin and Hooper 1989) to place a huge cognitive load on the learner who have to simultaneously process two modalities e.g. sight and auditory, for the same information. Still another feature worth mentioning is the way information were grouped together in a screen by screen instance. The typical interface has a whole screen filled with a dense amount of text forcing users to read all lectures from the screen. A dense screen forces users to stare at the screen for long periods of time (Aspillaga 1996) and puts a big load on the user's eyes. This is a feature that could be simplified if main points were bulleted. This could be complemented with an option for downloading and printing a PDF version of the same lectures eventually allowing users to read from printed text. The typical Moby generated course navigation[5] options for the hypertext menu have been placed on the right side. Interface design research (Tullis 1997) on hypertext branching recommends left side positioning of navigation branching for ease, consistency and predicatability. Screen by screen viewing for each lecture modules revealed a need for the eyes to move around the various information-filled frames detracting the user further from making a coherent sense of all information (Verdi 1985). Even if the basic usability design requirements were not met by the course, the design choice was consistent until the last screen. The navigation options for all lectures were placed in the same predetermined design location adhering to user-interface design principles of consistency and predictability (Tullis 1997). By using the text with audio combination to present lecture content, the course design fulfilled the W3C[6] requirement for accommodating various users including people with handicap.

Quality Assurance for Anthropology 15

QA Testing of various linkages in the course modules required clicking on all available active links from course lectures to all graphics files. This was a highly important part of the QA testing and was considered of utmost priority over features testing. The graphic file must match the link. When a file mismatch occurred the problem was immediately alerted to the person assigned and was resolved immediately. Features corrections was also ranked in order of importance from highest to lowest priority. An unresolved issue of highest priority would be one which will alter the course organization, the course content and the message being conveyed such as teaching about gorillas and the graphics shows no relation to gorillas, e.g, picture of an urban landscape.

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[2] Mediaworks is the Information and Educational Technology arm of UCDavis

[3] Moby Course Development is developed in three server environments, the development server, the test server and the production server. The Development Server has a machine name of halfmoon.ucdavis.edu. This server takes care of the code design, development and graphic design in Windows 2000/IIS system and web server. This server allows limited user-defined security groups (EduTech and Mellon Team) with the write access limited to these same two groups and the Administrators. The Test Server has a machine name of cloudybay.ucdavis.edu. It is a Windows 2000/IIS system. This is where all data files are loaded and updated during the testing phase. The Production Server named halfmoon.ucdavis.edu is housed at and managed by the UCDavis Data Center. It is a machine with a UNIX box with Solaris 7.0/Apache serving as the system and web server. The procedure sequence starts with the issues log. This log becomes the source of allocating tasks among members of the development team. The team leader then assigned tasks based on this log. Existing code and business specification are reviewed followed by a verbal or written business specification on the design requirements. The developer developed the code then tested it either on the test server or on a self-created personal Test File folder. Through e-mail communication, business specifications were constantly verified to make sure the code worked and passed the test. After passing the code test, the code was then moved to the test server. Once moved the code developer was notified. The programmer then informed the team leader by e-mail, that the code is working. If more work was required the programmer would likewise be notified.

[4] More suited to people with a auditory and visual handicap

[5] Hypertext linkages within Lecture Modules are located on the right side of the 4 frame lecture page screen

[6] World Wide Web Consortium is a consortium that develops, recommends and standardizes and disseminates information related to web technologies.

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Anthropology 15 is one of the purely online courses developed at the University of California, Davis. Towards the end[7] of the Winter Quarter of 2001, project development had already progressed significantly to the point of completion. Dr. Alexander Harcourt, the course's instructor worked with Mediaworks to produce the course from conception to final production. Prior to my involvement with the project, several types of communications in the form of meetings, e-mail and telephone conversations had transpired between the Instructor and the Course Development Team to convey how the project progressed. However, a summary documenting all requests was unavailable as to allow the development team any form of quality testing at various points in the project cycle. Still a member of the development team this author was given the task of conducting the Quality Assurance Testing for the course. With little time to waste at such short notice, copies of e-mail communications between the Professor and the development team had to be requested and turned over to this author for summary analysis[8] and provided the basis for modifying features and functionalities in question. As QA tester this author's role focused on documenting all requests for changes by Dr. Harcourt and thereafter performing the QA task of ensuring all change requests were incorporated in the course. Requests made prior to October 1 were already documented and incorporated. My responsibility was to document change requests made after that date. Assignment of my responsibility for this course was not made clear and tended to vary with every meeting. In a seemingly hierarchical and seniority driven team, offering advice or providing comments of any nature especially from a new addition to the group was not positively received. I therefore, had to wait for all forwarded e-mail messages a week before the scheduled release of the course. The e-mail communications were the only means of creating the summary of requests. With a pressure for time, this summary could only be done in a handwritten form in an excel spreadsheet. With the summary ready, copies were provided to members of the team tasked with QA testing. One member worked with problems that were mainly features in nature. Another member worked with the application related to ColdFusion templates. Another member made sure that all linkages worked. All of these tasks were frantically completed before the CD version of the course was due for release on December 17.

With the summary as a guide, QA testing proceeded. Lacking a well-defined QA procedure in place, each member of the team agreed which aspect of the course required more attention with functionality having the highest priority over feature or application. Due to the intense QA testing activities the course instructor was notified that no additional request for more changes were to be made after a certain date. This was done essentially to smoothen the flow of QA testing tasks among team members who prioritized among themselves which request must be completed over others and, whether the change was necessary considering the time pressure.

Conclusion

There was a major drawback to doing quality assurance testing for the online course within a very limited time. First, the quality of the product is not assured. Technical glitches may still lie undetected and can pose serious problems to the course. Second, depending on the severity of the problem, the course may require redesign and redevelopment which can cause severe drain on the development team's resources in terms of time, human, and equipment. In addition there is also the added pressure imposed on the morale of the entire members of the team who have to go through the whole project cycle. Quality assurance in an online course delivery is a lot more complex than traditional format because rules are not fixed and clear-cut and standards are evolving. The basis of comparison for both formats are totally different. In the traditional method we have a human imparting the knowledge. In a computer-mediated course the human is replaced by a machine. While course content remain unchanged the criteria for evaluating one against the other can be approached in various combinations and in many different ways.

Acknowledgments

The online version of Anthropology 15 was developed in collaboration between the content provider, Dr. Alexander Harcourt and Mediaworks, the central media unit in the UCDavis campus using a content delivery system called Moby and the campus portal, MyUCDavis. Acknowledgments are due to Prof. Harry Matthews for infrastructural information on Moby online course development and Dr. Barbara Sommer for course evaluation information. Special thanks ares due to the Andrew W. Mellon Foundation who provided the grant to support the Mellon project.

Reference

Aspillaga, M. (1996). Perceptual foundations in the design of visual displays. Computers in Human Behaviour, 12(4), 587-600.
Mediaworks E-mail Communications Educational Technology Team, University of California Davis. October 1-December, 2001.
Flowers, C.P., and Algozzine, R. F. (2000). Development and validation of scores on the Basic Technology Competencies for Educators Inventory. Educational and Psychological Measurement, 60(3), 411-418.
Grabinger, S. (1989). Screen layout design. Computers in Human Behaviour, 5, 175-183.

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[7] This author joined UCD, IET Mediaworks in November 2001.

[8] The lecture number, module number, page description and a summarized description of the problem
The choice of whether the problem is a feature, application, content or a functionality problem.
The main file containing the problem and the links and files associated with the problem
The level of priority attached to the problem
The date the request was made
Who was assigned to fix the problem with a suggestion on resolving the problem
The date the problem was resolved.

Hannafin, M. and Hooper, S. (1989). An Integrated framework for CBI screen design and layour. Computers in Human Behaviour, 5, 155-165.

Loo, R. (1999). Confirmatory factor analysis of Kolb's Learning Style Inventory (LSI-1985). British Journal of Educational Psychology, 69(2), 213-219.

Lucas, L. (1991). Visually designing the computer-learner interface. Educational Technology, July 1991.

Matthews, H. and Wilson, L. (2001).

Mediaworks Documents. (2001). Moby Online Course Documentation.

Plant, R. (1999). Moby System.

Selwyn, N. (1997). Student's attitudes toward comnputers: Validation of a computer attitude scale for 16-19 education. Computers in Education, 28(1), 35-41.

Tullis, T. (1997). Screen design. In M. Helander, M. Landauer, & P. Prabhu, (Eds.), Handbook of human computer interaction (pp. 503-531). North Holland, Amsterdam: Elsevier Science.

Twigg, C. (2000). Quality Assurance for Whom? Providers and Consumers in Today's Distributed Learning Environment. The Pew Learning and Technology Program. http://www.center.rpi.edu/PewSym/mono3.html

Verdi, M. et. al. (1995). Organized spatial displays and texts: effects of presentation order and display type on learning outcomes. The Journal of Experimental Education, 65(4) 303-317.

Applying Knowledge Map to Intelligent Agents in Problem Solving Systems

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Abstract: According to the four steps of problem solving proposed by Marshall in 1995, a knowledge structure is designed based on the Concept Map and the Concept Schema, which is so-called Knowledge Map. Knowledge Hierarchy derived from Hierarchy Map of Concept Map can be used to indicate the relationships among concepts, whereas Concept Schema represents the information of the corresponding concept. After the Knowledge Map is well analyzed and designed, three functions for manipulating knowledge in problem-solving systems, such as matching operation, locating operation and loading operation are considered. And finally an intelligent agent within Knowledge Map to accomplish problem-solving steps is implemented to providing assistances for students in distance learning environment.

Introduction

After the invention of computer, some interactive programs, called CAI Systems (Computer-Assisted Instruction Systems), are developed for help students learning. There are many previous researches from building a proper problem-solving system for students to solving a common problem by using computer system (Mayer 1992), such as four steps for solving mathematic problems (Polya 1965), seven stages of problem solving for science experiments (AUP 86), and so on. Another interesting research issue in CAI Systems is Intelligent Agent. Some Intelligent Agents are used for helping students doing science experiments in V.E.E. (Virtual Experiment Environment) (Huang et al. 1999; Kuo et al. 2001); the others are used to diagnose students' learning status in problem solving systems (Chang et al. 1999; Heh 1999; Chang et al. 2000). In this paper, an Intelligent Agent is designed with a kind of knowledge structure, Knowledge Map, to help student solving problems.

Using Knowledge Map for Solving Problems in Intelligent Agent

This paper proposes a new knowledge structure used for problem solving called *Knowledge Map*. The idea of *Knowledge Map* comes from Concept Map and Concept Schema. An example of *Knowledge Map* for partial domain of Physics is shown in (Fig. 1). The gray blocks are the original Concept Map and are drawn as a *Concept Hierarchy*, which comes from the idea of hierarchical *Concept Map*. For example, the concept, "Motion with Constant Velocity," is one type of "1-Dimensional Motion." The correspondence of white block to the gray one is the *Concept Schema*, which comes from the definition of schema in (Gagné et al. 1993) for presenting natural categories, events and text of a concept. Take "Motion with Constant Acceleration" for example, it has its own definition "acceleration is constant" and the physics formula "rule $v_t = v_0 + at$".

After constructing the *Knowledge Map*, some operations for manipulating knowledge in problem solving systems have to be designed in an Intelligent Agent: *1. Search-Operation*; *2. Locate-Operation*: finding what concepts should be accessed; *3. Load-Operation*: loading contents in concept schema into the short-term memory. To use the Knowledge Map for Solving Problem, this paper follows four problem-solving steps extended by four types of knowledge schemas (Marshall 1995; Cheng et al. 2001). In (Fig. 2), a problem loaded into a Problem Solving system. This problem is processed through four steps:

1. problem identification: loading problem into problem solving system and using knowledge map to construct *Knowledge Object Schema (KOS)*.

2. problem elaboration: elaborating the *KOS*.
3. problem planning: translating *KOS* to *Problem-Planning Schema (PPS)* and using knowledge map to do problem solving plan.
4. problem execution: using *PPS* to get the answer and produce results.

All these steps get knowledge from knowledge base in long-term memory and produce different schemas stored in short-term memory.

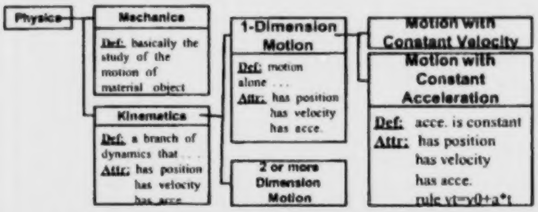
Physics
Mechanics
Def: basically the study of the motion of material object
Kinematics
Def: a branch of dynamics that . . .
Attr: has position
has velocity
has acce.
1-Dimension Motion
Def: motion alone . . .
Attr: has position
has velocity
has acce.
2 or more Dimension Motion
Motion with Constant Velocity
Motion with Constant Acceleration
Def: acce. is constant
Attr: has position
has velocity
has acce.
rule vt=v0+a*t

Fig. 1 Knowledge Structure - Knowledge Map

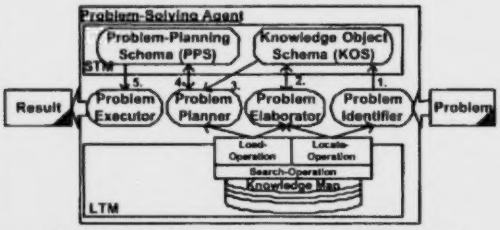
Problem-Solving Agent
Problem-Planning Schema (PPS)
Knowledge Object Schema (KOS)
STM
5.
4.
3.
2.
1.
Result
Problem Executor
Problem Planner
Problem Elaborator
Problem Identifier
Problem
Load-Operation
Locate-Operation
Search-Operation
Knowledge Map
LTM

Fig. 2 Flow Chart of Problem Solving Agent

Conclusion

This paper proposes a new knowledge structure for problem solving called *Knowledge Map* constructed by *Concept Hierarchy* and *Concept Schema*. *Concept Hierarchy* indicates the relations between concepts and *Concept Schema* stores concept-related information. This paper also shows the four steps of problem-solving and designs three operations for manipulating knowledge on *Knowledge Map*. With these operations, *Knowledge Object Schema* and *Problem-Planning Schema* are created to complete the whole problem solving process and help Problem Executor to generate results. The feature work of this paper is to change *Knowledge Map* to reticular one, increase (or insert) knowledge automatically, and construct Knowledge Map from natural language.

Reference

APU (Assessment of Performance Unit) (1986). *Science in school*. Age 15. Report No. 4 DES, England.

Chang, J., Chang, M., & Heh, J. S. (1999). Applying the Evaluation Model of Problem Solving to Agent-based Instructional System. *Proceedings of the 7th International Conference on Computers in Education*, Chiba, Japan, pp. 141-148.

Chang, J., Chang, M., Lin, J. L., & Heh, J. S. (2000). Implements a Diagnostic Intelligent Agent for Problem Solving in Instructional Systems. *Proceedings of the First IEEE International Workshop on Advanced Learning Technologies*, Palmerston North, New Zealand, pp.29-30, Dec. 4-6.

Cheng, K. F., Kuo, R., Yang, K. Y., & Heh, J. S. (2001). Intelligent Agent Construction for Problem Solving with Knowledge Schemas. *The 17th Workshop on Science Education*, Kaohsuang, Taiwan (accepted)

Gagné, E. D., Yekovich, C. W., & Yekovich, F. R. (1993). *The Cognitive Psychology of Scholl Learning*, New York : HarperCollins College Publishers.

Heh, J. S. (1999). Evaluation Model of Problem Solving. *Mathematical and Computer Modelling, Vol.30*, pp.197-211.

Huang, C. W., Hsu, C. K., Chang, M., & Heh, J. S. (1999). Designing an Open Architecture of Agent-based Virtual Experiment Environment on WWW. *World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Seattle, WA, USA, pp.270-275.

Kuo, R., Chang, M., & Heh, J. S. (2001). Applying Interactive Mechanism to Virtual Experiment Environment on WWW with Experiment Action Language. *IEEE First International Conference on Advanced Learning Technologies, (ICALT 2001)*, Madison, Wisconsin, USA, Aug. 6-8, pp.289-290.

Marshall, S. P. (1995). *Schemas in Problem Solving*, Cambridge University Press.

Mayer, R. E. (1992). Teaching for Transfer of Problem -Solving Skills to Computer Programming. *Computer-Based Learning Environments and Problem Solving*, Springer-Verlag Berlin Heidelberg, pp. 193 – 206.

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Using Digital Terrestrial Broadcasting in Schools

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Abstract: Digital terrestrial broadcasting is going to be introduced into Japan and there may be some possibility that it can be used for educational purposes in schools. We conducted an experiment to try DTB collaborative learning in three elementary schools. Students in these schools watched TV as the main content of DTB and then received information from other schools from data pages. Interviews of teachers and a questionnaire to the children revealed that it is interesting to use DTB as a learning tool but there are still some problems to be solved.

Digital terrestrial broadcasting(DTB) is going to be introduced into Japan and there may be some possibility that it can be used for educational purposes in schools. We tried to explore the possibility of using DTB in schools using them as a tool of collaborative learning in three classrooms.

1. Purposes and Framework of the Experiment

The purposes of this study was to develop a method to design multimedia contents on data broadcasting, to try the interactive function of DTB, and to make a list of necessary conditions as to learning using DTB. We chose three elementary schools for our experiment; the Attached Elementary School to the Faculty of Education of Kanazawa University, Meisei Elementary School, and Takahama Elementary School. Each school has an excellent IT teacher who leads other teachers. Attached elementary school is in the suburbs of Kanazawa city. Meisei elementary school is in the middle of Kanazawa city, and Takahama Elementary School is in a country area near Kanazawa city. Every school has a river near by and has an integrated curriculum for environmental learning in the sixth grade.

2. Outline of Implementation

Students in each school watch shows as the main content. The shows are from a series of TV programs named "*The only one earth*," which deals with various environmental issues for fifth and sixth graders in Japan. Collaborative learning with this series had already been tried and the results were analyzed(Kurokami, 1998, 2000). We were allowed by NHK to use this series for our project. We picked up two shows about "water" because topics of learning in the project schools are about water; river, water pollution, water insects, water usage, and so on.

After watching TV, students learn in depth about issues in the show deeply for their area. Sometimes they go to a field or a river outside of school and investigate the number of insects, the extent of water pollution and the way to clean up water, Afterwards, they make a multimedia data broadcast to be aired with the next main show.

The curriculum for environmental learning started at the beginning of sixth year. In the spring term, each class learned about environmental issues independently. After the summer vacation, they started learning about the environment collaboratively. We conducted DTB learning three times during this period. The main show of the first DTB was "*Water and Human Life*" and the content of the data broadcast was a self-introduction. They identified relationships between various phenomenon and human activities and watched the self-introductions from the other schools. The self-introductions contain photographs of schools, students and teachers, and texts about their learning activities. The second DTB was on Oct. 26, 2000. Topics of the main broadcast were about the ways to clean up water. Children of the Attached Elementary School visited *Sai river* and filmed their activities. From this, they edited 17 short movies out of their original digital videotapes. *Meisei Elementary School* contributed two short movies to the data broadcast. These movies became the main resource of the digital broadcast. The last broadcast for the children was to exchange comments with each other by way of a data-broadcast using up-link to the broadcasting center.

3. Result and Conclusions.

We conducted formal interviews with teachers three times during the experiment and conducted a questionnaire to the children after the period of the project. Answers from the questionnaire were as follows:
-It was very interesting to find out about the activities at the other schools.
-I would like to know more about the other schools.
-Watching the shows and the data was very interesting.
From this, we can think that most students were interested in the collaboration with DTB.

On the other hand, teachers said that it was very difficult to control the stream of learning. One of the reasons is the delay in seeing the data. Data sent from each school is connected to the show of previous broadcast. Therefore children have to watch the next show first before they can see this data, which is downloaded to each school behind the main show. It might be a little confusing for children. The other problems cited by teachers are as follows:
-Lack of data cache: The system we used had not cache for the main content at all. We could not stop the TV nor re-watch it. Also we could not also cache content of the data. Each show was 15 minutes long and watching data from the other schools took more than 30 minutes. A lesson in Japan is 45 minutes. Therefore, there was not enough time to think nor discuss topics from the show or the data. It is necessary to add a cache device to the system.
-Difficulty of BML editor: Children can write up their data using Broadcast Markup Language(BML) editor, but operation of the BML editor is not easy to understand. Sometimes using the BML editor was confusing for some students who has knowledge of HTML. BML editor has to be come more user friendly.
-Screen operation: The most confusing thing for children was that a mouse could not be used for the data broadcast. It is designed to be manipulated by remote control. Therefore children needed to be familiar with the screen and the movement of DTB.
-Time for editing: Children have to film and take pictures of their learning activities. Then they have to integrate these materials into a series of document. However, it is time consuming for the children to edit their own film and pictures into a multimedia broadcast of DTB. It was educational for children to carry out this activity, but it took too much time. A more flexible curriculum and time schedule are necessary.
-Limited size of movie file: In the regulations about DTB, each component on a data page cannot be over 1 MB. As the size of some movies from schools was more than the limitation, we ourselves put the big movies on the HDD of each television set and linked them to the data pages. Therefore, we need to increase the limitation of bytes. School children are increasingly making digital movie at school as a learning activity, so they need to be able to present all of their data.
-Privacy policy: People who could watch the DTB were strictly limited in this experiment, because there were only three sets on which to watch it in the Hokuriku area. Therefore, we could publish private information in the broadcasts. When this is launched on a full-scale, we would have to hide this information. The problem of privacy policy will occur at that time. If we use DTB for collaborative learning, we would need communication channel to exchange private information.

We think there is a huge possibility for using DTB as a learning tool in the future. These results will be useful for our next experiment.

References

Kurokami,H., Horita, T. & Yamauchi, Y. (1999). Development of a Collaborative Learning System based on NHK's Educational TV Program *Proceedings of ED-MEDIA 99* pp.1815-1816

Kurokami,H., Horita, T. & Yamauchi, Y. (2001). A Small History of Communication Board for Collaborative Learning Among Distant Elementary Classes, *Proceedings of ED-MEDIA 2001*, pp.1035-1040

Creating a Virtual Community with PT3: College of Education Students' Beliefs, Expectations and Attitudes toward Online Learning

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Abstract: Through the Preparing Tomorrow's Teachers to Use Technology (PT3) project, online distance courses in College of Education at New Mexico State University (NMSU) have become an essential component of the Teacher Education Program. Pre-service teachers have been engaged in the process of learning with and about technology. The main purpose of this study is to describe and analyze College of Education students' beliefs, expectations, and attitudes toward online learning. This is a qualitative ongoing case study. Through purposive sampling techniques, twenty-one students from six different online graduate courses in the College of Education were selected as participants. Videotaped interviews have been conducted to explore and evaluate students' reflections toward online learning in its natural environment. This study is exploratory in order to allow insights to emerge from a recursive data analysis process. The variables in the site of the research are highly complex and extensive. The research data is very context dependent and needs to be collected in its natural environment without controls and manipulations.

Overview of the Study

Over the past few years, online distance education has been explosively popular with College of Education students at New Mexico State University (NMSU). The Preparing Tomorrow's Teachers to Use Technology (PT3) project has been helping faculty integrate online learning environments into their courses. As a result, the College is dealing with the enormous growth of the electronic learning environments, which has encouraged the University to open its door to learn and teach in virtual milieus where students and professors can communicate with each other electronically. With the rapid growth and increasing accessibility of the Web, many professors are now offering various types of online-based courses, ranging from partially online to completely online, to their students. Email, electronic conferencing, synchronous and/or asynchronous chat and electronic bulletin boards have been used to enhance many classes in the College of Education. With the use of virtual learning milieus as a supplement to on-campus classes as well as in online classes, there is no doubt that the traditional classrooms are no longer bound by time and space in the College of Education.

When used appropriately online distance education can provide increasing numbers of convenient and relatively inexpensive learning and studying environments; it also has the potential to support real-world experiences to not only faculty but also students at NMSU. The College of Education has invested heavily in WebCT as a virtual learning environment. Since WebCT has provided new opportunities to use the Web as a medium for instruction, many courses and programs in the College of Education have been rapidly changing to keep pace with the use of WebCT.

WebCT is a unique educational delivery system. The use of WebCT, however, as a delivery medium in the academic setting in the College has started to change students' roles and learning strategies. Unlike traditional education, WebCT as an instructional tool has started to make College of Education students take responsibility for their own learning at their own pace in their own space. Learning with

WebCT has also put students at the center of their learning process. Professors are embracing WebCT into their curriculum both for online instruction and to supplement traditional education by incorporating new ways of accessing, delivering, exchanging and sharing information with their students whose beliefs, expectations and attitudes toward online learning have become an important tool for addressing problems, which may arise in implementing online tools.

Technology Integration into Learning Environment

WebCT by itself is just an electronic data source for the students. Like the use of any other educational media, designing WebCT as an instructional tool must be based on instructional theories, design models, and strategies. Since information can be sent though WebCT quickly, students may need to carefully redesign and revolutionize their new roles around online learning, methods, techniques and strategies in interactive and collaborative virtual learning activities.

This study has taken a grounded theory approach to allow the researchers to explore and discover the students' reflections toward online teaching for two reasons. First, increasingly academic institutions are beginning to offer graduate level teacher education courses online. Secondly, online learning opportunities and students' beliefs, expectations and attitudes toward online learning are relatively new phenomena. Students' reflections, however, toward online learning need to be more clearly defined, examined and/or analyzed to integrate and implement this technology into the curriculum efficiently. However, there is a lack of theoretical or empirical research on this topic (Wills & Becht 1997, Mendels 1998, Valenta et al 2001).

The main purpose of this study is to examine College of Education students' beliefs, expectations and attitudes toward online learning in higher education settings. Before entering the study, the researchers tend to analyze the research data inductively rather than to prove or disprove a hypothesis. The main focus in this study is: 1) to investigate and understand the insider's views toward teaching online courses in different subject areas, and 2) to expound on this study participants' perspectives and interpretations rather than researcher imposed categories.

Research Design

Participants and Setting

The purpose of this study is to investigate the students' beliefs, expectations and attitudes toward a particular phenomenon of online learning in different subject area experiences. During the 2001-2002 school year, research was conducted within the College of Education at New Mexico State University, a medium-sized research university in the Southwest. The College of Education has been offering classes online (in various degrees, i.e. enhanced or completely online) approximately four years.

The students in the College of Education were chosen for three major reasons: First, many members of the current students have been strongly interested in using the web as an instructional tool to make possible communication between regular class sessions (Baptiste & Kurubacak 2002). Each week students would post their assignments and any questions, concerns, or ideas online. The students could read, receive, post, exchange and/or share information on the discussion topics of each week before and after class. Sometimes students would email the course professor's account directly, when they had particular questions, suggestions and /or comments any time. Second, the most of course curriculums in the College of Education have included both computer-based learning activities into classroom and web-based learning activities, WebCT has been used for posting the students' messages and papers via email and electronic bulletin board. Finally, the majority of students in this study have been considering the idea of taking courses completely online in the near future and some of them are already taking courses online.

Twenty-one students from six different online classes in Teacher Education Program at the College of Education were identified for the interviews according to their willingness to participate the study. Four of these twenty-one students were male and seventeen of the participants were female in this research.

Data Collection

This study utilized qualitative data to provide detailed information to the researchers for analysis. Video and audio type taped interviews have been the instruments in this study. Therefore, the open-ended interview questions are designed to collect and analyze data on the students' beliefs, expectations and attitudes toward online learning in different subject areas. Each interview's questions were developed and modified according to investigating the focus of this study.

The researchers allowed the participants from the six different online courses in Teacher Education Program, as groups, to set the interview dates and locations themselves. Face-to-face interviews were held with all six groups in the College of Education building. Each interview lasted approximately 45 minutes in length. Although all interviews were video and audio recorded, the researchers wrote notes that summarized the major points of each session.

Researchers have been following a careful data management process to ensure high-quality accessible data and documentation of data collected. For these reasons, the researchers regularly recorded and systematically stored qualitative data on computers and videocassettes. The data has been indexed for easy and consistent retrieval.

Data Analysis

The analysis of the students' beliefs, expectations and attitudes toward online learning on the different subject areas is ongoing process, that began at the end of the Fall 2001 semester and will continue through the final written report. The data analysis process in this study is analytic and recursive to inform further decisions on data being collected. It also is restructured, flexible and open to the discussions with the stakeholders and reviews of related literature.

During the data analysis procedure, the researchers briefly followed these steps given in a logical order: 1) transcribed each video and audio type cassettes, and 2) identified patterns and themes. After transcribing the cassettes and identifying patterns and themes, the researchers triangulated the qualitative data and reported the results in descriptive and narrative form together.

Discussions and Interpretations

Content analysis of this study indicated that students have both positive and negative beliefs, expectations and attitudes toward online learning. Among the students' positive reflections in this study were that online courses could provide not only enhanced flexibility, but also student convenience and access to updated course information. Among some of the negative reflections that students reported about their experiences with online learning was decreased human interaction and collaboration as well as the increase in students' course work. The lack of technical support and knowledge about technology seems to be major problems for the students in this online learning environment.

Positive Students' Beliefs, Expectations and Attitudes toward Online Learning

The participants in this study learned best when they developed positive attitudes toward virtual learning environments. These positive attitudes motivated them to solve a problem, accomplish a task, set specific goals, work with others and informational resources during the learning process. However, it took time for these students to adopt a positive attitude towards online learning. The twenty-one interviewees in this study could eliminate their possible biases toward online learning when the instructors were aware of which WebCT methodologies and techniques affected their beliefs, expectations, and attitudes.

Therefore, the structure of any online course must involve determining the overall instructional approach, the theoretical and educational basis for that approach, potential strategies, methods, and instructional activities (Bannan & Milheim 1997). The participants in this study especially emphasized that they enjoyed working within the virtual environment because of enhanced flexibility, convenient course scheduling, and round-the-clock access to course related information.

Flexibility and Convenience

The participants in this study were working full time or part time while earning their master or doctorate degrees in the College of Education. The majority of students had to commute at least one hour to the campus everyday. What was most important to students in this study was that online distance education not only provided flexible time management, but also allowed them to save on travel time.

All of the interviewed students in this study stated that they could work anywhere at their own pace. Monica pointed out, "*[It'] comfortable for me to study at home, especially after the children go to the beds...but you have to discipline yourself, otherwise you can easily focus on doing housework rather than doing your assignments in your cozy study place*" However, the participants in this study were also aware that it required high self-discipline and self-confidence. Robert stated, "*[I] would like to study at home, however, you have to firmly arrange your schedule... to take the class online is different from...to attend the class on the campus...Also you can raise your voice online to ask a help when you need. It's not easy every time...sometimes I feel I am the goofiest student in the class [laughing]...WebCT-based course requires self-discipline. It is easy to be frustrated and drop out.* " Robert was not the only participant who felt that the online learning environment was different from face-to-face class settings. Nineteen of the other participants also agreed with Robert's viewpoint on virtual learning milieus; "students roles and responsibilities in online classes were not the same as their positions and tasks in a traditional face-to-face course".

Access the Course Online

Twenty-one interviewees highlighted that they could find useful information about the course and course work in their virtual class. These participants also pointed out that they regularly accessed WebCT to get online course information throughout the semester. All participants in this study indicated that they enjoyed reading about the course and assignments. One of them, Juanita, made her statement on this issue: "*[you] can read the instructor's messages before coming to class...I had a hard copy syllabus, but I always check the online one, if she [the instructor] changes the schedule or announce new activities.... I can learn new information very promptly, it is helpful.*" Juanita had significant previous experience taking WebCT classes and did not lack self-confidence. She regularly accessed the course web page from work because her work place provided a faster modem.

Of twenty-one participants, the majority pointed out that they would like to read the assignments posted by the other students in their classes. John stated: "*[I] always read the posted assignments...especially before the class...I' am amazed...the people focus on different details on the assignments...sometimes I have never ever thought these details.*" John also highlighted that "*[it] was very difficult to express himself or herself sufficiently...like at the face-to-face class.*" However, the majority of the interviewees in this study reflected their anxiety about the online assignments and other posting messages. Tim expressed the following statement: "*[it's] kind of weird; because everybody can read you...not only the instructor.*" The participants in this study felt that they were more motivated to work hard on their assignments, because the professor and other students would be reading them.

Negative Students' Beliefs, Expectations and Attitudes toward Online Learning

There were three main barriers for the students in this study to learn with online environment: 1) technological problems, 2) lack of technical support, and 3) lack of knowledge about technology. The students in this study sometimes had difficulties accessing the online course. John stated: "*[It's] frustrating to have problems, it's frustrating not to find the solution, and not to fix it.*" The lack of accessibility to the online course created negative reflections toward virtual learning milieus.

This study indicates that students are more successful online when they are trained on online learning and have regular technical support. Students must be encouraged and motivated to take full advantage of online learning milieus.

Limited Interaction and Collaboration Online

Interviewed students indicated that they did not have enough information about online learning and their changing roles in electronic learning settings. Kim stated, "*[I] always miss the class online, thus it* *is very hard for me to catch up…At the beginning of the semester, I had no idea about how I could access the course WebCT site, it took nearly over three weeks to learn, it is really heart breaking.*" Thus, they did not successfully nor actively interact with other students, faculty, and online educational resources. Also, the majority of the participants in this study stated that they needed to learn the skills of online communication. John pointed out, "*[Maybe] another form of communication is needed online. WebCT courses require high-level self-discipline as well. You have to logon regularly the course.*"

There were many comments that specifically addressed the lack of collaboration in online learning. Tim expressed his feelings about online collaboration, "*[Online] communication is not like to communicate somebody else in person. WebCT is not for me to talk with other. I always prefer to interact my friends face-to-face. It's warm and comfortable. You cannot get feedback promptly online. You have to always be careful whether somebody else answers you or not.*" When the interviewed students communicated with each other on WebCT, the students were not able to reflect on their experiences and fix their learning problems. The participants in this study, however, indicated that a majority of students in College of Education when lacking knowledge and experience with online environments tend to generate a lack of confidence when communicating online. The learning strategies, methods, and activities in online learning setting are different from face-to-face courses. Uncertainty creates curiosity, anxiety, and conflict in these students who have low comfort levels with using online technology. As a result, the students were less eager to participate in online learning. While virtual learning settings might be helpful in achieving vital educational goals, faculty members suggest that face-to-face communications are important to promote effective social interactions among students and between students and faculty.

The majority of the interviewed students preferred face-to-face class interactions. They also pointed out that their age, gender, personality, and cultural backgrounds highly affected their participation and contributions in various educational settings. Juanita strongly stated, "*[I] am better at face-to-face communication in person than at communicating online. I would like to observe the mimics, gestures and body languages when talking with someone. I have to see the eyes when I am communicating with her/him.*" Like Juanita, John (another participant) made few comments to the online course. He acknowledged that the variety cultural backgrounds of the students could support effective communication, but the face-to-face communication was more valuable and helpful than online interaction.

In addition, the online learning, communicating, and writing skills of students could be major barriers to interactive online learning. Kim highlighted that "*[special] I learning skills are needed for taking a WebCT class…for example writing is not easy for me…I don't enjoy typing the keyboard to do my assignments…It takes too much time for me to type, and it is not fun…It is easy for me to speak in person.*" Like Kim, Tim stated, "*[Reading] on screen is very difficult…I have to printout each screen to get the real his/her point of view*" Juanita, like Kim, also expressed similar feelings about studying online, "*[I] am one of the slower, and it takes all my time to write something for the class…I don't like it.*" When an online learning environment has cross-cultural communication and uses a systematic approach to deliver content, online students can connect theory and practice as well as have more in depth reflection in the construction of knowledge.

Overwhelmed Course Work

The majority of the participants in this study felt more time was spent on the WebCT class than in regular classroom. Jane loudly expressed her feelings with the statement, "*[I] did have to work very hard for the online class…I strongly feel online courses required more work.*" All of students in this study pointed out that they often times felt overloaded with information in their online classes and that virtual learning environments required more work. The majority of the participants in this study, like Jane, expressed their feelings of being overwhelmed by not only the quality but also the quantity of contributions of the instructor and other students. Kim pointed out, "*[I] feel I cannot write and think at a high level like the others in the class…I think it's depend on the course content, but I lost my concentration on the coursework…*" One of the most challenging aspects in implementing an online learning in higher education can be the structure and instructional strategies of the course content.

Conclusions

The body of the research literature dealing with students' beliefs, expectations and attitudes toward virtual learning milieus is small, but growing (Valenta et al. 2001). Online learning in higher education is a recent phenomenon, which requires more research as well. The use of virtual learning environments is gradually shifting, so it is necessary to keep pace with improvement on the learning process. The use of online communication in academic settings is increasing rapidly and has become a vital issue studied. This study shows that the key points of online learning are to offer online learning techniques and to provide reliable and regular technical support. In addition, encouraging and motivating students to take advantages of virtual learning as an educational tool is also a necessary measure to insure effective utilization of the online learning milieu.

An essential step in integrating online learning environments productively in higher education is starting with an explicit definition of the educational role of online learning and understanding the changing roles of students in virtual milieus. Integrating online learning into learning can lead the College of Education to adapt changing roles, needs, interests, and concerns. Students are, doubtlessly, one of the most important components in online teaching. On the other hand, the roles of students have been changing dramatically in virtual learning milieus; their needs, concerns and roles vary substantially from face-to-face educational settings. The major problem is that many students do not understand their responsibility to be active contributors of learning in the virtual milieu and that the professor's role is to be a facilitator and a mentor. Therefore, not only must students be trained how to instigate and contribute as online participants on WebCT, but they must also acquire good online learning skills and strategies before taking a WebCT based course.

To create a successful collaborative online learning environment, group or cooperative learning must be emphasized among students, and between students and professors. Virtual collaboration, which covers active participation and interaction, are essential experiences that students should have. Thus, WebCT must organize and structure online interaction among students, professors, experts from the outside, and/or global online resources with fewer time and space limitations. Online learning must also encourage and engage students to work together during learning activities. Conversely, promoting and maximizing group work and collaborative learning in a virtual environment is not easy. It is also difficult to identify social presence, authentic tasks, and cognitive strategies such as taking ownership of a task whose cognitive challenges are consistent with the cognitive demands of the design environment. This environment must support knowledge construction and idea sharing. This virtual learning setting must also enable students to continue work on their own tasks.

The overall teaching atmosphere in College of Education is highly academic and professional. Nevertheless, lack of online learning experiences and computing skills affect students' beliefs, expectations and attitudes toward online learning. The major challenge facing students is learning how to restructure their learning styles (through the use of online learning for better utilization of current resources) and how to implement improvements in online learning milieus. The delivery of courses via virtual learning environments requires training students in ways that maximize and allow them to further adapt their educational strategies. Thus, it is an essential issue to provide excellent training and technical support for higher education students.

References

Bannan, B. & Milheim, W. D. (1997). Design of Existing Web-Based Instruction Course. In B. Khan, (Ed.), *Web-Based Instruction* (pp.381-387). Englewood Cliffs, NJ: Educational Technology Publications.

Baptiste, H. P. & Kurubacak, G. (2002). Faculties' Reflections Teaching Online. Paper presented at the *Society for Information Technology and Teacher Education 2002 International Conference*. Nashville, TN.

Mendels, P (1998). Grant Program Accepting Proposals for Learning Technologies. *New York Times*. Retrieved June 25, 1998 from the World Wide Web, http://www.nytimes.com/library/cyber/week/021498education.html.

Valenta, A., Therriault, D., Dieter, M., & Mrtek R. (2001). Identifying Student Attitudes and Learning Styles in Distance Education. *Journal of Asynchronous Learning Networks*, 5 (2), 111-127.

Wills, R. & Becht, T. (1997). The Effectiveness and Impact of Online Learning in Graduate Education. *Educational Technology*. 35 (6), 37-42.

Towards An Adaptive Multimedia Learning Environment: Enhancing the Student Experience

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Abstract: In this paper, we describe the development of an adaptive multimedia learning environment that utilises multimedia presentation techniques in its interface while still providing Internet connectivity for management and delivery purposes. The system supports the WWW as its addressing space but uses the local client areas tostore media items expensive in terms of delivery time. Learning objects that provide frameworks for tasks and other summative assessment activities are stored on a server and delivered when required. The system supports link annotations in its adaptivity and employs an overlay student model with stereotyping when accessing the course content.

Keywords: Educational multimedia, Adaptive Systems, Dynamic course generation, Student profiles.

1. Introduction

Large classes of students with different cultural and academic needs, coupled with the large range of individual approaches needed to deal with some of student learning issues raised above, have created problems for institutions catering for large numbers of students. A direction that a number of academic institutions have pursued is to place course materials in an on-line format. These materials can either replace pre-existing lectures/tutorials, or supplement it. Needless to say, a great variety of educational materials exist for possible reuse within the public domain and are available via their Universal Resource Locator (URL).

As has been pointed out [17, 18], the World Wide Web (WWW) provides a vehicle for the development of a learning environment with teaching structured towards the development of lifelong learning skills, and catering for the expectations and learning styles of students with a wide range of backgrounds. Early Australian examples of the use of the WWW in IT education abound. Boalch [3] provides an examination of the use of the WWW as a support medium for the delivery of a first year unit in Information Systems at Curtin University. He provides an evaluation of site utilisation and user feedback in the case where subject information and course details were provided on the WWW for students.

The Eklunds [8] examine the use of the WWW to supplement traditional IT teaching. They provide case studies of two examples of the re-structuring of traditional forms of IT course for Web-delivery. Jones [11] of Central Queensland University gives details of case study involving the design, presentation and evaluation of an undergraduate unit in Systems Administration taught completely via the WWW to on-campus and distance students.

However these and many newer systems that have been developed, rely on the low-level concept of interactivity (derived from a distance education paradigm) as the relationship between an individual student and text, and fail to use the technological interactivity, which is available. Common online learning environments often fail to maximise the potential of current multimedia resources. While the value of HTML pages and threaded discussions is acknowledged, they do not display the ability to adapt teaching material for the needs of individual students.

Multimedia objects within learning environments, provide a possible enhancement to the presentation of our on-line materials. Ricketts [16] describe the successful use of a hybrid CD/WWW presentation of course materials delivered in distributed mode where multimedia elements were provided on CD. The Herringtons [9] describe the benefits of multimedia within authentic assessment used in a teacher pre-service course. Looi et al [13] describe a collaborative WWW based system that provides for on-line communication and collaboration in the creation of multimedia artefacts for the WWW.

Further, Jonassen et al [10] take the position that the true worth of multimedia and hypermedia might be obtained through the learner constructing knowledge via the use technology, rather than as a mode of delivery. Although the authors agree that the creation of multimedia and hypermedia artefacts is a powerful mechanism for individual learning, we do not discount the learning benefits attributed to the construction of different media views of content; we would argue that more individual learning styles could be accommodated.

Our view then of a learning environment is a domain populated with instructional items, presented as either multimedia or hypermedia objects with some addressing mechanism. This address might be a URL, or a directory path to a locally stored object. We use the term object to conform to the IEEE Learning Technology Standards Committee specification [7] for learning objects and further, agree with Wiley's [20] interpretation as 'any digital resource that can be reused to support learning'.

2. Adaptive Teaching

Various researchers who have experimented with adaptive teaching on the WWW have used techniques and principles derived from Intelligent Tutoring Systems (ITS) and particularly Anderson's rule based cognitive modelling [1]. Others have used Adaptive Navigation Support [4] to provide adaptive navigation through hypertext pages and thus developed adaptive textbooks for the tutoring, particularly, of software applications [4].

ITS and hypertext/hypermedia architectures provide different means of access to the educational materials contained within the knowledge domain. Hypermedia systems employ referential links that enable uses to typically follow non-sequential paths; organisational links (eg hierarchical) do provide some structuring that maps the expert's view of the domain. The pedagogical module of the ITS, provides information about the teaching process; this is non-existent in unstructured hypermedia systems and the user is generally free to explore the domain.

Adaptive systems couple the course model with a student model to provide adaptive navigation support. An adaptive system that makes available specific content (adaptive presentation) [4] provides students with a format of the new knowledge and skills appropriate to the students' level of understanding. Alternately, the system might provide links to appropriate content (link level adaption) [4]. Some systems also employ stereotyping within their student modelling structure. This appears to be an appropriate technique where distinct student groups with similar characteristics can be identified. However, any system based on stereotypes and preferences should be observable and thus editable by the user [12].

This paper presents techniques that are being developed to provide adaptivity within an introductory multimedia course[1], the aim of which is to provide the foundational knowledge and skills required to create and utilise a range of media items within multimedia presentations. The students undertaking the course come with a diverse range of knowledge and skills. The prototype developed is referred to as an Adaptive Multimedia Learning Environment. (AMLE).

3. Implementation of AMLE

AMLE is essentially a collection of multimedia and hypermedia learning objects that are tagged with and address or path that enables the system to locate it. Learning objects, irrespective of their form and functionality, can then exist on remote servers, or indeed as local files. Our architecture is based upon a concept which has associated documents similar to [15]. Concepts can vary in presentation and can have hypertext/hypermedia links embedded within them; concepts are further grouped into sessions.

a. AMLE's Architecture

Two major decisions were undertaken in the early development of the prototype; firstly, to ensure that our items were consistent, we decided to use Adobe Acrobat pdf files as the default format; every concept has a version in this format. Associative links within these files can address the WWW in total, as well as the local file space. A player called a concept viewer to display concepts in this format, has been created.

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[1] http://multimedia.com.unisa.edu.au

The second decision taken was to keep media rich items on the local file system. The rationale for this was that the course offered initially would be administered each semester and the concepts would be static over this period; the time taken to deliver these materials would be greatly reduced. However, these still could be accessed through their URL if they existed on a server.

We have created an event driven interface (client) with Macromedia Director that provides hypermedia functionality, and a range of concept viewers to support different media formats. The main interface of the client connects to a remote server and accesses data defining both the course domain and the student profiling information. Thus, media files that constitute concepts and related activities are stored locally but administered over the WWW.

This WWW connectivity then provides the facility to monitor student usage and register assessment items. Lecturers/tutors interact with the course and student model through a standard WWW browser. Other learning objects that document assessment tasks and/or other course information are stored on the server side and accessed through either a WWW browser, or the main interface.

We have developed this multimedia learning system using Macromedia Director, ColdFusion, HTML and CGI Perl script that allow rapid prototyping; our main interface exists as a run time version while some tools and other applications can exist as source code. This is of significance in the initial course on offer because students can create multimedia artefacts that can be inserted directly into their workspace.

b. Interface details

The main interface provided for students to access the learning materials can be classified as a hybrid browser. It takes advantage of the multimedia development environment and enables a range of concept players to be used depending on content availability and student preference. These range from a concept being displayed as text formatted with HTML tags, to a concept being displayed as an acrobat pdf file, containing both textual and graphical information. Video and audio formats can be utilised, along with appropriate animations. A range of other appropriate tools is provided in the interface to enhance the learning environment. For example, on-line tutorial groups can be established with the ability to discuss particular content-based issues.

The main interface is a windows environment that initially provides authenticated logging on/off facilities. Once identified and registered, the user is provided with the current session, or the pre-test for that session if that is the first time that the student has accessed that session. From there, individual concepts can be accessed through a session player. Sessions are groupings of concepts and tasks that the domain expert has predefined for the course. This would correspond to the content provided in a weekly lecture(s) and associated tutorial/practical activities

It has been argued that link annotation [6] provides the user with extra information about the content available, enabling a more informed decision. Annotations are employed within the session viewer to indicate the content that a mouse click will provide. Where the system can infer that the student knows the concept or can perform the task, the session viewer is annotated accordingly. Links are not hidden so that the student is still able to follow it for revisional purposes.

c. Domain knowledge

Our course model is organised hierarchically into courses, sessions, concepts and documents. Sessions have been defined from concepts; sessions can have any number of concepts but a concept can only appear once within any session of a course. A concept consists of many documents; a document can be the content of a concept, its objective or some practical activity.

Our implementation is supportive of other possible domains of knowledge; the delivery system then is content independent. Tools for both the generation and subsequent use of the system have been investigated and an on-line database supporting both the student and course models, has been established. The placement of content into small modules, provides a mechanism for the flexible reuse. The course metadata is stored on a remote server along with the student profile information. We utilise an overlay model [5]and allow WWW access to this information.

To accommodate a range of students at various levels in their programmes, we pre-test at the session level. Another alternative considered and still to be investigated, might be to pre-test at the course level and infer knowledge from the results. For the practical components, students might be able to demonstrate the possession of some particular skills; this then needs to be handled manually and/or electronically.

The content of the delivery system is relatively static; that is, the teaching components that are delivered through a range of players accommodating text, pdf modules, video, audio, animations, etc. and any other media format that might become available in the future, are stored at the client side. The components of the delivery system involving the course structure and assessment pieces, student profiles and assessment results, data of those on-line, are stored on the server side.

Assessment at the concept level is based on a competency model; an evaluation is made of a student's understanding of a concept through questioning. Mastery of these randomly selected questions is reflected in the student profile that drives the adaptivity within the system. Where a concept is a skill or task, students may be asked to do something and have it registered manually; for example, the concept might be the scanning of an image. The concept might be demonstrated and the student asked to perform the task; completion of this task is manually registered. We distribute weekly tasks and longer summative assignments etc. through a server when required.

d. Instructional design

The hypertext/hypermedia learning environment constructed allows the instructor to employ a range of instructional methodologies. Constructivist principles underpin the environment and are supported; students create multimedia artefacts and place them into their workspace (or on the WWW), search out content, and satisfy authentic tasks. These in total, provide the macro level scaffolding [2] that allow the students to use particular content in different, albeit overlapping, contexts.

We are developing tools (search engine, glossary, concept map) to enable the user to search and access concepts directly as required. As students become more familiar with the environment, the instructional strategies may vary; for example, more problem based learning activities could be introduced. These activities might relate to the construction of multimedia artefacts, the acquisition of some understanding, or the establishment of a reasoned point of view with regards some ethical issue like copyright.

Student/student and tutor/student interactions are being established via online discussion groups which have the potential to support collaborative learning. This could be tutorial discussion groups with a number of their peers currently logged on addressing some weekly task. The number participating in these discussion groups is 4 by default; however, this is a system parameter and can be changed. Students are initially allocated on a first in, first allocated basis but any part of the student profile could be used for this purpose

e. Student and course administration

An on-line instructional management system has been constructed to establish courses based on concepts and sessions. An 'Administration Tool', enables course coordinators to create particular courses and direct content at particular groups. We have the potential to administer concurrent versions of a course directed at particular groups.

Lecturers and tutors have WWW access to our student model. Lectures can add/delete a tutorial group, add a new student, search for existing student, and update student's detail such as tutorial scores, assignment scores and exam scores. Tutors have access to update and search facilities of students' tutorial and assignment details.

AMLE uses and maintains student profiles that contain a summary of the student's competencies and other preference information. The coupling of the course model with the student profile has the potential to allow students to proceed at their own rate through the learning material. Further, the management system enables tutors to enter marks electronically and subsequently manage the assessment components of the course. Reporting mechanisms then cope with student, tutor and course co-ordinator requirements.

4. Current and Future Work

Our major concern has been to provide adaptivity and interactivity for our students since we recognise that our students' backgrounds and cultures contain a wide range of learning styles and expectations. We have used the on-line management components of the proposed system to maintain the assessment profiles of current students. However, the web-based materials that have been used thus far have not provided us with the granularity at the concept level to enable adaptive technologies. To this end, we have created a range of prototypes with varying interfaces to access the course model, and a number of players to display the content. These will be trialled with students in the near future.

A range of tools including tutorial chat facilities, notebooks and email, are provided in the interface for the users to take advantage of. Further work will involve the pre-testing of students and the full utilisation of student preference data collected.

The range a questions and question types that are randomly presented and marked by the system are a topic of current investigation. Results from these form the basis of the student's competency model and the subsequent adaptivity. Tutors are able to enter marks directly into the student competency profile for tasks where the competency for a concept can be demonstrated. The student's competency profile is further enhanced by an assessment profile that includes summative activities that could extend over a number of sessions. Both profiles are available to the students through a WWW browser interface that displays their current competency and assessment states.

A number of instructional methodologies and educational activities underpinned by a constructivist philosophy are being explored. So too are the different tools that will be available within the interface; for example, an online helpdesk that simulates a tutorial helpdesk situation where students pose questions to tutors who are currently on line

5. Conclusion

We are developing components of a multimedia learning environment that we feel have the potential to enhance on-line learning. The system presents course materials as concepts and adapts to prior knowledge through the use of link annotation. We have also introduced stereotypes into the overlay student model and have coupled this to different content presentations. Students can also specify the type of media presentation they prefer to use within the concept viewer. A range of other tools like search engines, indexes, helpdesk, tutorial groupings etc. will allow the lecturer to employ a range of instructional methodologies to satisfy the requirement of the course.

The dynamic components of the learning environment i.e. assessment, course structure, and other instructional artefacts. are stored on a remote server and are accessed through the WWW. Tutors have convenient on-line access to student groupings to enable marks entry.

We utilise two forms of assessment; namely formative assessment that includes the mastery (or competency) of particular concepts or skills conducted generally at a weekly level, and summative assessment that necessitates the use a range of knowledge/skills in its satisfactory completion. These are recorded within the overlay model of the student profile. Student preferences and settings, along with marks etc that make up the assessment profile of the students model, are available to the student for perusal and alteration.

6. References

1. Anderson, J., *The architecture of cognition*. 1983, Cambridge: MA.
2. Bannan-Ritland, B., N. Dabbagh, and K. Murphy, *Learning Object Systems as Constructivist Learning Environments: Related Assumptions, Theories and Applications*, in *The Instructional Use of Learning*

Objects., D.A. Wiley, Editor. 2001, Association for Educational Communications and Technology: Bloomington, IN.

3. Boalch, G. *WWW as an Educational Support Medium: An Australian Case Study.* in *AusWeb96.* 1996. Gold Coast, Australia.
4. Brusilovsky, P., *Methods and Techniques of Adaptive Hypermedia.* User Modeling and User-Adapted Interaction, 1996. Vol 6(2-3): p. 87-129.
5. Brusilovsky, P. *Adaptive Hypermedia: From Intelligent Tutoring Systems to Web-Based Education.* in *Intelligent Tutoring Systems.* 2000. Montreal, Canada: Springer-Verlag.
6. Brusilovsky, P., J. Eklund, and E. Schwarz, *Web-based Education for all: a tool for development adaptive courseware.* Computer Networks and ISDN Systems, 1998. 30: p. 291 -300.
7. Committee, I.L., *Learning Objects Metadata Draft v4.1.* 2000.
8. Eklund, J. and P. Eklund. *Integrating the Web and the teaching of technology: Cases across two universities.* in *AusWeb96.* 1996. Gold Coast, Australia.
9. Herrington, J. and R. Oliver, *Using situated learning and multimedia to investigate higher-order thinking.* Journal of Interactive Learning Research, 1999. 10(1): p. 3-24.
10. Jonassen, D., K.L. Peck, and B.G. Wilson, *Learning with Technology: A Constructivist Perspective.* 1999, Upper Saddle, NJ: Merrill, Prentice Hall.
11. Jones, D. *Solving some problems of University Education: A Case Study.* in *AusWeb96.* 1996. Gold Coast, Australia.
12. Kay, J. *Stereotypes, Student Models and Scrutability.* in *ITS2000.* 2000. Montreal, Canada: Springer-Verlag.
13. Looi, C.K. and D. Ang, *A multimedia-enhanced collaborative learning environment.* Jouarnal of Computer Assisted Learning, 2000. 16: p. 2-13.
14. Murray, T., C. Condit, and E. Haugsjaa. *A Preliminary Framework for Concept-Based Adaptive Hypermedia.* in *ITS-98 workshop on WWW-Based Tutoring.* 1998.
15. Pilar da Silvar, D., R. Van Durn, and H. Olivie. *Concepts and documents for adaptive educational hypermedia: a model and a prototype.* in *2nd Workshop on Adaptive Hypertext and Hypermedia, HYPERTEXT'98.* 1998. Pittsburgh, USA.
16. Ricketts, J., et al., *Multi-media - Asynchronous distributed education.* Social science computer review, 2000. 18(2): p. 132-146.
17. Slay, J. *Using the World Wide Web to Create Foundations for Lifelong Learning - An Australian Perspective.* in *Teleteaching, IFIP World Computer Congress98.* 1998. Vienna.
18. Slay, J. *Using the WWW to Create an Effective Cross-Cultural Learning Environment.* in *Hong Kong Web Symposium 98.* 1998. Hong Kong University.
19. UNISA, *Graduate Qualities - a brief guide to assessing students for Graduate Qualities*, UNISA Learning Connection.
20. Wiley, D.A., II, *Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxaonomy,* in *The Instructional Use of Learning Objects.*, D.A. Wiley, Editor. 2001, Association for Educational Communications and Technology: Bloomington, IN.

The eLearning Concept at Helsinki University of Technology, Finland: Working with the 7-Step Approach on the eLearning Platform

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Abstract: The E-Education and Research Unit (www.cs.hut.fi/itlab) has provided multiformat eLearning courses since spring 2000. The eLearning platforms underpinning these programs are WebCT (www.webct.com) and Edulink (www.edusolutions.fi). In autumn 2001 the Education Unit launched its first fully Internet based courses using the investigative learning theory as a background theory and applying the well-known 7-Step Model of the Problem-based learning The 7-Steps Model was supplemented with orientation module which included personal assignments such as setting own learning objectives and selecting the methods to reach them. Mediamaisteri LTD's (www.mediamaisteri.com) eEvaluation tool was selected for self-evaluation. Two studies are in process concerning these courses: adults' comprehension of ICT as a tool of developing and creating their own expertise are examined as well as the development of critical thinking as the manifestation of the students' epistemological autonomy.

Working with the 7-Step Approach on the eLearning Platform

The E-Education and Research Unit (*www.cs.hut.fi/itlab*) has provided multiformat eLearning courses since spring 2000. The eLearning platforms underpinning these programs are WebCT (*www.webct.com*) and Edulink (*www.edusolutions.fi*). In autumn 2001 the Education Unit launched its first fully Internet-based courses using the investigative learning theory as a background theory and applying the well-known 7-Step Model of the Problem-based learning. The focus of the 7-Step Model is in rational, individual problem solving and information gathering which proceeds step by step. The steps of the model are *clarification of terms associated with the case, determining the problem, analyzing through brainstorming, constructing an explanatory model to describe the phenomenon, formulating learning objectives, information gathering by self study and application and evaluation of knowledge.* (Schmidt 1983.) The method trains to solve problems in groups, problems of which one have no previous knowledge or information.

The eLearning courses lasted from August to December 2001, accounting for 2 or 3 credits. Some 60 students completed these courses. The 7-Steps Model was supplemented with orientation module which included personal assignments such as setting own learning objectives and selecting the methods to reach them. Mediamaisteri Ltd's (*www.mediamaisteri.com*) eEvaluation tool was selected for self-evaluation.

The groups organized themselves independently, with each student joining a group that had targets closely matching his/her own. After an orientation session, each group was given a case-study and the general discussion forum provided by the Edulink platform was closed. In line with the 7-Step Model, the groups elected a chairman and a secretary at the very beginning. The teacher's role was to support the students and the group as and when required. Group work proceeded independently and the tutors played their planned guiding role. Technical support and the tutors of the groups monitored the step-by-step progress and the completion of the individual learning tasks while also providing related guidance and feedback.

The Studies and the Preliminary Results

The main issue addressed by Mrs. Inkeri Laaksonen's Master's Thesis is to clarify adults' comprehension of Information and Communication Technology as a tool of developing and creating their own

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expertise. Another issue that the thesis addresses is how adult students perceive their own expertise and whether the learning culture changes as it moves towards eLearning. The target group is adult learners who are studying Master' Degree in Computer Science while being employed on full-time bases. The qualitative basis, and the basis for the research methodology of the thesis, is existential phenomenology. The research method applied is Colaizzi's method of phenomenological psychology (Lehtovaara 1995; Valle & Halling 1989, 41–59).

The method selected for gathering material for the thesis was written stories. The preliminary results of the thesis indicate that group work on the Internet was perceived to be easier than conventional face-to-face group work, and that shy or quiet students could make themselves heard more easily over the Internet: "*Discussion forums of eLearning platform have helped me take other people's opinions into account* ", "*Group work is much freer over the Internet than in face-to-face groups*". On the other hand, the eLearning culture is taking its first steps, and this is reflected in the stories. ICT plays a large role for some of the writers: "*ICT has played a very large role in developing my expertise*", "*Without doubt the Internet is a natural place for most people to develop themselves, seek information and keep in touch*". Some writers miss social interaction: "*All of us want to talk with other people about other topics besides work or school every now and then, but on the Internet that kind of small-talk is impossible and therefore getting to know someone else is impossible in that environment*". The ease of searching for and finding information on the Internet in the course of developing one's expertise was underscored in the stories, although critical inspection of the authenticity of the information was regarded as a problem: "*I think that faced with today's information overload, filtering out correct and useful information from incorrect and useless information has become a key issue*".

Facilitating autonomy could be regarded as a broad principle in the philosophy of education, which can be carried out in different learning environments and with learners of different ages. Autonomy has become a part of distance education as study modes in adult education have developed. The aim of Mrs. Tiina Front's doctoral thesis is to specify the concepts and conceptions of the learner's autonomy and of open learning environments, especially eLearning environments. The main goal is to define the criteria or dimensions that could be used to analyze the development of the student's autonomy and the roles of support, interaction and distance in this developing process. The learner's autonomy is defined here as the autonomy of action and autonomy of thinking (Launis 1994), on the one hand, and the epistemological autonomy and trans-situational autonomy, on the other hand (Candy 1991). The development of critical thinking is the manifestation of epistemological autonomy, which is the focus here. Garrison et al. (2000) describe the development of critical thinking in the practical inquiry model.

The data gathered from the ecourses at the Helsinki University of Technology will be coded and analyzed according to the four categories derived from the cognitive presence descriptors (Garrison et al. 2001). The results will show how the 7-Step model supports the development of critical thinking in terms of increasing the learner's autonomy. The preliminary results are presented in ED-Media.

References

Candy, P.C. (1991). *Self-direction for lifelong learning. A comprehensive guide to theory and practice.* San Francisco: Jossey-Bass Publishers.

Garrison, D. R., Anderson, T. & Archer, W. (2000). Critical inquiry in a text-based environment: computer conferencing in higher education. *The Internet and Higher Education* 2 (2-3), 87-105.

Garrison, D. R., Anderson, T. & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *The American Journal of Distance Education* 15 (1), 7-23.

Launis, V. (1994). Kenelle itsemääräämisoikeus kuuluu. In J. Pietarinen, V. Launis, J. Räikkä, E. Lagerspetz, M. Rauhala & M. Oksanen. (1994). *Oikeus itsemääräämiseen.*

Lehtovaara, M. (1995). Tutkimus ja tutkimuksen tutkimus fenomenologisesta näkökulmasta. In Nieminen, J.(ed.)*Menetelmävalintojen viidakossa. Pohdintoja kasvatuksen tutkimisen lähtökohdista*. Tampere. Tampereen yliopisto.

Schmidt, H. G. (1983). Problem-based learning: rationale and description. *Medical Education*, 1983 (17), 11-16.

Valle, R. S & Halling, S.(1989) (ed.). *Existential-Phenomenological Perspectives in Psychology. Exploring the 7Breadth of Human Experience*. New York: Plenum Press.

Helping Teachers COPE with Student Performance Data: An Interactive Assessment Database Tool

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Abstract: Project COPE (Computer Organized Physical Education) is a data management system designed to help teachers productively deal with the inordinate amount of assessment data they encounter. When teachers collect performance data on paper based forms it is difficult for them to use the information efficiently. Project COPE involves the use of a computerized data management system coupled with hand held recording units to record and organize information about student performance. This technology is useful in all educational settings including the classroom and the gymnasium.

Introduction

Project COPE (Computer Organized Physical Education) began as a data management system to help elementary physical education teachers productively deal with the inordinate amount of assessment data they encounter in teaching (Lambdin, 1997). Elementary physical education teachers often teach 300-600 students and have contact with the same students over a five to seven year period from kindergarten to fifth or sixth grade. However, information about student needs often is not passed on from year to year in useable formats because of the overwhelming number of students and difficulty in organizing the huge amount of data. When teachers collect performance data on paper forms it is difficult to use them efficiently. It is very time consuming for teachers to transfer data from paper to computer systems after class is over. This causes teachers either to spend a great deal of time doing paperwork or to give up attempts at tracking student progress. Because the cost to benefit ratio of data recording is so high, teachers often have chosen to collect only the simplest data on student learning (test scores). The data often are used for the sole purpose of calculating a grade for the report card and then discarded when a new year and new grade book are started. Given the difficulty of recording and manipulating student data, the teacher's memory has been considered the best device for identifying student needs when planning for instruction.

Dynamic Data Management System Components

Project COPE uses a database created in FileMaker Pro to organize the data, and hand held units to aid in one step data entry. The use of PDAs (Personal Digital Assistant) allows direct data input during class activities rather than having to transpose from teacher notes. When dealing with hundreds of students and scores of objectives this direct entry option is crucial. Just as hand held units are used by clerks in stores and meter readers on the streets, teachers across the country are beginning to use PDAs to provide for efficient assessment data entry during teaching and learning activities.

The current system has been developed so that it could be used in any content area. There are six main functions in Project COPE. They are *Students, Assessments, Individual Data, Class Summary, Help Data, Mastery Data,* and *Reports.* Using the various features supplied with the Project COPE templates, teachers identify which grades, classes, and semesters they are teaching. If necessary, teachers can create new grades or a new class with ease within the program. After initial setup the teacher is able to assign three or four objectives to assess on any given day. This information is then exported from the desktop computer to the personal hand held device using Filemaker Pro Mobile. Teachers enter data for students on the various objectives using the hand held device during their teaching. After data are entered in the PDA, *the sync capabilities of the PDA transfer the collected data* from the hand held device to a computer. Using the *find, sort,* and *script* capabilities of the database teachers are able to easily determine which students have mastered each objective and who still needs additional help. The organization of information in this way is invaluable in making instructional and lesson planning decisions. Another advantage of utilizing Project COPE in classroom teaching is that feedback information can be printed out in customized *report cards* which indicate specific individual mastery of learning objectives rather than just a letter grade. This enables complete and useful information about learning and performance to be viewed by students' and their parents. Finally, summary information for use in program evaluation can easily be compiled.

Conclusion

The impact of the use of dynamic and interactive systems such as Project COPE is enormous. The general system is equally useful in recording emergent reading characteristics, use of problem solving mathematical strategies, performance characteristics for mature throwing and catching, and the exhibition of pro-social behaviors. Teachers are able to efficiently record data, easily manage data and effectively use the information to individualize instruction and monitor the success of their own teaching. Students receive the benefit of appropriately targeted instruction. Parents receive specific information about their children's learning needs and teachers and administrators are able to obtain often elusive summary data on program impact. If knowledge is power, Project COPE provides teachers, students, parents and administrators with increased power in learning environments.

References

Lambdin, D. (1997) *COPE: Computer Organized Physical Education*. Journal of Physical Education, Recreation, and Dance, 68(1), 25-29.

Hard Choices for Individual Situations by Bruce Landon, Ph.D.

Overview

The Decision Dinner - a parable about the weighted average decision strategy
by Bruce Landon and Nancy

The novelty of the proposed decision process can be illustrated by a parable about a small group of decision makers and relating it back to the online learning product selection situation. First, assume the task of selecting a restaurant for a board of directors' first dinner in a new city. Also imagine that this dinner is pretty important, perhaps not quite as important as the Nixon dinner in China, but a dinner of consequence, nonetheless. The first steps in the process would be to scan the available resources to see which restaurants (like product providers) are available and then to proceed to get menus (lists of the features available in each provider's product). The menu information could be augmented with reviews of the items on the menu but this would still not be enough. What the decision making group needs to know is what kind of items the members of the board actually like to have for dinner, i.e. which menu items are important to them. So the group decides to collect some more information by sending out a stakeholder survey to find out what each of the board members enjoys for dinner.

To construct this survey, the decision making group had to make a short list of restaurants (product providers) and from their menus make a short list of the most promising items (important features) because the board members would have never responded to a survey that was as long as all of the menus from every restaurant. The group sent out its survey and analyzed the results to calculate the importance weighting for each of the dinner menu items. Knowing the consequences of making a mistake on selecting a restaurant for both the decision makers and the board of directors, they elect to use the most rational decision making strategy known: the weighted averaging strategy.

To be able to use this strategy, the decision makers will have to find out how suitable the menu items actually are. So they have dinner at each of the restaurants to taste and judge the quality for themselves. Not only do they have to carefully taste the suitably of the menu items (features) but they must rate each one on a consistent scale so that the scores can be used in the weighted average strategy. They decide to all use a scale where 0 means awful and 10 means wonderful on suitability rating forms used when they go to the restaurants. Then night after night, dinner after dinner, they evaluate the suitability of each of the short listed restaurants on all of the important menu items. Finally using the board members' weights for each menu item and the decision makers' suitability scores for each menu item at each restaurant, they calculate the winner from the data collected.

The winning restaurant is the one that has the highest average score when the menu item weights are multiplied by the menu item suitability scores. The decision makers make the reservations with the winning restaurant and the board of directors proceeds to have a great dinner. The board of directors was impressed by the rationality of the group of decision makers but in truth they were more impressed by the dinner after which they voted to give bonuses to the decision makers and all live happily ever after.

Selecting an online eductional delivery application is analogous to selecting the restaurant in the parable above. The members of the board of directors are analogous to the stakeholders who will be impacted by the selected product i.e. the students, faculty, staff, and administrators. If the consequences of making an error and selecting the wrong product were not important there would be no need to be so rational as to use the weighted average decision strategy and the group of decision makers could use a less rational process. When the consequences are important such as in the assigning of course grades then a very similar rational process is most often used called weighted averaging grading.

This chapter will focus on faculty use of a decision-making process for complex situations. The analysis part of the process describes and compares course management software focusing on: technical specifications, instructional design values, tools and features, ease of use, and standards compliance. The extensive comparisons provide faculty with side-by-side product feature descriptions. The decision-making focus of the chapter and of the companion site is on supporting a detailed rational decision process for selecting course management software. This decision process uses a grading style model familiar to educators that compensates for the cognitive illusions and limitations of decision makers to achieve a transparent decision process for selecting the "best" application for each local situation. The current site obviously meets needs for decision-making support as evidenced by 16k visitors a month to the site. By the fall of 2002, there will be similar decision-making supports available which will focus on student services, teaching technologies and online education policies.

Introduction

Faculty make decisions every day and most of them are informal choices about what looks good on the menu for lunch. Sometimes, faculty make quite formal and rational decisions about which student gets an A and which student gets an F using a strategy of weighted averaging. The way in which decisions are made often reflects the importance of the decision and the situation as well as the decision maker. The research in psychology over the last few decades has illuminated some of the strengths and weaknesses in the way that people make decisions with the important finding that in many situations people are less than rational decision makers. When a person is overloaded with information or under time pressure then their decision-making can be quite compromised and they seem to use "rules of thumb" to make a decision. The case of selecting an online educational delivery system is examined from this perspective in this chapter. First the difficulties facing the decision maker are addressed and then a remedy is demonstrated to show how decision-making can be assisted to prevent the decision process from being compromised by these "rules of thumb" using a web tool for comparative analysis.

Why choices are difficult

Too many products

The situation is reminiscent of the early automobile industry when there were over a hundred automakers. Like the early auto industry many other competitors will not survive in the long run. The current front-runners: WebCT and BlackBoard started out as small almost personal projects a few years ago and are now multi-million dollar enterprises that span the global education marketplace. There may well be others out the current products that will evolve into the major brands of tomorrow as the market matures. The point of this analogy is that selecting a learning management system is much more complicated than selecting a new car, in part, because there are so many competing models. There are over 100 products in this marketplace that range from relatively simple limited function applications like WebBoard which just provides threaded discussions and chat to complex enterprise wide learning systems that link to backend databases and administrative data systems used by colleges and universities. Previously in 1997, I had attempted to characterize these products as components or suites by this categorization turned out not to be useful because there were so many variations from product to product he became difficult to classify new products. Also, the products in this marketplace evolve quite rapidly with a new model or version almost every year, like automobiles. So to deal with this rapidly changing market it seems better to characterize products in terms of the features that they provide.

Too many product features

The feature and tools are organized in terms of the group that they are most likely to be interested in them: Learners, Learner Supporters and Technical Administrators. These major groupings are further divided into subtypes of features/tools and finally into the individual features of the product. This schema has grown over the years and the language has changed as well so that some of the terms have been replaces in common usage by other terms as in the case of Newsgroup being supplanted by the term discussion or forum. A glossary of terms provides some help for those who are unfamiliar with this area (http://wwww.c2t2.ca/landonline/glossary.html), but the fundamental problem is that there too many features/tool about too many products to keep track of easily (products * features = 3474 facts) especially to keep track of in your head. The most frequent problem in making good decisions in this kind of situation is that of forgetting or omitting some important part of the problem when making the decision. Often we are overly optimistic about how big a decision problem we can do "in out head."

Too little working memory in decision-makers

Nobel laureate, Herbert Simon (1979) characterized the human decision making capacity as having "Bounded Rationality" (also see Gigerenzer & Selten, 2001). When people face decisions they operate within the bounds or capacities of the human mind. They are limited by fallible perceptions, wandering attention, faulty memories, and fluctuating information-processing abilities. People don't optimize, but instead resort to simplifying rules of thumb in order to proceed with their decision-making. These limitations have been investigated for decades with the repeated finding that working memory limitations play a major role in limiting the ability to make rational decisions.

The notion of limited memory was articulated well by George Miller (1953) as the magical number seven plus or minus two "things" that you hold in your mind at once while working on a problem (presumably due to a phonological loop process, Baddeley 1986, cited in Anderson 2000). This limited working memory is a profound handicap for a rational decision maker because when one works with ideas in the head then one is moving them around sort of like a juggler. When there are too many "things" then some of them will get dropped or set aside from consideration in the decision-making. Stated in another way, decision-making becomes more difficult as the number of things to consider increases and quickly reaches a point of overloading working memory.

When facing difficult decisions, people encounter overload and then they resort to ways of coping that involve cognitive shortcuts. When overloaded, they are more susceptible to cognitive illusions (Kahneman and Tversky, 1996). Cognitive illusions are similar to perceptual illusions in that they stem from the fact that in both types of illusions the person can focus only on a small part of the situation at one time. In the case of perceptual illusions this is because the fovea of the eye that sees fine detail encodes only a small segment of the spatial panorama at each fixation. In the case of cognitive illusions this is largely because the conscious working memory can hold only a few "things" and the rest must be inferred or extrapolated in ways that are sometimes biased. In both types of illusions the person is not necessarily aware of any "illusion" at all and may believe that they are "seeing everything correctly."

Too many Cognitive Illusions in Decision-Making

The discrepancies associated with cognitive illusions may be seen a little more clearly in contrast to an idealized rational decision process. In the idealized process, one starts by selecting relevant features/criteria and then assigning an importance weighting to each of those features. Next one evaluates each choice option on each of those important features and assigns a suitability score. Finally one makes the rational decision to choose the option with the highest weighted average suitability score (the average of the weights for a feature multiplied by the feature's suitability score). Choosing the option with the best score is the rational decision (Keeney and Raiffa, 1976 as cited in Roe, Busemeyer and Townsend, 2001). With only a couple of optional choices and a few important features it is likely the limitations of working memory would be overwhelmed even if one were able to do the mental multiplication part. When one is overwhelmed by the size and complexity of the decision situation then one is susceptible to a host of cognitive illusions. A few of the major ones are: Availability Heuristic, Representativeness Heuristic, Hindsight Bias, Gambler's Fallacy, the Framing Effect, Similarity Effect, Decoy Effects, and Overconfidence Effect. When the decision situation is simple and small, on the other hand, most people can and do make good judgments unaffected by these cognitive illusions.

The Availability Heuristic investigated by Tversky and Kahneman (1973) is a powerful cognitive distortion. Essentially, it is captured by the by the saying, "out of sight – out of mind." It turns out that the believing the truth of a piece of information is related to the ease of recall. If something does not easily come to mind then the inference is that it must not be true (Begg, Amour and Kerr, 1985). Unfortunately, the ease of recall is affected by circumstances that have nothing to do with the truth of the information such as the vividness of the information and the number of times it has been repeated. The power of the Availability Heuristic is not lost on those who repeatedly advertise on radio and television.

Another powerful cognitive illusion is the Representativeness Heuristic (Kahneman and Tversky, 1973). The illusion is that if something looks like one of those then it must be one of those in spite of relevant base rate information to the contrary. Common versions of this are "you can tell a book by its cover" and "if it looks good then it works well." These rules of thumb leave out the base rate information such as about how likely it is for a random book to be a good read. The cognitive illusion is to be unable to process additional information about the likelihood of an event given the overwhelming impact of how it looks on the surface.

The Hindsight Bias is the tendency to believe, after the fact, that one would have foreseen a particular event (Fischhoff, 1982 as sited in Galotti, 1999). This has also been referred to as the "I-knew-it-all-along-phenomenon" that inflates self-esteem and feelings of overconfidence in one's predictive abilities. The notion is that hindsight is always 20-20, but in reality, many events like the weather are still uncertain predictions before the fact.

There is an entire industry built on the cognitive illusion of the Gambler's Fallacy. This is the popular illusion of believing that in a game of chance that the more you loose the greater your chance of winning (Tversky and Kahneman, 1971). The truth is that the odds of winning stay the same. The illusion is belief that the law of large numbers applies in the situation of small numbers and that there would necessarily be some balance in the situation of a specific gambler. This shows up as the gambler's belief that in a fair game of chance after you have lost for a while it becomes more and more likely that it is your turn to win. Other forms of this can occur in committees who believe that after a string of poor decisions it is their turn to get lucky in picking a good vendor or whatever has been the focus of their decision-making.

The Framing Effect refers to the impact of the context on the decision. People tend to avoid risks that are described in terms of benefits, but tend to take the same risks that are described in terms of loss (Tversky and Kahneman, 1981). This is reminiscent of the rule of thumb: win – stay, lose – shift. The illusion is that the value of losses is greater than the value of gains when mathematically they are equal. This misinterpretation of the importance of risk can bias the importance weighting of features and thus bias the decision process.

Similarity Effects (Tversky, 1972) and Decoy Effects (Roe et al, 2001) are both products of confusion. When a new option is added to a choice set that is similar to one of the existing options the original option is less likely to be chosen because this effect sort of divides the mind share like a similar product can divide the market share. The Decoy Effect is a special case of the Similarity Effect where a range decoy that is more extreme than the original choice set dramatically reduces the choice likelihood of nearby options (Roe, 1999). In effect, the extreme decoy sabotages the nearby options by altering their context.

Decision Deadlines can also influence the role of Cognitive Illusions. When deadlines are quite short the decision maker tends to rely more on fewer pieces of information. In effect the working memory is further limited by time pressure. Roe's (1999) analysis suggests that the option chosen under time pressure is simply the one that is the current focus of attention when time runs out. With longer decision deadlines the more subtle similarity effects exert more influence. Longer decision timelines in the context of face-to-face group decision making tend to be associated with more extreme decisions due to attitude polarization (Moscovici and Zavalloni, 1969). It is rarely the case that truth wins in the group decision-making situation (White, 1993 as cited in Myers and Spencer 2001).

Overconfidence is a paradoxical Cognitive Illusion in that it is the illusion that one has no cognitive illusions and that one's decisions are without bias. Kahneman and Tversky (1996) have found a replicated tendency for people to be more confident than is warranted by the evidence and to overestimate the accuracy of their beliefs. This overconfidence extends to eyewitnesses testimony where Loftus (1979) has found that the witness's confidence in their testimony to be unrelated to accuracy of their testimony. This overconfidence has the side effect of enhancing personal self-esteem and thereby contributing to resistance to being influenced otherwise i.e. stubbornness.

In summary, there are many mental obstacles for those who would be rational decision makers. Many of these Cognitive Illusions stem from the limitations of working memory. These are the same limitations that cause people to not be able to remember long strings numbers like international telephone numbers. Because large and complex decisions situations are beyond the capacity of working memory, people resort to rule of thumb strategies to do the best they can. In such overwhelming situations Cognitive Illusions bias judgments and compromise decision-making.

Making the decision situation smaller and simpler can circumvent these obstacles. Dividing up a complex decision into several small and simpler decisions keeps the load on working memory within normal capacity and then decision makers can be quite rational in making good decisions.

Donald Norman (1999) has made the case that human-computer interactions can and should be designed to take account of normal human fallible perceptions, wandering attention, faulty memories, and fluctuating information-processing abilities. With good design of decision-making processes that keep the in-the-head part small and simple, a system can be optimized to enable quality decision-making. The normative weighted averaging strategy can be easily divided up into small and simple component parts and then later recombined (outside-of-the-head) into a rational decision process that leads to the "best option." There is a powerful decision-making synergy in combining the focused judgmental prowess of people with the memory and computational prowess of computers.

How people normally Make Decisions: The 5 Basic Strategies

There are five basic decisions strategies (Payne & Bettman, 2001) for choosing among options (products, services etc.) based on features or aspects of the options. All of these five strategies are compromised by the reality that the set of options is limited to those known to the decision-maker and the "best" option may be simply missed in the whole process. While the names of these strategies on may be unfamiliar is quite likely that everyone has used all of the following strategies at one time or another:

Lexicographic strategy (aka one reason, pick the best)
Elimination by aspect strategy (aka pick the last)
Satisficing strategy (aka Bounded Rationality Model)
Equal weight strategy (aka scoring strategy)
Weighted averaging strategy (aka weighted adding strategy, grading model)

The Lexicographic strategy involves two steps: selecting the most important feature and then picking the product from all of the options that is best on that one feature. There is no requirement for the features to be expressed as numbers. If there is a tie then the decision maker simply repeats the process on the second most important feature. This non-compensatory strategy does not allow for some features of an option to make up for other less adequate features. The only involvement of a second feature is in the case of a tie that is broken by considering the next most important feature and selecting the option that is best on that feature.

The elimination by aspect strategy is a simple screening strategy involving two steps: setting the requirements for each of the features and then eliminating options one at a time which do not meet any one of the requirements. The decision maker examines the features of each option one by one and the option is eliminated as soon as a feature is found that does not meet the requirements. This popular strategy does not need for the features requirements be expressed as numbers and is easy-to-use. The elimination by aspect is a non-compensatory strategy so that once an option is rejected on any feature that option is eliminated from further consideration. This strategy does not necessarily result in a single best option since more than one option may pass on all of the requirements. Including any features that are irrelevant or biased in favor of one of the options compromises this process.

The Satisficing strategy (Simon, 1955 cited in Gigerenzer and Selten, 2001) is more psychologically developed model of sequential decision-making that includes setting requirement cutoff levels for each feature. An option is examined until it fails to meet one of the cutoff levels then it is rejected and the next option is considered. The first option that passes on all of the features is selected. If none of the options pass all of the cutoff requirements, then the requirements are reduced to new lower cutoff levels and the process is repeated. The satisficing strategy is non-compensatory and effected by the order in which the options are presented as well as the aspiration level of the initial cutoff requirements.

The Equal weight strategy is comprehensive and considers all of the features on all of the options. The suitability values of one (passed) or zero (failed) are assigned to each to each feature on each option. The total suitability score for each option is the simple sum of the feature suitability values for that option (all features are weighted equally). The option with the highest sum of the values is selected. This strategy is directly analogous to multiple choice test scoring where correct answers are awarded one, wrong answers are awarded zero, and the highest sum score identifies (selects) the best student on the test. This compensatory numeric strategy enables some features assigned one's to compensate for other features that were assigned zero's. This strategy is more useful when there are many features because there is less risk of a tie for best score.

The Weighted averaging strategy is a more complex version of the simple sum score model where each feature is also assigned an importance weighing. This idea implies that the decision maker is willing to make trade-offs to arrive at the selected option. The process involves five steps: (1) setting the importance weights for each of the features, (2) for each option then determining the numerical suitability value for every feature, (3) multiplying the feature suitability value times the feature weight, (4) then summing these weighted features subscores into an option total score, and (5) finally selecting the option with the highest average score. The averaging of the weighted option total scores simply returns the scores to the scaling metric of the feature suitability value units (which are often on a rating scale such as 1=poor to 9=excellent). This strategy is directly analogous to the grading model where different parts of the grade are weighted differentially (or subsections of an exam are weighted differentially) to arrive at the final mark. The weighted averaging strategy is compensatory in two ways: high scores on one feature compensate for low scores on another feature and a lower importance weight on one feature is compensated for by a higher importance weight on another feature. This strategy is less likely to result in ties between options than is the equal weight strategy when using a relatively small number of features. Furthermore, the weighted averaging strategy is considered the normatively rational decision process because it uses all of the information available in a consistent manner to arrive at a selection. This model is similar to the multiple linear regression model used in statistical analyses and suffers from some of the same shortcomings, most notably it is compromised when irrelevant features are used and when unreliable suitability values are used.

Decision makers often make use of combinations of the above strategies. In combined strategies the decision is made in phases. The initial phase is often to screen out some of the potential options in order to reduce the complexity of the situation to as short list of options. This phase is followed by a more thorough consideration phase to select the best option from a short-list of candidate options. The primary reason that everyone does not use the weighted averaging strategy all the time for all decisions is because it would be too mentally difficult and too time consuming. Other strategies are heuristic attempts to make good decisions with less effort and in less time and sometimes they seem to work well enough.

Idealized decision-making process for comparison

Selecting a online educational delivery application is a high-stakes gamble that can impact the future prosperity of an educational institution. The weighted averaging strategy is ideal decision-making process because it is considered to be the only normatively rational decision process. In its most rational form every possible product option would be considered on every possible feature – nothing would be left out. The process involves the five steps: (1) setting the importance weights for each of the features, (2) determining the numerical suitability value for every feature of every product option, (3) multiplying the feature suitability value times the feature weight, (4) then summing these weighted features subscores into a product option total score, and (5) finally selecting the product option with the highest average score from among all of the possible product options. In this ideal there are three major difficulties: discovering every possible product option in a dynamic expanding market, accurately determining the importance weightings of each of the features, and accurately determining the suitability of each feature on every product. The practical difficulty is simply not having sufficient time and resources to carry out the process. The recommended process is below intended to approximate this ideal strategy within the practical limitations of time and resources.

Tailoring decision processes to Individual Situations by involving the stakeholders

The ultimate success of a decision process in addition to making a good decision is that others, the stakeholders, cooperate with the decision makers and carry out the decision and implement the chosen alternative. Tetlock (1983 as cited in Gigerenzer 2001) has studied the social aspects of rationality and proposed three social goals that are important for maintaining this cooperation. The first social goal is that decisions are made in a transparent way that is understandable and predictable. The second social goal is fairness where the decisions are made in a way that does not violate the expectations of people. The third social goal is where decisions are made in an accountable way that can be justified and defended in public. Decisions, which meet all three of these social goals, are more likely to pave the way for the acceptance by the stakeholders of the eventual decision to select a particular product over the competition.

One direct way of accomplishing these goals is to involve the stakeholders in the overall decision process. Including several of the stakeholders on the decision-making or decision-recommending committee often does this. The common difficulty with this approach is that there are many times more stakeholders than there are members on the committee. By dividing up the decision-making tasks it is possible to meaningfully involve more stakeholders and still keep the decision-making committee to a workable size. There are a couple of obvious groups of stakeholders: the student learners and the faculty who will be using the selected system to deliver online courses or use it to deliver the online portion of blended regular courses. In many institutions there will also be other stakeholders who will be interested in some involvement in the decision process. Other obvious stakeholders are the systems and computing personnel who would be doing the technical administration of the Learning Management System if it is not hosted from the vendor's site. Also, there may be a myriad of learner support services from the registrar to instructional design personnel to the library and disabled student services personnel who all have a stake in the decision process. Finally, depending on the level of involvement the institutional Board of Directors may well have political role to making their priorities felt in such an important institutional decision. One recommended approach is to involve some of the stakeholders in deciding the importance of specific product features and also involving the more technical expert stakeholders in judging the suitability a specific feature in a particular product.

When the initial importance weightings of the product features for the comparative analysis site were developed there were many differences of opinion among the experts involved in the peer review committee. These differences were worked out and consensus was achieved by using a couple of face-to-face meetings followed a nominal group process similar to the Delphi process (Delbecq, Van deVen and Gustafson 1975). After people met and had an opportunity to talk about what they thought was important and why, they were then asked to provide importance ratings for the specific features. These ratings were simply averaged to provide a mathematical consensus without resorting to additional face-to-face meetings. The resulting averages were also sent back to the peer review committee by email with requests for further comments if members had strong feelings that there was an error anywhere. These requests produced some new ratings that were again averaged and circulated again for comment and revision. It took only a couple of rounds of this nominal group process to produce a consensus on the feature weights. This consensus was in part because the process was transparent, fair, and accountable as recommended by Tetlock (1983, cited in Gigerenzer 2001).

Focusing on what is important

Colleges and Universities are hugely different as are institutions of 3,000 students and institutions of 30,000 students. Historically, much of educational market has been a geographical patchwork of niche markets with some exceptions. In each institutional situation of there are some considerations that are more important than others. One way to approach the problem of too many products and too many features is to limit the consideration to only those things that are locally important. Determining what features are needed in an institutional Learning Management System is often a political process in each institution that can involve many people. This process is informed by the institutional history of what has worked well and what has not, as well as expectations about what will be needed in the future. In practice, different institutions and faculty within those institutions use products in different ways and in more than a few cases some features of a product are never used. This situation results from the newness of the market and the rapid pace of technological change in recent times. In this situation the wiser approach would seem to be to focus on what is needed rather than what is offered in the market. The idea of a needs analysis is not a new idea, but it can be particularly advantageous in selecting a Learning Management System by informing the process of which product features fit into the institution's needs and which ones are less needed or merely duplicate existing institutional systems.

Each institution is unique and that uniqueness can be augmented or diminished by the choice of an institutional Learning Management System. Sometimes institutional mission and goal statements can provide a guide to which directions to pursue and sometimes these policy documents play no real role in the decision making of the institution. What is at issue in the selection of a Learning Management System is the potential commitment to a product that is as far-reaching as the institutional decision about which word processor application to support. Once the decision is made it will not be easy or inexpensive to undo that decision. By basing the decision around the unique needs of the specific institution there is a better chance that decision made will further the success of the institution rather than the opposite.

Thinking in terms of the audiences of users

One way to reduce the complexity of the decision process is to divide the product features into groupings based on the group of people who are more likely to be involved with those features. In this instance one can think about three different groups of people: Learners, those who support the learners more or less directly and those who are involved in the technical administration of the software installation. These three groups do not exhaust the possibilities but provide a starting viewpoint.

The learners or students are usually the largest group of users. It is useful to consider the Learning Management System from their perspective since any problems or short comings are going to effect so many people and because many institutions profess a "learner focus" as part of their mission. However learners are not a homogeneous group and the needs of "first time users" may well be very different from those of returning successful students.

The Learner Support group includes faculty, teaching assistants, instructional designers, various administrators and others who's job it is to help learners to be successful. The titles and descriptions of these roles vary dramatically from situation to situation

The audience of technical administrators consists of those folks who operate the server as well as those who administer the authorization or security policies out of sight. In many situations is this audience also includes additional administrators involved in setting up course shells on the server and arranging for access to registration lists. In general, the technical administrators operate behind the scenes and are able to access parts of the software system that are not available to instructors or course developers.

Thinking in terms of product features

Within each of the three audiences the features of the products can be further grouped into clusters of features and this can reduce the complexity further. On the Online Educational Delivery Applications site (http://www.c2t2.ca/landonline/) the following conceptual groupings have been used to provide targeted views for the learners, learner support, and technical administrator audiences respectively:

- Learner Tools (for learner audience)
  - Web Browsing
  - Asynchronous Sharing
  - Synchronous Sharing
  - Student tools
- Support Tools (for learner support audience)
  - Course
  - Lesson
  - Data
  - Resource
  - Administration
  - Help desk
- TechInfo (for technical administrator audience)
  - Server Platform
  - Client Platform
  - Pricing
  - Limitations of package
  - Extra Considerations

Within each of these conceptual categories there would be a small number of specific application tools or features. Altogether there were 62 such specific features that could be a part of an individual application. The complete listing of application features inside of the above conceptual structure attempts to organize the otherwise overwhelming list of features: (adapted from http://www.c2t2.ca/landonline/option2.asp)

Check Features to include

Learner_Tools
Web_Browsing
☐ Accessibility
☐ Bookmarks
☐ Multimedia
☐ Security
Asynchronous_Sharing
☐ E-mail
☐ BBS file exchange
☐ Newsgroups
Synchronous_Sharing
☐ Chat
☐ Voice Chat
☐ Whiteboard
☐ Application sharing
☐ Virtual space
☐ Group browsing
☐ Teleconferencing

Support_Tools
Course
☐ Course planning
☐ Course managing
☐ Course customizing
☐ Course monitoring
Lesson
☐ Instructional designing
☐ Presenting information
☐ Testing
Data
☐ Marking on-line
☐ Managing records
☐ Analyzing and tracking
Resource
☐ Curriculum Managing
☐ Building knowledge
☐ Team Building

TechInfo
Server_Platform
☐ RAM
☐ Disk Space
☐ WindowsNT 40 Server
☐ Apple Server
☐ Unix Server
Client_Platform
☐ Minimum Level
☐ Target Level
Pricing
☐ Start-up Cost
☐ On-going Cost
☐ Technical Support
Limitations of package
☐ IMS Compliance
☐ Number of courses
☐ Number of students

☐ Videoconferencing

Student_tools

☐ Self-assessing

☐ Progress tracking

☐ Searching

☐ Motivation building

☐ Study skill building

☐ Building motivation

Administration

☐ Installation

☐ Authorization

☐ Registering

☐ On-line fees handling

☐ Server security

☐ Resource monitoring

☐ Remote access

☐ Crash recovery

Help_desk

☐ Student support

☐ Instructor support

☐ Number of connections

☐ Number of instructors

☐ Other Limitations

Extra_Considerations

☐ Options

☐ Exit Considerations

No product had all of the possible features and no institutional situation needed all of the features either. The Online Educational Delivery Applications site was intended to help institutions find products with the features that they need and for vendors of products to be discoverable on the basis of the product functionality in the context of a rapidly developing marketplace. The list of product features also turns out to be a moving target over time as new technologies are incorporated into the evolving applications.

Product Reviews and Rapid Product Change

The situation of finding appropriate application candidates is made substantially more difficult by the fact that the products themselves are changing. Most of the products will release a new version one or more times per year and in many situations this "revision" can change the product substantially, especially when the newness comes from a company merger or acquisition. Published product reviews and comparisons quickly become dated in spite of the best of intentions. This dynamism among the vendors is heightened further by technological changes such as the advent of database back-ends on courseware systems that has occurred during the last several months.

In the context of the field of rapidly moving products it is very difficult be base decisions on what is available, but it is still quite feasible to base decisions on what is needed in the individual situation. The institutional context of online learning is changing more slowly than the marketplace and it can be argued that a needs analysis is more valuable than a market analysis in such a situation.

Screening phase of decision-making based on requirements of Individual Situations

The elimination by aspect strategy is a screening strategy involving two steps: setting the requirements for each of the features and then eliminating options one at a time which do not meet any of the requirements. To be able to decide which features are important the conventional approach is to conduct some sort of needs analysis of what is required in the institutional setting. This analysis often reveals the uniqueness of the needs of the future users of the online system. At this stage it can be beneficial to involve the stakeholders: students, faculty, student support personnel, and the technical administrators to gain later acceptance of the eventual decision as well as to become aware of needed features that might have been otherwise overlooked. Politically it can be beneficial to even involve representatives from the governing board of the institution when this decision will represent a new pedagogical direction or is expected to involve significant long-term resource commitment.

Situational Requirements

Individual situation are both nominally different and substantially different. Sometimes the differences are so large that our tendency to attend to differences makes it seem like some institutions are as different as day and night. While there are a host of differences between institutions there are also some similarities so that examining an example of decision-making can be instructive about similarities in the processes. As the online educational delivery applications have begun to move from the one-size-fits-all mold of the industrial era, they are more adaptable to individual situations but still the applications have different strengths and weaknesses. The ideal of making decisions based on individual local institutional situations is to exploit the synergy of matching the strengths of a product to the specific needs of the specific situation. The uniqueness of local situation can be described in many ways but by using the features of the products as the focus for this description the potential synergy is easier to find and exploit. This involves, for example, translating a local need for better two-way communication between instructors and students into the importance of the e-mail feature. Likewise the need for orienting and assisting instructors in how to use an online educational delivery system can be translated into the importance of an instructor help desk feature. When this feature importance is expressed as an importance weighting then this information can be utilized in the weighted average decision strategy which combines information about many such attributes into a overall suitability score as is described in more detail in the example below.

The deciding of which features are more important versus which features are less important based on an analysis of the local situation goes a long way toward reducing the risk that the chosen application will be accepted by the stakeholders and will benefit the institution. Including irrelevant features at this stage will bias the process in favor of those applications which have those irrelevant features so this deciding which features are required is a fundamental part of the overall decision process. This is a process where the stakeholders, as described above, can help out by being involved in determining which specific features are important enough to be "needs" rather than "wants." The elimination by aspect strategy does not require that the feature requirements be numeric so simply identifying which features are really needed is enough. There are 62 feature categories on the Online Educational Delivery Applications site and there are undoubtedly some additional ones are critical in some situations.

The outcome of the deciding which features are important is a Shortlist of important product features. Any product that does not include all of those features would not meet the needs of the institution and should be screened out of the competitive options for the final selection. This initial product screening can effectively be done by the elimination by aspect decision-making strategy. The decision maker examines the features of each option one by one and the option is eliminated as soon as a needed feature is missing or completely inadequate.

Screening tools on the web

Once the set of needed features has be determined then the Online Educational Delivery Applications site can be used to identify which applications provide those features so the number of potential options can be reduced to just those that are likely candidates. By using a page like the above table the decision maker can check the checkbox next to the required features and then click submit and the returning page will include a list of applications which support those features. Using that same page the candidates can be further investigated in side-by-side comparisons of feature descriptions. This side by side comparison may help in further reducing the list of applications to only the appropriate options for the local decision situation.

Making a Short List of Application Options

Using the web tool described above greatly speeds up this elimination by aspect process for those applications that are reviewed on the site. The elimination by aspect is a non-compensatory strategy so that once an option is rejected on any feature that option is eliminated from further consideration. This strategy does not necessarily result in a single best option since more than one option may pass on all of the requirements. The usual outcome of the elimination by aspect strategy is to result in a short list of possibly acceptable options that become the narrowed focus for a more discriminating decision strategy. It may be prudent for comparison purposes to include in the short list any applications that are used by consortia where the local institution is a member or in the case of community colleges the application that is used by local universities where the college has special relationships.

Evaluating product suitability as part of the weighted averaging strategy

Evaluating products (or externally hosted product options) can be a very large task. The greater the number of products and the greater the number of important features multiplies quickly into a potentially overwhelming product research task. This task can be partially shifted to the vendors by structuring a competition among the likely candidates where they are invited to bring the information to the decision makers rather than the decision makers seeking out the vendors and trying to find out the most current product information. The market has matured enough so that most vendors are capable of responding to a request for proposal (RFP) to supply the desired product functionality. Many institutions already have RFP procedures but may never have used them for a situation as complex as selecting an online educational delivery application.

Inviting the shortlist of vendors to competitive presentations/proposals (RFP model)

The RFP model has been described for web software acquisition recently (http://www.technologynews.net/rfp/infotech_rfp.doc) as a necessary part of the decision process.
The RFP model offers several advantages over less formal product selection processes including: all vendors get the same information and have a fair opportunity to compete while the decision makers get a proposal document that can be used to assess both the vendor interest and competence. Local procedures may vary but in general a useful RFP should include the following sections (according to the info-tech research group at http://www.technologynews.net/rfp):

1) Executive Summary
2) Reasons for the online educational delivery application so vendors can understand local situation
3) Explanation of the vendor selection process (the elimination by aspect strategy as above)
4) Explanation of the proposal evaluation process (the weighted average scoring as above)

5) Description of the decision-making team
6) Description of in-house resources that will also be used in the online educational delivery
7) Background Information about the institution and the competition
8) Time line for the vendor's deliverables
9) Penalties for missing deadlines
10) The Specifications including short, medium and long-term specification lists and descriptions
11) General terms and conditions for the institutional agreements
12) Special terms and conditions such as the number of references required, legal requirements etc.

The RFP would be sent to the short list of possible vendors. The vendors will likely have questions as they prepare their proposals so it is useful to have a designated contact person who can supply consistent clarifying information to all of the vendors' requests for information. When the proposals are received there is often another round of elimination by aspect strategy to determine which proposals are in the competitive range. The US Department of Defense (http://web.deskbook.osd.mil/reflib/mfarsups/072ua/009/072ua009doc.htm) further advises that a proposal may be considered outside of the competitive range if (1) it does not address the essential requirements, (2) has a substantial technical drawback the would essentially require a new proposal to fix, or (3) the proposal contains major deficiencies, omissions, or out-of-line costs. They also advise that these proposals are part of a negotiation process and at the end of negotiations, the competitive vendors should be provided with one additional final opportunity to submit a revision known as the "best and final offer."

The RFP method is a time-consuming and involving process both for the institution and for the potential vendors that can be used to produce a fair vendor competition where the best candidate is selected and the social goals of rational decision-making are accomplished. The Online Educational Delivery Application site provides web tool support for the Weighted Averaging Strategy calculation part of the of decision-making. This decision engine tool is little more than an automated score sheet that combines the feature importance and the feature suitability scores into an appropriate total product score. The tool does however enable the decision-makers to use the most rational strategy of decision-making, which would be impossible to do in one's head. The following example illustrates the decision engine web tool using two vendors (WebCT and BlackBoard) with three features (accessibility for persons with disabilities, student help, and instructor help).

Quantifying feature importance in Individual situations

For the purposes of this example let us assume that our institution is part of the Consortium that is offering us the opportunity to use either WebCT or BlackBoard for our existing system. Further lesson soon that there are only three important issues: meeting the 508 accessibility regulations so that are federal funding is not jeopardize, meeting the help desk requirements of our students, and meeting the help desk requirements of our faculty. We could use the default importance weightings from the site that are 1.0 for accessibility, 1.2 for student support, and 0.8 for instructor support but it would be better to tailor the importance weighting to our institutional setting. So for this example let us assume that we did some campus wide information meetings and formed an advisory committee of interested stakeholders.

Potential of involving stakeholders in setting weights

Then with the help of our stakeholders we put together a little three-item telephone survey of a random sample students and a random sample of instructors. The results of our little survey were importance ratings of 9 for the accessibility item, 7 for the student support item, and 6 for the instructor support item. Those numbers can be just entered into the web Decision Table form because the form to product the importance weights normalizes the numbers before they are used.

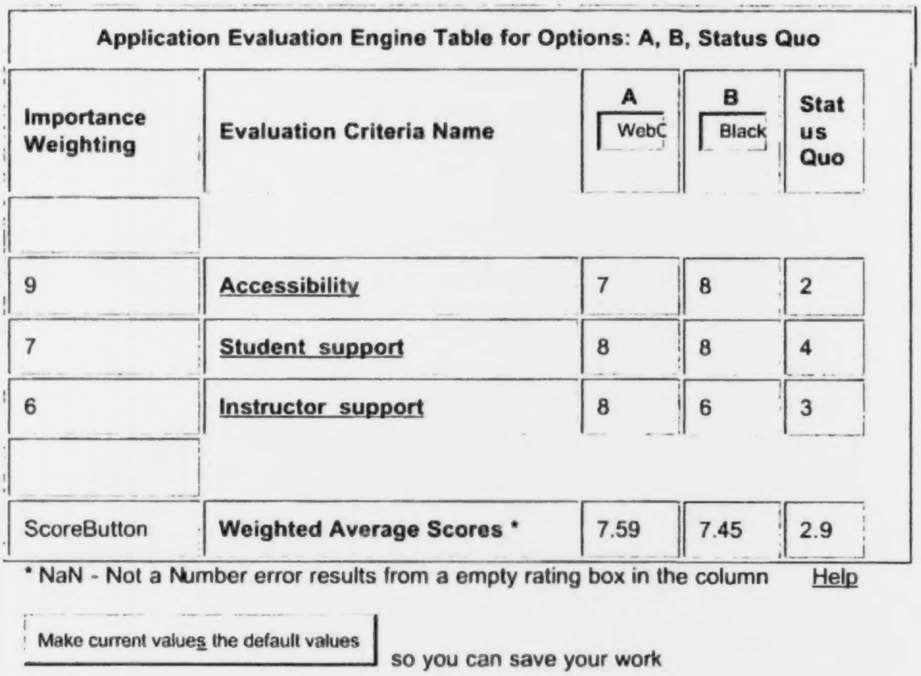
Judging product feature suitability to local situation

Different persons can make the suitability judgments than were involved in the setting of the importance weights. In this example we could conceivably involve the members of our advisory committee to nominate from among themselves a task group who have experience with our existing system and are willing to spend a week working with WebCT and a week working with BlackBoard to specifically evaluate the accessibility, the student help desk, and the instructor help desk. Further our task group could also get others to help with their evaluation as they chose with the only caveat that at least two persons with disabilities be involved in checking out the accessibility aspects of the two products.

If we had allowed more time it might have been possible conduct a request for proposals and have representatives from the two vendors provide information and trial facilities to the task group to make their hands-on experience come to them. After a week the task group meets with the advisory committee and presents their considered judgments, which are averaged to make them more reliable. Their judgment of the suitability of the accessibility for WebCT is 7, for BlackBoard is 8, and for the status quo is 2 on a scale of 1 to 9. Their judgment of the suitability of student support for WebCT is 8, for BlackBoard is 8, and for the status quo is 4. Lastly, their judgment of the suitability of instructor support for WebCT is 8, for BlackBoard is 6, and for the status quo is 3. Now this is where the doing it in your head is overwhelming with normalizing three numbers to an average weight of 1.0, then multiplying nine pairs of numbers and then averaging three columns to arrive at the winning Weighted Average Score of 7.59 for WebCT followed by runner up BlackBoard with a Weighted Average Score of 7.45 which is well ahead of the status quo at 2.9 socore.

Demonstration model of the Comparative Analysis Decision Table with Three Options

(Insert table similar to the one below adapted from http://www.c2t2.ca/landonline/option4.asp)
Instructions:
To compare applications A and B just enter your ratings for each criteria into the boxes in the column and then press **Score**. Be sure to enter a rating or a 0 (for skipping a criteria) for each of the criteria so that the score can be computed.



Application Evaluation Engine Table for Options: A, B, Status Quo

Importance Weighting	**Evaluation Criteria Name**	**A** WebC	**B** Black	**Status Quo**
9	**Accessibility**	7	8	2
7	**Student support**	8	8	4
6	**Instructor support**	8	6	3
ScoreButton	**Weighted Average Scores ***	7.59	7.45	2.9

* NaN - Not a Number error results from a empty rating box in the column Help

Make current values the default values so you can save your work

Rechecking by doing Sensitivity Analyses

One of the benefits of using a computerized process is easy to have the machine perform calculations again. The results in the decision table can be recalculated after tweaking the numbers to see if it makes any difference in which one is the winner. The adjusting and recalculating can be done on the basis of the know variability of the numbers involved to get a better idea of the stability of the solution. In the present example lets say we were curious to see if WebCT would still be the winner if the average instructor support rating were one unit lower so we can try a rating of 7 in place of the original 8 and then score the whole table again. In this case the change of a rating from a 8 to a 7 would in fact change the winner to BlackBoard because the Weighted Average Score for WebCT would drop to 7.32 which is lower than BlackBoard. The point of doing a bit of rechecking is that it can become clear as in this case that the products are so close that the small changes in the judgments would change the outcome.

The other rechecking that can be done is to examine if the outcome would change if the importance weights had been a little different. In the present example if the importance weight for accessibility were changed to 90 from 9 to examine a 10 fold increase in the importance of accessibility then BlackBoard would be the winner with a weighted average score of 7.88 compared to WebCT with a score of 7.13. Notice in both of these instances of rechecking the status quo never wins so one reasonable conclusion from this is that our institution should prepare for a change from the status quo as at least that much is quite clearly an outcome of this decision process.

Summary and checklist

The main reason for getting so involved in the decision of which learning management system is the best for an institution to select is that this is a very important decision. Normally when people make a decision or even groups of people make a decision they do not make a rational decision. Only when the judgments that people make are quite small and simple can they avoid cognitive illusions and biases. Fortunately this kind of product selection decision can be divided up into many smaller decisions that can then be recombined into a weighted averaging decision-making strategy that approximates true rationality. The trade-off is suggested to first use an elimination by aspect strategy to arrive at a short list of competitive products worth considering and then do a more detailed weighted averaging strategy to find out which one has the best score. After that the decision table can be further investigated by doing sensitivity analyses to find out how stable the

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selection of the winner turned out to be. Using the web tools on the site developed for this decision-making can facilitate this process:
http://www.c2t2.ca/landonline

The online educational deliver application decision checklist:

1) First decide what features are important in the local situation
2) Screen options out based on feature criteria using web tools
3) Making a shortlist of product and features required
4) Optional Request For Proposals (RFP) from vendors on the shortlist
5) Judging the importance of features and assigning feature weights
6) Evaluating the product features for each of the shortlist candidates
7) Using the Comparative Analysis Decision Engine Tool to pick a winner
8) Rechecking your work with sensitivity analyses
9) Communicating how the decision was made to stakeholders

References

Anderson, J.R. (2000). Cognitive Psychology and its Implications 5th Ed. Worth, New York.

Begg, I., Amour, V., & Kerr, T. (1985). On believing what we remember. Canadian Journal of Behavioural Science, 17(3), 199-214.

Delbecq, A.L., Van de Ven, A.H., and Gustafson, D.H. (1975) Group Techniques for Program Planning: a guide to nominal group and Delphi processes. Scott Foresman, Glenview.

Galotti, K. M. (1999). Cognitive Psychology In and Out of the Laboratory, 2nd Ed. Brooks/Cole Wadsworth, Belmont.

Gigerenzer, G. & Selten, R. (2001). Rethinking Rationality. In Gigerenzer, G. (Ed.) & Selten, R. (Ed.), (2001) Bounded rationality: The adaptive toolbox. (pp1-12) MIT Press, Cambridge.

Kahneman, D. & Tversky, A. (1996). On the reality of cognitive illusions. Psychological Review, 103(2), 583-591.

Loftus, E. F. (1979). Eyewitness testimony. Harvard University Press, Cambridge.

Miller, G.A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 63, 81-97.

Moscovici, S. & Zavalloni, M. (1969). The group as a polarizer of attitudes. Journal of Personality and Social Psychology, 12, 124-135.

Myers, D.G. & Spencer, S. (2001). Social Psychology Canadian Edition, McGraw-Hill Ryerson, Toronto.

Norman, D.A. (1999). The invisible computer: why good products fail, the personal computer is so complex, and information appliances are the solution. MIT Press, Cambridge.

Payne, W.J. & Bettman, J.R. (2001). Preferential Choice and Adaptive Strategy Use. In Gigerenzer, G. (Ed.) & Selten, R. (Ed.), (2001) Bounded rationality: The adaptive toolbox. (pp. 123-146). MIT Press, Cambridge.

Roe, R.M. (1999). A Dynamic Neural Network Model of Multiple Choice Decision-Making, Proceedings of the Twenty First Annual Conference of the Cognitive Science Society edited by Hahn, M & Stoness, S.C. 614-618.

Roe, R.M., Busemyer, J.R. & Townsend, J.T. (2001). Multialternative Decision Field Theory: A Dynamic Connectionist Model of Decision Making. Psychological Review, 108(2), 370-392.

Simon, Herbert, (1979). Models of Thought, Yale University Press, New Haven.

Tversky, A. (1972). Elimination by aspects: A theory of choice. Psychological Review. 79, 281-299.

Tversky, A. & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. Cognitive Psychology, 5, 207-232.

Tversky, A. & Kahneman, D. (1981). The framing of decisions and the psychology of choice. Science, 211, 453-458.

Usability Study of the ECIC Learning System

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ABSTRACT

The aim of the ECIC project is the dissemination of participative methods of organizational development originating from Scandinavian countries to other European countries. To support this process we developed a hypertextual learning system. Because of the heterogeneous target group and the ill-structured domains of ECIC detailed usability testing is necessary. First tentative results indicate that graphical overview maps play an important role and interactive examples are very motivating.

KEYWORDS: hypermedia application, usability, interactivity, navigation

INTRODUCTION

The aim of the European Continuous Improvement Circles Project (ECIC) is to disseminate participative methods of organizational development originating from Scandinavian countries to the rest of Europe. Examples for such methods are improvement circles where people come together to discuss a given topic, for instance implications of new information technology for their workplace. A facilitator guides this discussion process in order to attain agreed goals.

Manuals on paper can give an introduction into such methods but sometimes they lack the capability to convey the complex nature of such approaches. More interactive forms of representation like hypermedia are probably more appropriate for participative methods. In addition, the ECIC project consisted of several fairly similar methods strongly related to each other. Therefore, we decided that a hypertext-based learning system might be a viable form of introducing this topic to European countries not acquainted with such approaches. The potential learners of the ECIC methodologies are representatives of business administration or Civil Service who often do not hold academic degrees. The ECIC learning system has to be adapted to the needs of this user group. A thorough evaluation of the learning systems is, therefore, necessary. The methods of ECIC can be seen as an ill-structured domain [1], therefore it is the main interest of our usability study to verify the structural representation and the user interface supporting the interpretations of the learner as an ongoing process.

EVALUATION METHODS

The evaluation has several aims. The most important one is to find out how users navigated the learning system. The ECIC methodologies are quite similar to each other and influence each other in their development. Users should, therefore, get extensive information about the structure of the material to be able to see similarities and differences of the different approaches. In this context, several aspects are interesting. The learning system contains several pages with graphical overviews. We wanted to know whether spatial visualization of information is effectively realized in our program. Dee-Lucas [6] assumes that spatial visualization is especially important for these learners who compare the target content and generate relationships that are not explicit in the text. Tosca [4] points out that the relevance of links is the result of an ongoing interpretation process by the learner. To get information about this process, we analyze whether users prefer some types of links above others and which links are more understandable than others. We are also interested in how long learners examine single pages or nodes.

The ECIC learning system tries to present the information in an interactive way. One of our questions is whether users are motivated by interactive examples or not. If they engage in working with interactive examples for an extended period of time this might be an indicator for the attractiveness for such pages. An important variable is also whether texts are clear and understandable. A final question is what users keep in mind when they have finished using the learning system and if their recollection is based on specific representations in the program.

There are several methods of evaluating computer software [3][5]. We chose a combination of thinking aloud protocols and software logging. The thinking aloud protocols are supposed to convey data about users' attitudes towards the learning system and the motivation for their behavior. We have formulated several short questions, which are based on our research interests formulated above. Users are asked to keep these questions in mind while they work to focus their utterances. It is well-known that thinking aloud protocols are a fairly disruptive form of investigation. Nevertheless, we find that this method conveys information, which cannot be obtained otherwise, like, e.g. learners' motivation for using or not using specific links or graphical overview maps. In order to interpret correctly if a user stays at the same topic during a long time, it is important to know whether the user finds the topic very interesting or very confusing.

We also developed a monitoring tool to log the users' actions. This tool creates a log-file with information about the duration of a session, the exact time when a page is accessed or left and the object, which is used to leave a page.

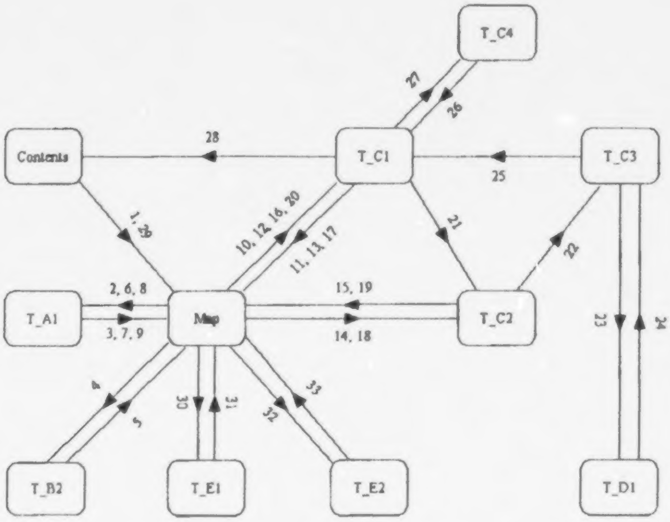

Figure 1: Navigational Graph of the first 33 moves, users' moves start at "Contents", the moves are shown by the ascending numbers next to the directed arrows; "Map" is a graphical overview map, "Contents" is the main content of ECIC learning system, "T_A" to "T_D" stand for theme A to theme D which represent four different topics of ECIC.

From these data we can infer whether users traverse the document hierarchically or in a sequential way and whether they visited the graphical overviews or maps to a large extent. The monitoring tool also provides information about how long users visit a specific node. Based on this information, a directed graph can be constructed showing the moves of the user (Fig. 1). McEneaney uses similar graphs to visualize users' behavior [2].

If analysis of users' behavior is only based on navigational log-files, wrong conclusions could be drawn. Both methods – thinking aloud protocols and software logging – are supposed to complement one another to give a more comprehensive view of learners' behavior.

RESULTS

So far, we have tested two persons who worked with the ECIC learning system. Those tests were very extensive and yielded a large amount of data. During the test we also investigated whether the test procedure we developed was viable or not. We realized, for example, that asking the users too many questions during the test was rather disruptive. One (tentative) result of our evaluation is that the graphical overviews played an important role for the subjects, although one of the two persons also employed a sequential mode of browsing to a large extent. For both subjects, it was difficult at first to adapt to the hypertextual form of organization of information. As expected, users spend very much time examining pages with complex information. But Interactive examples engage users' attention even when they do not convey very much information. One user mentioned that some of the interactive examples in the learning system gave him a more vivid impression of the method described. After the test we asked the users to write down the most salient information they kept in mind. One of the subjects drew a graphical map resembling the overview map in the program. The same person used the graphical overview map of the ECIC learning system very frequently.

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CONCLUSION

The evaluation of the ECIC learning system is an ongoing process. So far, we have data from two subjects. These data indicate that graphical overviews or maps probably play an important role for learner navigation. We intend to investigate several more subjects to get more representative results. Furthermore, we want to develop a more systematic method of analysis for the thinking aloud protocols and for the directed graphs representing the learners' paths through the document.

ACKNOWLEDGEMENTS

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REFERENCES

1. Spiro, R.J., Feltovich, P.J., Jacobson, M.J., Coulson, R.L. Cognitive Flexibility, Constructivism, and Hypertext: Random Access Instruction for Advanced Knowledge Acquisition in Ill-Structured Domains, in: T.M. Duffy, D.H. Jonassen (Ed.) (1992): Constructivism and the Technology of Instruction. A Conversation. Hillsdale, N.J.: Lawrence Erlbaum, p.57-76

2. McEneaney, J.E. Visualizing and Assessing Navigation in Hypertext, in Proceedings of the Hypertext '99 conference (Darmstadt, Germany) ACM: 1999, p.61-70

3. Preece, J. (ed.) Human-Computer Interaction. Wokingham, England, Reading, Mass., Menlo Park, Cal.: Addison-Wesley 1994

4. Tosca, S.P. A Pragmatic of Links. In: Hypertext'00 Proceedings (San Antonio, USA), ACM Press: 2000, p.77-84.

5. Barrit, M. and Scott, D.J., The element of surprise: Stories from the qualitative evaluation of educational technology in Proceedings of the ED-Media'99, (Seattle, USA) p. 1584-1885

6. Dee-Lucas, D. Instructional Hypertext: Attentional Strategies and Text Representations Developed for Different Types of Learning Goals in Proceedings of the ED-Media'98 (Freiburg, Germany) p. 245-250

Students as Faculty Mentors: Reversing the Role of Teacher and Learner

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Abstract: When it comes to understanding and using information technology, today's pre-service education students often know more about technology than their college professors or their field-based teachers in K-12 classrooms. University and K-12 faculty members, on the other hand, know more about teaching and learning than pre-service students and less about technology. By bringing these two groups together as student mentor-faculty pairs, both students and faculty members benefit from the expertise of the other. This panel will describe how the Faculty Mentor Program developed at the University of Vermont (an initiative of the Preparing Tomorrow's Teachers to Use Technology [PT^3] Implementation Grant) brings education students and university faculty together to support new ways of learning for both groups.

Powerful Partnerships

Powerful partnerships can occur when college students are given an opportunity to teach their teachers. By facilitating student mentor-faculty pairs, new relationships are established, new skills are acquired and modeled, coursework is reinforced by practical experience, and student knowledge is tapped and utilized. When the roles are reversed, when the learner is given an opportunity to become the teacher, both sides gain.

To prepare teachers to work in tomorrow's classrooms, education students must be engaged in a program that allows them to learn not only the skills to use technology effectively but also the ability to integrate information technology to improve student learning. Part of the pre-service teacher's professional preparation should include a teacher education faculty who are not only skilled in using technology systems and software but model effective use of technology as a standard component of coursework (National 2000). Pre-service teachers typically are exposed to at least one course in information technology during their preparatory program. Through this course, students either learn new technology skills and applications or reinforce existing skills. It is less common, however, that teacher education programs have faculty who are modeling the effective integration of computer technology. Without these role models, pre-service teachers are less likely to use technology in their own teaching (Beisser 2000). National educational technology standards recommend that pre-service teachers know how to use and integrate technology, both for instructional and professional purposes (National 2000). In effect, pre-service teachers are being asked to meet standards that are seldom modeled and that their college teachers and in-service cooperating teachers often fail to meet themselves.

Because college students often have or acquire information technology skills through coursework, their knowledge can be tapped to support college and in-service faculty. "Using graduate students to mentor college of education faculty has been shown to be an effective technique for integrating technology into the coursework of pre-service teachers" (Beisser 1997). When graduate students are unavailable, undergraduate students have also been an effective option (Beisser 1997).

Faculty Mentor Program

Recognizing the need to promote and support the use of information technology in its educational program, the College of Education and Social Services at the University of Vermont (UVM) initiated a Faculty Mentor Program in the Spring semester of 2001 as part of the Preparing Tomorrow's Teachers to Use Technology (PT^3) Implementation Grant. The Faculty Mentor Program was created to help education faculty (both within and outside UVM) strengthen technology skills and to increase the integration of information technology in college coursework. Undergraduate education students were paired with K-16 faculty members to accomplish a set of goals established by the faculty member, the student mentor and a PT^3 grant team member. Initially, three University faculty and one K-12 faculty member volunteered to work with undergraduate students. In the Fall semester of 2001, five University faculty members established student mentor partnerships and additional support was extended to three, in-service K-12 faculty members working with pre-service teachers. In the Spring semester of 2002, the number of student mentor-faculty pairs is anticipated to increase to twenty.

Both students and faculty benefit from this relationship. Students elect to earn $10/hour or college credit for their work. Within UVM, education faculty members have worked with student mentors to create online course syllabi and resources, develop new online courses, and to improve or enhance courses already in place. With student mentorship, faculty members have learned new software, explored new presentation models, developed online courses using WebCT, and have begun to model the use of information technology in their courses. (Examples may be found at: *http://www.uvm.edu/~inquiryb/, http://www.uvm.edu/~litblock/, http://www.uvm.edu/~crathbon/.*)

Through this experience, students establish a working relationship with their professors, reinforce their own technology skills by becoming the teacher, and participate in discussions with the professor about the rationale and purpose of the materials under construction. In fact, some student mentors have been instrumental in advising faculty members about ways to improve or strengthen course work. These student mentors have become "critical friends" of their professors and both parties have become co-learners.

In the K-12 arena, student mentors have the opportunity to work in a local school district with a classroom teacher and their students. In this partnership, the student mentor may work directly with the classroom teacher to strengthen the teacher's technology skills or with students to integrate technology into the curriculum. Often, the student mentor may be more knowledgeable than the classroom teacher about the use of technology skills. Student mentors have helped K-12 faculty learn how to use presentation software (such as PowerPoint) with middle school students to create science presentations, to introduce basic word processing, keyboarding, and paint program skills to second grade students, to research educational software available in the classroom, and to create web pages for curriculum or classroom projects. In turn, mentor students learn more about the complexities of being a classroom teacher. Here again, mentors and teachers share their knowledge and expertise and mutually contribute to their learning.

Studies have shown that it takes five to six years for teachers to use technology effectively in their teaching (Beisser 2000). Ongoing support therefore is critical to support professional development efforts in information technology. Student mentors can be employed to reinforce concepts and skills learned during PT^3 workshops or summer institutes. This continual assistance enables the faculty member to move forward while providing reinforcement for the student mentor as well. Practical applications of technology provide students with models for their future growth as computer-using teachers.

Outcomes

As a result of the Faculty Mentor Program, notable growth has been seen in the use and modeling of information technology. More University faculty members have begun to borrow laptop computers and more time has been devoted to developing new online projects. Without the support of the student mentors, this increase in use and interest would not have been as rapid. Faculty members who are now using technology to support their courses are gaining recognition. As faculty web pages improve, other faculty members become increasingly interested in how technology can improve their course presentations. Students who enroll in courses offered by professors that use technology "spread the word" about the course to other students. This interest, in turn, encourages more faculty members to integrate technology into their coursework and to consider new approaches. Faculty members are beginning to publish online exemplars of student work. This enables the professor to demonstrate an expectation for student work and, as a result, the standards for student performance have been raised. Some faculty members have begun to archive student work online, allowing the student's work to become a knowledge base for other students. This growth in the use and modeling of information technology has been supported by the efforts of student faculty mentors.

The Faculty Mentor Program provides an opportunity for pre-service teachers to reinforce their skills in information technology. Students establish a collegial relationship with their professors and they gain more confidence in their own abilities. It provides them with practical experiences that they can document and use when seeking employment. Students who work in K-12 classrooms receive the benefits of working directly with students to see how information technology can be used to support learning. In this environment, they learn about different networking systems and infrastructure, educational software, curriculum requirements, school rules on appropriate use, the challenges of out-dated or limited resources, and many information management lessons.

Evolving Strategies

As this program continues, the PT^3 grant team will refine its approach and methods to improve and strengthen student mentor-faculty pairs. Expectations and guidelines need to be established for both the student and the faculty. Commitment must be mutual on both sides. Faculty members cannot expect students to produce content for their courses, but they can be active collaborators by soliciting and sharing constructive feedback. Everyone must be an active participant in the learning process. Student mentors are not substitutes for secretarial assistance. Student mentors must learn how to be effective teachers and supporters of information technology integration. With collaboration and support, both parties gain from this partnership.

Overall, both the pre-service teacher and the education faculty benefit from this model. The knowledge and energy that a college student provides is a resource to professors, K-12 faculty and K-12 students. In turn, pre-service teachers gain experience, confidence, and practical application to help prepare them to become tomorrow's teachers.

Panelists

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Adam Deyo, PT3 Graduate Assistant, College of Education and Social Services, University of Vermont. (Adam.Deyo@uvm.edu) Mr. Deyo holds a Bachelor of Science in Early Childhood Education from the University of Vermont and a Level One Teacher Licensure for Kindergarten through Third Grade. He was a Child Development Specialist at the University of Vermont's Campus Children's School for two years working with Infants, Toddlers, and Preschoolers. In addition, he mentored two separate groups of student teachers in the classroom throughout their pre-service work with young children each year. Mr. Deyo currently is seeking a M.Ed at the University of Vermont and assists on all aspects of the Preparing Tomorrow's Teachers to Use Technology Grant in the College of

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Sandra A. Lathem M.Ed., PT3 Outreach Coordinator, College of Education and Social Services, University of Vermont. (Sandra.Lathem@uvm.edu) As PT3 Outreach Coordinator, Ms. Lathem recruits and supervises student mentors that work with K-12 faculty in the Burlington and South Burlington School Districts. She supports UVM student mentors to assist them with their knowledge and integration of technology in the K-12 classroom and works with K-12 faculty to set goals and objectives for the student-faculty mentorship. Previously, Ms. Lathem served as the Technology Coordinator for the Addison Northeast Supervisory Union in Bristol, Vermont and has been an educational technologist in Vermont school systems during the last ten years. Formerly, Ms. Lathem was the Executive Director of VITA-Learn, a statewide, non-profit organization supporting information technology integration in Vermont K-12 schools. Ms. Lathem received her Masters of Education in Professional Development, Curriculum and Instruction from the University of Vermont in 1995.

Joyce L. Morris, Ed. D., PT3 Professional Development Coordinator, College of Education and Social Services, University of Vermont. (Joyce.Morris@uvm.edu) Professor Morris is an assistant professor in the Department of Education at the University of Vermont. Her research interests include electronic portfolio construction for assessment and learning and professional development of faculty using technology tools. At the University of Vermont, she has taught undergraduate courses in educational technology, science methodology, portfolio construction, and general education. At the graduate level, she offers courses in using computers in the classroom, web design, telecommunications, and connecting technology to the standards for in-service teachers. Prior to her appointment at the University of Vermont, Professor Morris was a science teacher who integrated technology into her curriculum at a Bronx, N.Y. middle school. She wrote and received a grant from Apple Computer that provided a 22 station, networked classroom in 1989. Using these computers, students created science animations, used computer probes to conduct experiments and record data, published science pictionaries for younger students, and participated in a number of telecommunication projects with TERC.

References

Abruscato, J.,Agne, R., Baker, S. (2001). *Welcome to Inquiry Block.* [Online] Available: http://www.uvm.edu/~inquiryb/

Beisser, S.R., (2000 conference proceedings). Technology Mentorships in Higher Education: An optimal match for expanding educational computing skills. *SITE-Society for Information Technology and Teacher Education International Conference*, San Diego, CA.

Beisser, S.R., Kurth, J.L. & Reinhart, P. (1997 conference proceedings). The teacher as learner: An undergraduate student and faculty mentorship success. *SITE-Society for Information Technology and Teacher Education International Conference*, Orlando, FL.

Bell, L. (Ed.) (2001). Preparing tomorrow's teachers to use technology. Perspectives of the leaders of twelve national education associations. *Contemporary Issues in Technology and Teacher Education*, 1(4). [Online]
Available: http://www.citejournal.org/vol1/iss4/currentissues/general/article1.htm

Franklin, T., Turner, S., Kariuki, M. and Duran, M. (2001). Mentoring Overcomes Barriers to Technology Integration. *Journal of Computing in Teacher Education*, 18(1), 26-31.

Knox, B., Mekkelsen, J. (2001). *Welcome to the Literacy Block: Learning to Teach Reading and Writing Responsively*. [Online] Available: http://www.uvm.edu/~litblock/.

McGee, P. (2000). *Preservice Technology Mentoring*. San Diego, CA.: Society for Information Technology and Teacher Education International Conference. (ERIC Document Reproduction Services No. ED 444 571)

National Educational Technology Standards for Teachers, (2000). *International Society for Technology in Education (ISTE) NETS Project.* [Online] Available: http://www.iste.org.

Rathbone, C. (2001). *Charlie Rathbone's Home Page*. [Online] Available: http://www.uvm.edu/~crathbon/.

Student Mentors and Technology Interns (2001). [Online] Available: http://www.uvm.edu/~cess/pt3/mentors.html.

Teacher–Designed Software for Interactive Linear Equations: Concepts, Interpretive Skills, Applications & Word-Problem Solving

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Abstract: No longer just a user of commercial software, the 21st century teacher is a designer of interactive software based on theories of learning. This software, a comprehensive study of straight-line equations, enhances conceptual understanding, sketching, graphic interpretive and word-problem solving skills as well as making connections to real-life and scientific phenomena. Developed using Maple and Hyperstudio, this software of 40 questions actively captures students' visual intelligence and evokes thinking to provide generative responses. Other features include corrective feedback, hide-and-show, scoring, timing and a student output file containing a student's 1st and 2nd responses and revealing any misconceptions held and difficulties encountered.

Introduction

A straight-line equation, the most basic kind of mathematical function, is one of the most unifying ideas in mathematics. It has extensive applications in the world of science, especially physics, business and social science. From my experience as a high school mathematics and science teacher for about 20 years, I have seen how the lack of a conceptual understanding of straight-line equations has hindered students' understanding of science, especially physics. Some difficulties encountered by students include the inability to interpret a graph, to determine its algebraic representation, to verbalize the relationship between the two variables, to sketch a simple line without going through a table of values, or to see the graphical representation associated with an algebraic expression.

Dreyfus & Eisenberg (1982) found that students of low ability had difficulty with the graphical concept of a function. In another study in 1991 they contend that the chief source of difficulty encountered by beginning calculus students is their inability to exploit the visual representations associated with the concept of functions. Vinner and Dreyfus (1989) surveyed 307 college students on their concepts of a function and only 8 % of the students made reference to its graphical representation. In fact many studies investigated students' understanding of graphs of function and concurred that students lack the skill in interpreting graphs and fail to see the connection between the algebra and geometry. (Knuth, 2000).

In this computer age when a large quantity of data can be easily represented in different graphical forms, it is vital that students be proficient in the interpretation and extrapolation of graphs to deduce important information and relationships between the variables. Computer technology has freed students from the laborious task of graph plotting with pencil and paper but very often a student is not even aware that he/she has made a mistake in keying in information, resulting in the display of a different graph or function. Thus it is important that students have the conceptual, intuitive and visual understanding of straight-line equations in terms of positive and negative slopes, and *y* intercepts before embarking on the use of graphing software.

As cited in the Before It's Too Late report (2000), computer technology has not only changed the way we live and the way business is conducted, it has changed the demands of our work force, which calls for students to be equipped with the ability to think and solve problems. Educational reforms all over the world are bringing changes to meet such demands. NCTM (National Council of Teachers in Mathematics Standards) (2000) calls for a shift in emphasis from a curriculum dominated by the memorization of isolated facts to one that emphasizes conceptual understanding, problem-solving, functional relationships, multiple representations and connections, in particular between algebra and geometry, as well as to the real-world and other disciplines. My study of straight-line equations is in response to NCTM's multi-faceted frames of learning.

In Ontario, the New Curriculum, which consists of 4 years of high school compressed from 5, was introduced in 1999. Many topics, including straight-line equations, have been moved from higher to lower grades causing difficulties for many students. A recent report confirms a higher failure rate of our grade 9 and 10 students. ("Poor Math", 2001). Teachers with an increased workload of 6 courses from 5 are also faced with larger class sizes and new-immigrant students of very diverse ethnic backgrounds, languages and learning abilities. Professional developments for teachers and the use of computer technologies in the form of software or the Internet are high on the agenda to support student learning.

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Computer Technology and Learning

Douglas Noble (1988, P. 241) has given one of the clearest discussions of the three rationales for the introduction of computer into schools.

"The first focuses on... technological society [which] requires new skills, including computer literacy...second rationale...technology of education: computer-based instruction offers new, effective and efficient ways to present material, to individualize instruction...third rationale focuses on a technology of mind: interactions with computers enhance cognitive skills while offering the possibility for intellectual mindstorms".

According to cognitive theories, computer technologies are cognitive learning tools, which expand human abilities such as memory and processing. Roschelle (1994) regarded technology as a form of inquiry with three functions derived from Dewey for the following:

a. to provide a stable, long-term access to a problematic situation in which the learner can repeatedly replay and reflect.
b. to provide focus and context to identify new features and relationship.
c. to augment ways of acting so that their meaning is more readily available to others.

Many studies have shown that calculators and computer-based materials have enhanced learning. Schwartz (1999) confirms the 5 aspects of mathematical activities, namely, conjecturing & exploring, evaluating & analyzing data, modeling, conceptually grounding manipulative skills, and the deepening of understanding, which can be enhanced by the use of computer technology. In mathematics, before students can create ideas or apply their ideas, they need to have a good grounding of basics, facts and conceptual understanding. Despite all the merits of computer technology, a teacher must use it wisely to ensure effective learning and must give clear instructions and guidance. I am in total agreement with Bland (1996, p.2) who says, "Technology should be used to expand possibilities for students, and to permit them to explore otherwise inaccessible problems. However, it should only be introduced after they understand the mathematical concepts involved, and are able to manually use them in simple problems".

Exploring and conjecturing are stimulating and can even evoke critical thinking for the average and above average students but for the less mathematically inclined, who often fail to discover patterns or conjectures, they feel very lost and frustrated. Mayes's (1992) study concluded that the average students performed better with the use of mathematical software with exploratory and programmable functions, but not the weak students. Recently, constructivism has been met with opposition by parents and educators as indicated in the "Math Wars" brewing in California which called for the adoption of the "three phase approach", namely the direct instruction in skills, the help phase and the self-regulated drill and practice (Becker & Jacob, 1998). Hirsch (1997, p.6) cites, "... only through intelligently directed and repeated practice, leading to fast, automatic recall of math facts, and facility in computation and manipulation can one do well at real-world problem solving".

Brady (1991, p.149) once said, "the best teaching aid is often those designed by the teachers themselves".

Thus, I have embarked on this project of designing a CAI software (mainly to serve the mathematically less inclined) with 40 questions that provides lots of practice, at the same time incorporating a multi-faceted frame of learning, delving in depth and width into all the topics related to straight-line equations. The research also examines students' conception or misconceptions of straight-line equations as well as ways of thinking and difficulties encountered in word-problem solving, interpretation of graphs, and scientific applications.

Software Design & Learning Theories

Piaget's and Skinner's Theories. Mellon & Sass (1981) suggest Piaget's developmental theory as a theoretical foundation for CAI. Piaget emphasized the movement of students through sequential stages of cognitive development; each stage builds on the previous one to develop effective learning. Skinner (1938) listed four important tenets about learning, which include a short learning process, reinforcement, immediate feedback and provision of "stimulus discriminations' for path to success, most of which are incorporated in the design.

Jonassen's Activity Theory. Interactivity has been identified as an important characteristic of the computer environment to the acquisition of deep learning. According to Jonassen and Rohrer-Murphy (1999), Activity Theory posits that conscious learning emerges from activity or performance. This software is designed with a high degree of interactivity, constantly asking the student what to do next and leading her through a continual process of interpreting, judging, constructing, applying concepts, translating modes of representation, and reinforcing algorithmic skills.

Real-Life & Interdisciplinary Learning. Students have often asked me "What good are the *x* and *y* in the real word? How are they helping me to find a job?" In the teaching of mathematics, it is imperative to bring in applications be they science, business or real-life problems, to foster conceptual understanding as well as convince students of the power and usefulness of mathematics.

Beane says that students are to "... integrate learning experiences into their schemes of meaning...And knowledge is called forth in the context of problems, interests and concerns at hand." (1995, p. 616). Carifio (1994) identifies key contextual features as familiarity, imageability and variable type (discreet or continuous quantities). The questions in the software are carefully prepared to incorporate such features i.e. real-life and scientific phenomenon that students are familiar with or can relate to.

Problem-based Learning. Problem solving is a form of higher-order thinking and depends on a student's resources, heuristics, control, and worldviews (Schoenfeld, 1985). My software aims at developing better heuristics and control in students as well as fostering the ability to identify relevant information, to transform words into symbolic equations, to assign suitable variables and notation for immediate recall of significant information, to discern the reversal error (Rosnick, 1981). and to apply the optimum algebraic skills. Through working with the word problems, students will learn to plan and sequence their tasks, justify their answers, and test their final answers by integrating algebraic and geometric methods.

Howard Gardner's Visual Intelligence. Gardner (1983) notes that many students have preferred ways of learning depending on their "intelligence" which could be kinesthetic, spatial or visual, musical, verbal, intrapersonal, interpersonal or naturalistic. This software captures the visual intelligence of the student through the many vivid representations of graphs created by Maple (Char et al., 1991) and fosters logical reasoning in the interpretation of graphs. According to Mones-Hattal & Mandes, (1995, p.891) visual literacy is "a cognitive process that includes mental rehearsal, introspection and visualization .....whereby each exposure to the visual image permits the observer to become a keener interpreter of the visual display".

My Interactive Straight-Line Equation Software

This software consists of 4 modules, namely, A: Slope by visualization or calculation, B: Graphical to algebraic form, C: Applications and D: Word-problem solving. The graphs were drawn with Maple. First the grid was drawn with tiny circles each representing integer coordinates or some multiples of integers. A set of horizontal points was generated using the Maple "seq" function and the corresponding points were drawn with the "plot" function. These two functions were placed inside a loop to draw subsequent lines of points forming a grid. The line $y = mx + b$ was then drawn and the whole graph was exported to Hyperstudio. (See Appendix I for Maple Program). Hyperlogo in Hyperstudio is used in achieving the more sophisticated interactive features such as keeping track of the number of times a student has answered an item or analyzing if the response is correct and furnishing a corrective feedback. The following table shows the correspondence between the features of this software and Kuittinen's (1998) four criteria or demands for a good CAI.

Demands (Kuittinen)	**Characteristics** (This software)
Domain - Dependent	-Questions are relevant to instructional aims and curriculum related -Questions are interdisciplinary or related to real-life phenomena
Instructional	-Each module carries at least one worked example -Generative responses as well as multiple-choice questions. -Immediate feedback; correct answer is displayed after 2 incorrect inputs. -A high level of interactivity to elicit continuous student participation; step by step guidance. -Ample questions for practice. -Questions are contextual in nature. -Student performance is assessed with an output file, which has a record of the 1st and 2nd responses. - Student's achievement score is recorded giving an indication of the student's progress. –Timing feature keeps a record of the time the student spends on a question giving an indication of perceived difficulty.
	-Powerful graphics with clear and precise graphs on a dotted grid to capture student's visual intelligence and to facilitate the skill in interpreting graphs. -Hide-

User Interface	and-show feature to capture student's attention and concentration on one particular idea at a time. -Drag-and-drop feature to help students tack on x and y coordinates to an ordered pair of a point. -Learner's choice of method in word-problem solving. Only when the student fails to achieve the answer does he have to follow certain prescribed steps, those steps taken by experts! Hopefully this trains students to emulate experts. -Accommodation of upper and lower case input. -Navigation is easy; each card is linked to the first card, which has the exit icon, as well as automatically to the next card or the menu selection card. – In some modules, questions are identified as easy, moderate and difficult. -Texts of different colours and highlighting for easy reading. -Students can work at his own speed.
Pragmatic	Hyperstudio will have to be installed in the computer to run the software. I am now preparing a compact disk with Hyperstudio embedded in so it can run independently. Thus the software is portable and does not require any technical support for installation. The modules could easily be posted on the Internet.

Table of Characteristics of Software

Nature of Questions & Links

Module C: Applications

1. Ohm's Law	6. Speed of sound
2. Density	7. Motion
3. Friction	8. Snell's law (light)
4. Electric charge	9. Heat
5. Electrical energy	10. Cooling of Water

Module D: Word-Problem Solving

1. Dimensions	6. Distance, speed
2. Mixtures	7. Distance, speed. (different starting times)
3. Money (coins)	8. Tickets, money
4. Age	9. Car rentals
5. Concentrations	10. Numbers

Visit http://fcis.oise.utoronto.ca/~vlawrence/stlines.html to view sample computer screens.

If you have **Quick Time 5** on your machine, you may try out a sample of the interactive software at http://fcis.oise.utoronto.ca/~vlawrence/hypertrl.html

Proposed Study

A class of grade 10 students who have covered the content of straight line equations will be given a pre-test of 8 questions , 1 on slope by inspection, 1 by calculation, 1 on transformation from graphical to algebraic form, 1 from algebraic to graphic form, 1 on formulation of equation given relationships expressed in words, 1 on the interpretations of a graph representing a scientific phenomenon, and 2 on word-problems. From the results of the pre-test, weak and average students (selected few) will be solicited for interviews. The whole class is then exposed to the interactive software but think-aloud protocols or audio-video taping may be employed to the selected few who work individually or in pairs. Students are then given a questionnaire about their learning experience with the software, followed by a post-test and a final interview (selected few), the latter to probe further into their misconceptions captured in computer files, audio-video taping and post-test.

Pilot Tests & Findings

In the first pilot study, 57 grade 9 students (from 3 classes) wrote a pre-test followed by treatments of modules B (graphic to algebraic) and C(applications). Students were then given a questionnaire in my absence, followed by a post-test. A quantitative analysis of the pre and post-test using the comparison t test for two means from dependent (correlated) samples pointed to a significant difference in the scores or gains. Feedback from questionnaires revealed that 91% of the students affirmed that the software had enhanced their learning.

In the second pilot test, three grade 10 students were interviewed individually followed by a pre-test. Each then interacted individually with module D (problem-solving) followed by a questionnaire and a post -test. Both feedback from the questionnaire and results of the post-test indicated significant gains in learning. Analysis of "captured files" also revealed certain misconceptions held and difficulties encountered by students, some of which were the inability to reduce ($9A + 6S = 7500$), relating to time frames (to add or subtract when leaving a point at a later time), handling special cases (solving $C=40+0.2D$ and $C=30+0.25D$, did not see coefficient of 1 in C provides direct subtraction or equating), false commutation (length is 2 cm less than width as $L = 2-w$), faulty conversion between decimal and percent etc.

In general the students agreed that the software had helped them to attain a better conceptual understanding of straight-line equations, had improved their graphing, graphic interpretive, algebraic and problem-solving skills, in particular, the transformation of relationship in words to symbols. They also indicated that they view mathematics as more meaningful and have less fear of word-problem solving.

Conclusions

In view of positive pilot study results, this interactive software will not only enhance the learning of straight-line equations related to graphical interpretive and problem-solving skills but also foster a better understanding of scientific principles and usefulness of mathematics in the real world. Misconceptions and students' ways of thinking can shed light to how teachers should teach and serve as a resource for curriculum designers and planners. To accommodate students' learning in this computer technology era, software must not only cover all aspects of a topic; it must link them, actively and interactively engaging the user as a builder of his own knowledge. These principles of software design can be applied to other topics in the mathematics curriculum, in particular the extension to quadratic, exponential, logarithmic and trigonometric functions.

Appendix I

This MAPLE program generates the graph consisting of the grid points, coordinate axes and the straight line $y = 10x + 20$

```
with(plots):hlines:={};
                    hlines := {}
 for j from 1 to 6
 do
   yval:= 10*j:
   yrlist:=[seq([i, yval],i=1..4)]:
   hlines:=hlines union {plot(yrlist, style=point,symbol=circle,colour=blue)}:
 od:
display(hlines);
 e:=plot(10*x +20, x=0..4):
  display({e} union hlines);
```

References

Beane, J. A. (1995). Curriculum Integration and the Disciplines of Knowledge. *Phi Delta Kappan*, 76(8), 16-22.

Becker, J. P.; Jacob, B. (1998). Math war developments in the United States. The International Commission on Mathematical Instruction, Bulletin, 44. [http://www.mathunion.org/ICMI/bulletin/44/MathWar.html]

Before it's too late. (2000). U.S. Dept. of Education, The National Commission on Mathematics and Science Teaching for the 21st Century, Washington, DC.

Brady, R. (1991). A close look at student problem solving and the teaching of mathematics: Predicaments and possibilities school science and mathematics. *School Science and Mathematics*, 91(4), 144-151.

Char, B.W.; Geddes, K. O.; Gonnet, G. H.; Leong, B.L.; Monagan, M. B.; Watt, S. M. (1991). *Maple V library reference manual.* New York, Springer-Verlag.

Carifio, James; Nasser, Ramzi. (1994). Algebra word problems: A review of theoretical models and related research literature. Paper presented at the Annual Meeting of the American Educational Research Association. (New Orleans, LA, April 5-8)

Dreyfus, Tommy; Eisenberg, Theodore. (1982). Intuitive functional concepts: A baseline study on intuitions. *Journal for Research in Mathematics Education*, 13(5), 360-80

Du Plessis, Johan P.; And Others. (1995). A model for intelligent computer-aided education systems. *Computers & Education*, 24(2), 89-106

Gardner, H. (1983). *Frames of mind: the theory of multiple intelligences*. New York: Basic Books.

Hirsch, E.D. (1997). *Address to Cal State Board, April 1997*, mimeographed 9 pages, California State board of Education.

Jonassen, D., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology, Research and Development*, 47(1), 61.

Knuth, E. J. (2000). Understanding the connections between equations and graphs. *Mathematics Teacher*, 93(1) 48-53

Kuittinen, M. (1998). Criteria for evaluating CAI applications. *Computers & Education*, 31, 1-16

Mayes, R. L. (1992). The effects of using software tools on mathematical problem solving in secondary schools. *School Science and Mathematics*, 92(5) 243-48

Mellon, C.A.; Sass, E. (1981). Perry and Piaget: Theoretical framework for effective course development. *Educational Technology*, 21(5) 29-33

Mones-Hattal, B; Mandes E. (1995). Enhancing visual thinking and learning with computer graphics and virtual environment design. *Computers & Graphics*, 19(6) 889-894

National Council of Teachers of Mathematics. (2000). Curriculum and evaluation standards for school mathematics. Reston, VA: The Council.

Noble, D.D. (1988). Education, technology, and the military. In L.E. Beyer & M.W. Apple (Eds.), *The Curriculum: Problems, Politics and Possibilities* 241-258. Albany: State University of New York Press.

Poor math scores raise alarm. (2001, December 7). *The Toronto Star*, p. A1.

Roschelle, J. (May 1994). Collaborative inquiry: reflections on Dewey and learning technology. *The Computing Teacher*, 21(8), 6, 8-9

Rosnick, P. (1981). Some misconceptions concerning the concept of variable. *Mathematics Teacher*, 74(6), 418-20

Schoenfeld, A. (1985). *Mathematical Problem Solving*. Academic Press. New Jersey. Jonanovich, Publishers

Skinner, B. F. (1938). *The behavior of organisms: an experimental analysis*. New York: Appleton-Century-Crofts.

Swartz, J. (1999). Can technology help us make the mathematics curriculum intellectually stimulating and socially responsible? *International Journal of Computers for Mathematical Learning*, 4(1), 99-119.

Vinner, S. ; Dreyfus, T. (1989). Images and Definitions for the Concept of Function. *Journal for Research in Mathematics Education*, 20(4), 356-66

Web Navigation: The Role of Metaphor, Concept map, and Individual Differences

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Abstract: The flexible nature of hypermedia allows it to be tailored to an individual's needs. Despite the many degrees of navigational freedom, however, users of hypermedia often find difficulty locating information, feel disoriented, or even become "lost in hyperspace" within such large seas of data. Research findings suggest that the disorientation problem could be solved if users are able to hold a conceptual overview of the hypermedia structure. Variables such as the different ways of representing information structure cues and cognitive styles may affect learners' cognitive abilities in knowledge structuring and should be taken into account together.

INTRODUCTION

With the development of large information space such as digital libraries, however, users of hypermedia often experience difficulty locating information. Scholars (Beasley & Waugh, 1995; Dias & Sousa, 1997) have suggested that the navigational problem could be solved if users are able to hold a conceptual overview of the hypermedia structure. In other words, if users can substantially construct a structural knowledge (Jonassen, Beissner, & Yacci, 1993) of the information provided in the hypermedia system, their performance could be improved. In a hypermedia context, graphical browsers have been introduced as either schematic (concept map) or spatial (hyperlink) representations of the network. Both methods above represent what Halasz and Moran (1982) have called "conceptual models". Yet, it may not always be easy for novice learners to use an abstract conceptual model. If a supplied conceptual model is not familiar to the learner, then this strategy will not work (Halasz & Moran, 1982). Consideration of this issue suggests the usage of the metaphorical GUI (Carroll & Thomas, 1982; McKnight, Dillon, & Richardson, 1991;Rizk, Streitz & Andre, 1990), e.g., the office metaphor, to help with the development of new cognitive structures from existing ones.

CONCEPT MAP AND METAPHORICAL GUI

Despite of some exciting possibilities in the realm of user- centered learning, there is a fundamental problem regarding hypermedia; it provides too few structural cues for some users (Charney, 1987; McDonald & Stevenson, 1996; Dias & Sousa, 1997). They need to depend on some sort of consistent layout and structure for their understanding and would succumb to confusion or disorientation if their expectations were violated. Designers have to realize what types of structure cues hypermedia could adopt and then evaluate them at the planning stage.

Concept maps (Nielsen, 1990; West, Farmer, & Wolff, 1991) are maps that display experts' knowledge structures graphically. This navigation tool is similar to the cognitive representation formed by the learners and is a mental representation of external spatial relations used to navigate in physical spaces (Dias & Sousa, 1997). In hypermedia-based instruction, concept maps are presented as templates to facilitate the novice's acquisition of experts' knowledge structures. The concept map has been categorized by Jonassen, Beissner, and Yacci (1993) as an organizing strategy which might help learners to construct or reorganize their knowledge structures by showing how concepts relate to each other.

Another type of structural cues is the metaphorical GUI. When a computer user learns a new computer program, he calls upon his prior knowledge (analogies or metaphors) as the basis on which to form a new mental model. Designers can take advantage of users' existing mental models to present ways of conceptualizing computer functions and to design interfaces for computing systems (Carroll & Thomas, 1982). Nepon and Cates (1996) state that appropriate use of graphics embedded in interface metaphors may have the potential to increase "the rate at which users can process, understand, and respond to a display" (p. 1). They note Bielenberg's (1993) view on the "transfer" function of metaphor and suggest that interface designers may use visual metaphors to design a conceptual model in order to conform to users' mental models in a complete and painless manner while the users are learning a new domain. Bishop and Cates (1996) also suggest that a metaphorical GUI helps users to establish expectations for the new computer systems and facilitates the understanding of the systems to be learned by utilizing the users' familiar concepts and experiences.

Apart from the representational aspect of hypermedia, the effects of learners' cognitive characteristics on the navigational problem are another concern in this study.

COGNITIVE STYLE

Wickens (1990) and McDonald and Stevenson (1999) indicate that once the correspondences among the physical presentation of the real world, the user's egocentric view of the real world, and the user's mental representation of the world are broken, disorientation will happen. The physical presentation of the real world is the way that author uses to convey information. The user's egocentric view of the real world could be viewed as an internal issue regarding the way that users interpret what they see. How users interpret what they see highly relate to the individual cognitive styles. Several studies have found that among other individual elements, the effects of cognitive styles, is arguably one of the most important factors that might affect learners' performances, especially in a hypermedia environment (Andris & Stueber, 1994; Chang, 1995; Leader & Klein, 1996). Cognitive style refers to an individual's cognitive tendency for perceiving, processing, and organizing information. A subject's structuring ability or cognitive style might be more strongly manifested in a non-linear environment. When a learner tries to link incoming information with established ideas, the incidences of misconception might increase if the text's organizational pattern can not be used appropriately. Disorientation and confusion thus may occur simultaneously and become potential hazards for studying in a hypermedia environment (Hammond, 1993). In this study, cognitive style will be examined within the dimension of "Wholist" and "Analytic" (Riding & Glass, 1997)

SUMMARY

It is hypothesized that learners' cognitive styles and two types of structure cues could affect learners' feelings of disorientation. Learners' cognitive characteristics play a central role in the regulation of learning processes. Yoder (1994) and other researchers (Rasmussen & Davidson-Shivers, 1998) feel that it is essential for educators to beware of the differences of individual cognitive styles and their effects on performance. However, little is known about the manner in which students employ these characteristics in a hypermedia context to search information, or about the way in which this execution is affected by different information representation approaches (Burton, Moore, & Holmes, 1995).

REFERENCE

Andris, J. F. and Stueber, A. M. (1994). Studying Student Navigational Patterns in a Hypermedia Geology Lab Simulation and their Relationship to Learning Style. Presented at the Seventeenth Annual Conference of the Eastern Educational Research Association, Sarasota, FL.

Beasley, R. E., & Waugh, M. L. Cognitive mapping architectures and hypermedia disorientation: An empirical study. Journal of Educational Multimedia and Hypermedia, 4, 239-255.

Benyon. D.R, Hook, K. (1997). Navigating in Information Spaces; Supporting the Individual *INTERACT '97, Australia*

Bielenberg, D. (1993). Interactive design and the mythical intuitive user interfaces. Journal of Interactive Instruction Development, 6 (2), 14-19.

Anchored Instruction in a Situated Learning Environment

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Abstract: The purpose of this study was to design and develop multimedia-based anchored program and to examine the effects of students' and group characteristics on the problem-solving process in anchored instruction with the multimedia program in a situated learning environment. Sixty-eight students were assigned to small groups via a stratified random sampling procedure. The students were working cooperatively as a group on the authentic task of multimedia-based anchored instruction. The results of the analysis showed that group composition as well as students' characteristics significantly exerted differential effects on the problem-solving process. The implications of the results for anchored instruction were discussed.

Introduction

Along with advances in information and communications technology, there has been a shift towards a new paradigm of education and training. The emerging paradigm entails the characteristics that distinguish between industrial-age and information-age educational systems (Kang & Kim, 1999; Reigeluth, 1999). The educational system based on a new paradigm supports a constructivist approach to the teaching and learning process and fosters learner-centered, interactive, contextualized, and meaningful learning environments with diverse, multiple perspectives.

There have been an increasing number of studies on anchored instruction in authentic and situated learning environments with highly interactive and engaging forms of technology-supported contents (e.g., Bransford et al., 1994; Brown et al., 1989; Cognition and Technology Group at Vanderbilt, 1991; 1992; 1993a; 1993b; Crews et al., 1997; McLellan, 1996; Shih, 1997; Ruokamo, 2001; Young, 1993). The anchored instruction approach emphasizes authentic learning in solving complex problems typically found in real world situations and collaborative work in small groups to generate sub-problems and develop solutions utilizing embedded data. This approach can provide students a situated learning environment that facilitates problem-solving as well as problem-definition skills and collaborative efforts among students during group work on the authentic task.

In general, research on anchored instruction has shown positive effects on students' cognitive and social-affective outcomes (e.g., Cognition and Technology Group at Vanderbilt, 1992; 1993a; 1993b; 1997; Hmelo et al., 1993; Lee & Hwang, 2001; Serafino, 1999; Shih, 1997; Ruokamo, 2001). Most of the studies have utilized the *Adventure of Jasper Woodbury* series developed by Cognition and Technology Group at Vanderbilt as the anchored program. Until recently, however, few studies have investigated anchored instruction with different forms of anchored program for students from a different cultural background. To this end, the present study attempted to develop multimedia-based anchored courseware that is adaptive to elementary school curriculum in Korea and to examine the factors affecting the problem solving process in anchored instruction with multimedia courseware in a situated learning environment.

The purpose of this study was to design and develop multimedia-based anchored courseware and to examine the effects of cognitive style of the student, the type of problem-solving task, and group composition on achievement in anchored instruction with multimedia courseware in a situated learning environment. The achievement results in understanding of problems, accuracy of problem solving, and reasoning and organization of problem solving of students working on original and analogy tasks were compared in heterogeneous and homogeneous groups featuring individual and group accountability.

Method

Sample

The subjects for the study were sixty-eight students (33 females, 35 males) in the sixth grade at two elementary schools in a metropolitan city in Korea. All the subjects had some previous experience with computers and the Internet at or outside of school in a variety of subject areas. The subjects were assigned to small groups via a stratified random sampling procedure on the basis of pretest results. They remained in the same groups throughout the study.

Procedure

Before the study began, students were asked to complete a background survey regarding students' previous experience with computers. The pretest was administered to assess students' previously acquired knowledge with the subject or content areas of the authentic task. Stratified random sampling was used to assign students to heterogeneous and homogeneous groups. Heterogeneous groups consisted of high- and low-score students. Homogeneous groups consisted of students of the same-level score. Students were unaware of the composition of the group. Students also took the Group Embedded Figures Test so as to identify those with field dependence or field independence. Students were then given practice sessions of anchored instruction with multimedia courseware developed for the study. They were instructed to work cooperatively as a group on the authentic task of multimedia courseware, to help each other learn, and to make group decisions on the course of their actions in solving a set of problems. Students worked for five 80-minute instructional sessions.

Multimedia Courseware

For the purpose of this study, multimedia courseware was designed and developed for Anchored Instruction. This courseware appears to be one of the first programs for anchored instruction that was designed to be adaptive to elementary school curriculum in Korea. In developing multimedia courseware, the author attempted to meet the design principles for the development of the anchored program identified by Cognition and Technology Group at Vanderbilt (1990; 1991; 1992; 1993a; 1993b; 1997). The design principles include: (1) video-based presentation format, (2) narrative format, (3) generative learning format, (4) embedded data design, (5) problem complexity, (6) pairs of related adventures, and (7) links across the curriculum. The subject or content areas are cross-curricular, including proportion and ratio in mathematics, geography in the social studies, and environmental awareness in science. The multimedia courseware provides a situated learning environment where students work together as a group on the authentic task so that they can generate and solve a series of problems and sub-problems and relate the solutions to the complex problem. Through their learning process, students can explore the hyperlinked multimedia contents of the anchored program with embedded data. In designing and developing the user interface of the courseware, a special emphasis was placed on user-friendliness and efficiency. A simple, intuitive design with a text-based menu, rather than a complicated design, was preferred (e.g., Harper et al., 1993; Hedberg at al., 1994).

Research Design and Data Analysis

The study employed a randomized block factorial design. The between-subjects factors included Cognitive Style, Task Type, and Group Composition. The within-subjects factor included achievement scores of understanding of problems, accuracy of problem solving, and reasoning and organization of problem solving. The analysis of covariance (ANCOVA) was performed to determine the interaction effects as well as the main effects of cognitive style, task type, and group composition on achievement in understanding of problems, accuracy of problem solving, and reasoning and organization of problem solving with students' pretest results serving as the covariate. The level of significance was set at .05 in this study.

Results and Discussion

The means and standard deviations for achievement in understanding of problems, accuracy of problem solving, and reasoning and organization of problem solving are presented in Table 1. The results of the analysis of covariance for achievement by cognitive style, task type, and group composition are shown in Table 2.

Understanding of Problems. Significant main effects were found for cognitive style, $F (1, 59) = 4.306$, $p < .05$, for task type, $F (1, 59) = 6.189$, $p < .05$, and for group composition, $F (1, 59) = 5.328$, $p < .05$. Significant interaction effects were also found for cognitive style and group composition, $F (1, 59) = 4.078$, $p < .05$. These results indicate that students working on the analogy problem-solving task scored higher than did those working on the original problem-solving task and that cognitive style of the student and group composition exerted differential effects on achievement in understanding of problems, as shown in Tables 1 and 2. Field independent and dependent students tended to achieve differentially across the groups of different composition on the posttest of understanding of problems. The students in heterogeneous groups scored higher than did those in homogeneous groups. This pattern is more noticeable among field-independent students than field-dependent students. The mean score of the field-independent students in heterogeneous groups was the highest (4.28); the mean score of the field-dependent students in homogeneous groups was the lowest (2.38).

Accuracy of Problem Solving. There were significant main effects for cognitive style, $F (1, 59) = 6.012$, $p < .05$, and for task type, $F (1, 59) = 7.303$, $p < .05$, and significant interaction effects for cognitive style and task type, $F (1, 59) = 2.655$, $p < .05$. Yet, main effects for group composition were not statistically significant, as seen in Table 2. These results indicate that the achievement of field-independent and field-dependent students was dependent on the type of problem-solving task on which they were working within a group. Field dependent students with analogy task tended to score higher on the accuracy posttest than those with original task (3.85, 2.94, respectively). For field independent students, however, this pattern did not emerge: There were only slight differences between students working on analogy task and those working on original task (4.31, 4.29, respectively).

Reasoning and Organization of Problem Solving. As the results in Table 2 show, no statistically significant effects were found for cognitive style, task type or group composition, or for the interaction among cognitive style, task type and group composition. The results indicate that the differences between the posttest means were not statistically significant, probably due to the relatively large standard deviations, as shown in Table 1. For reasoning and organization of problem solving, the achievement scores of field-independent and field-dependent students were not significantly different from each other, regardless of the type of task and the composition of the group.

This study examined the effects of cognitive style of the student, the type of task, and group composition on achievement in understanding, accuracy, reasoning and organization of problem solving in anchored instruction with multimedia courseware in a situated learning environment. As pointed out earlier, this study appears to be one the first studies that have focused on the factors affecting anchored instruction at the elementary school level in Korea. The findings of the present study corroborate and extend current knowledge of anchored instruction. The results of the analysis of covariance indicate that group composition as well as students' cognitive style and task type significantly exerted differential effects on the learning outcomes. In general, both field-independent and field-dependent students in heterogeneous groups showed higher achievement than did those in homogeneous groups. With regard to the type of task, students working on analogy tasks tended to understand the problems better and to be more accurate in problem solving than did those working on original tasks. The results show that the effects of cognitive style of students were dependent on the composition of the group and the type of problem-solving task. Thus, the results of the present study allow for a closer examination of the relationship of students' individual and group characteristics in the problem solving process in a situated learning environment, and corroborate and lend further support to the previous studies on anchored instruction (e.g., Bransford et al., 1994; Chinien & Boutin, 1992; Chou & Lin, 1997; Crews et al., 1997; Leader & Klein, 1994; Lin & Davidson, 1994; Liu & Reed, 1994; Mevarech et al., 1991; Ruokamo, 2001; Shih, 1997; Small & Grabowski 1992; Summerville, 1998; Williams et al., 2001).

While important and interesting findings have been revealed, the study needs to be replicated. In addition, there are several suggestions for future research. First, the subjects of the study were relatively homogeneous in terms of the socioeconomic background. The analysis of data from a nationwide probability sample across various student populations might yield more generalizable results. Second, the problem-solving tasks that students were working on in small groups included original and analogy tasks. Future research employing other types of problem-solving tasks may be worth further investigation.

Table1. Means and standard deviations of the achievement scores

		Understanding	Accuracy	Reasoning and Organization
Cognitive Style				
Field Independence	M	3.53	4.30	2.65
	SD	1.45	0.83	1.80
Field Dependence	M	2.60	3.40	1.76
	SD	1.57	1.30	1.65
Task Type				
Original Task	M	2.37	3.24	1.74
	SD	1.79	1.57	1.77
Analogy Task	M	3.30	4.01	2.26
	SD	1.27	0.76	1.68
Group Composition				
Heterogeneous	M	3.25	3.77	2.33
	SD	1.37	1.24	1.49
Homogeneous	M	2.54	3.57	1.75
	SD	1.70	1.27	1.90

Table 2. ANCOVA results for problem solving by cognitive style, task type, and group composition

Source of Variation	Sum of Squares	DF	Mean Squares	*F*	*P*
Understanding					
Cognitive Style (A)	9.385	1	9.385	4.306	.042
Task Type (B)	14.137	1	14.137	6.189	.016
Group Composition (C)	11.614	1	11.614	5.328	.025
A x B	1.815	1	1.815	.833	.365
A x C	4.529	1	4.529	4.078	.049
B x C	.327	1	.327	.150	.700
A x B x C	1.263	1	1.263	.579	.450
Residual	128.595	59	2.180		
Accuracy					
Cognitive Style (A)	8.357	1	8.357	6.012	.017
Task Type (B)	10.152	1	10.152	7.303	.009
Group Composition (C)	.733	1	.733	.053	.819
A x B	3.691	1	3.691	2.655	.049
A x C	.874	1	.874	.063	.803
B x C	.781	1	.781	.056	.813
A x B x C	.115	1	.115	.579	.775
Residual	82.014	59	1.390		
Reasoning and Organization					
Cognitive Style (A)	9.997	1	9.997	3.361	.072
Task Type (B)	2.057	1	2.057	.698	.407
Group Composition (C)	9.516	1	9.516	3.228	.077
A x B	.256	1	.256	.087	.769
A x C	5.506	1	5.506	1.868	.177
B x C	.284	1	.284	.096	.757
A x B x C	1.413	1	1.413	.479	.491
Residual	173.896	59	2.947		

References

Bransford, J. D., Goldman, S., Hickey, D., Lin, X., Petrosino, A., Secules, T., & Sherwood, R. (1994). *Problem-based macrocontexts in science instruction: Theoretical basis, design issues, and the development of applications.* Paper presented at the annual meeting of the American Educational Research Association.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning, *Educational Researcher, 18(1)*, 32-41.

Chinien, C. A. & Boutin, F. (1992) Cognitive style FD/FI as learner selection criterion in formative evaluation: A qualitative analysis. *Performance Improvement Quarterly, 5(2)*, 24-33.

Chou, C. & Lin, H. (1997). *Navigation maps in a computer-networked hypertext learning system*. Paper presented at the National Convention of the Association for Educational Communications and Technology.

CTGV (1991). Technology and the design of generative learning environment. *Educational Technology, 31(5)*, 31-40.

CTGV (1992). The Jasper series as an example of anchored instruction: Theory, program description, and assessment data. *Educational Psychologist, 27*, 291-315.

CTGV (1993a). The Jasper series: Theoretical foundations and data on problem solving and transfer. In Penner, L. A., Batsche, G. M., Knoff, H. M., & Nelson, D. L. (Eds.). *The challenge in mathematics and science education: Psychology's response*. Washington, DC: APA.

CTGV (1993b). Toward integrated curricula: Possibilities from anchored instruction. In M. Rabinowitz (Ed.). *Applied cognition: Developing instruction and assessing competence* (pp.33-55). Hillsdale, NJ: LEA.

CTGV (1997). *The Jasper projec*. Mahwah, NJ: Lawrence Erlbaum Associates.

Crews, T., Biswas, G., Goldman, S., & Bransford, J. (1997). Anchored interactive learning environments. *International Journal of AI in Education, 8*. 46-52.

Harper, B. M., Hedberg, J. G., Brown, C., & Corderoy, R. (1993). Information landscapes, user interface and simulation: Improving learning outcomes. In C. Tat-seng, & T. L. Kuni (Eds.), *Multimedia modelling* (pp. 99-109). Singapore: World Scientific Publishing House.

Hedberg, J. G., Harper, B. M., Brown, C., & Corderoy, R. (1994). Exploring user interfaces to improve learner outcomes. In K. Beatie, C. McNaught, & S. Wills (Eds.), *Interactive multimedia in university education: Designing for change in teaching and learning* (pp. 15-29). Amsterdam, North Holland: Elsevier.

Hmelo, C. E., Williams, S. M., Vye, N. J., Goldman, S. R., Bransford, J. D., & Cognition and Technology Group at Vanderbilt (1993). *A longitudinal study of the effects of anchored instruction on mathematical problem solving transfer*. Paper presented at the annual meeting of the American Educational Research Association.

Kang, M. & Kim, M. (1999). *Information society and education*. Open Education Publishing.

Leader, L. F. & Klein, J. D. (1994). *The effects of search tool and cognitive style on performance in hypermedia database searches*. Paper presented at AECT.

Lee, M. & Hwang, S. (2001*). The development and effectiveness of an anchored multimedia program*. Paper presented at the seminar of Elementary Education Research.

Lin, C. H. & Davidson, G. (1994). *Effects of linking structure and cognitive style on students' performance and attitude in a computer-based hypertext environment*. Paper presented at AECT.

Liu, M. & Reed, W. M. (1994). *The relationship between the learning strategies and learning styles in a hypermedia environment*. Paper presented at AECT.

Mevarech, Z. R., Silber, O., & Fine, D. (1991). Learning with computers in small groups: Cognitive and affective outcomes. *Journal of Educational Computing Research*, 7(2), 233-243.

McLellan, H. (1996). *Situated learning perspectives*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Reigeluth, C. M. (1999). *Instructional-design theories and models. Volume II*. Mahwah, NJ LEA.

Ruokamo, H. (2001). *The solver learning environment and anchored instruction on mathematical word problem-solving*. Paper presented at Ed-Media.

Serafino, K. C. (1999). *Prior knowledge and anchored instruction on students' complex mathematical problem solving and transfer*. Unpublished doctoral dissertation, Fordham University

Shih, Y. (1997). *Effects of knowledge abstraction with Anchored Instruction on learning transfer*. Paper presented at the National Convention of the Association for Educational Communications and Technology.

Small, R. V. & Grabowski, B. L. (1992). An exploratory study of information-seeking behaviors and learning with hypermedia information systems. *Journal of Educational Multimedia and Hypermedia, 1(4)*, 445-464.

Summerville, J. B. (1998). *The role of awareness of cognitive style in hypermedia*. Paper presented at the National Convention of the Association for Educational Communications and Technology, St. Louis, MO.

Williams, D., Min, L., & Benton, D. (2001). *Analysis of navigation in a problem-based learning environment*. Paper presented at the World Conference on Educational Multimedia, Hypermedia, & Telecommunications.

Young, M. F. (1993). Instructional design for situated learning. *Educational Technology Research and Development, 41(1)*, 43-58.

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Investigating User Requirements: Design of Computer-based Anatomy Learning Modules for Multiple User Groups

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Abstract: User data and contextual information about anatomy education was employed to guide efficient and effective design of learning applications. The research focused on designing educational software to provide students and teachers different anatomy learning modules corresponding to key topics for coursework and professional training. The data collection emphasized user perspective, experience, and demands in anatomy learning. Collective data were sorted and analyzed using multidimensional scaling and cluster analysis. The learning modules' design encompasses both unified core-components required by all users and specific features demanded by some subgroups. This study begins to fill an important void by describing how user requirements were systematically collected and analyzed and then transformed into guidelines informing the iterative design of multiple learning modules. A powerful instrument to design and polish the content and user interface is demonstrated in this study.

Introduction

A key objective of the Visible Human Project at the University of Michigan is to facilitate the use of medical images from the Visible Human (VH) Dataset in anatomy learning. It is our observation that anatomy teaching differs from one group to another in heath sciences due to their unique requirements in the class and professional goals in the field. We are interested in how appropriate and useful content can be provided in the specific context where anatomy is learned. The intent is to use user data of contextual information about anatomy education to improve iterative design (Boyle, 1997), and thus create a learning environment that is efficient and effective.

However, no efficient methods of transforming user requirements to concrete designs have been suggested in previous research. Hence, this study attempts to begin to fill an important void by describing how user requirements, associated with users' learning experiences, were systematically collected and analyzed and then transformed into guidelines informing the iterative design.

Methods

One or multiple focus group (Morgan, 1997) sessions were conducted with each group of target users: students and faculty in professional schools of nursing, medicine, dentistry, kinesiology and surgery. All eleven researchers then met as a group to share and discuss information gathered in the different focus group sessions. One team member created a matrix for pooling user requirements from all focus groups. After each researcher rated the matrix independently, a summary containing the mean rating from all evaluators for each cell was generated. Examination of these rating data using cluster analysis and multidimensional scaling (MDS) (SYSTAT, 1989) was performed to find target groups who received similar scores in all requirements. Two kinds of hierarchical algorithms, the Complete Linkage and Ward's Method, were used to compare the similarity of all requirements across different users and further group comparable requirements into clusters.

Results

The results from the MDS show that different user groups are distributed into the four quadrants based on their requirements. We observed that users who share similar experience and training objectives in their health care education became a natural group. The two optimized dimensions were interpreted by comparing the attributes of the groups on the opposite ends along each dimension. Thus, the vertical dimension was conceptualized as anatomical scope or breadth of focus; the horizontal dimension was interpreted as level of professional development, novice versus expert (right versus left). These results indicate at least four clusters of users that the design should accommodate.

Results from the hierarchical algorithm show clusters of similar requirements. Each cluster of requirements was composed of numerous related functions and features that should be integrated simultaneously into the learning environment. To make the results in the summary matrix more informative to the interface design, clusters were categorized by level of demand and correlated with characteristics of the users who requested them.

Conclusions

In interpreting the requirement clusters and user clusters resulted from the analysis, we suggested at least two sets of functions and features should be used in the anatomical learning modules. One set of core components used as the base design and framework would be common across groups. Their content was identified in the focus groups as important requirements for learning anatomy by faculty and students across the different disciplines. The second set of functions and features would not be universal across all groups but would fulfill the needs of self-selected users groups that parallel their specialties. To design learning modules with both unified core components and user-specific applications, the program should be flexible, allowing for dynamic insertion of different learning tools for different users. One possible way to achieve this goal is to provide an interface that users can employ to select and enable suitable learning materials.

Interpretations of ideas and feedback from users are powerful in designing and polishing the VH user interface system. In this study, the research design combines both quantitative and qualitative research methods and does not rely solely on one or the other. Through these methods, we were able to (1) identify the group of users who share similar content, (2) suggest the general design framework and special components suitable for specific users, and (3) discern the priority of implementing each requirement. The design described in this paper will continue to evolve throughout the software development process, enabling the research team to link users' needs with the ability to construct an appropriate and customized instructional design.

References

Boyle, T. (1997). Project development, evaluation and delivery, Design for Multimedia Learning: Prentice Hall Europe.

SYSTAT MDS. (1989). The System for Statistics: SYSTAT, Inc.

Morgan, D. L. (1997). Focus groups as qualitative research.: SAGE publications Inc.

The Online Interactive Curriculum Portal as One Key to the Well-Structured Learning Activity of Students

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Abstract: In contrast to traditional types of learning and teaching processes and learning medias, such as printed material for Web and hypermedia learning resources, Web resources and Web-based activities are quite often unfortunately more or less separate parts of the planning process and curriculum documentation in an organization's traditional organizational level of educational. This paper introduces a portal system based on curriculum content. An attempt is made to solve the problem of integrating the access and use of learning through both traditional and modern post-modern types of resources into an online interactive coherent system of curriculum documentation at the organizational-level. At our university, we have developed an Online Curriculum -based Internet Web portal as a pilot for one course in order to integrate all learning resources through Online Curriculum / Online Syllabus, "*eCurriculum / eSyllabus*", content into one location. The heart of the system is located on the public Internet and the recent beta testing system is currently based on the HTML standard, thus avoiding the commitment of the organization to a single platform for learning resources.

Introduction

Recently, there has been a rapid increase in the use and the will to use and develop different learning types, learning resources, and course contents and even entire course modules that are partly or wholly based on the pedagogical use of computers and computer networks. A very important question to ask is how our curricula and the formats for curriculum representation should be developed in order to support possible new post-modern types of learning and provide easy access for the use of new types of learning resources.

In general, the pedagogical planning process is said to be a process that generates a more or less coherent structural model of resources, systems, and activities for learning and education and the use of different systematic tools in order to achieve the goal.

That the concept of a curriculum and its importance are undoubtedly a central key element in the traditional educational process is quite clear. It can be said that the entire activity of learning is constructed around a curriculum, and the curriculum is the integrating element for the entire educational module or its part - a course or the whole programme. The goals of a curriculum also form the basis for the evaluation and assessment of the outcome of learning. In general, a curriculum can be viewed at the least as the vision of the goals and similarly as the systematic representation of the tools (both mental and material) needed in order to achieve that vision.

The Traditional Ways of Representing Curricula

Often, a curriculum and its different representative formats are also used as the requirements for a course. It may be published in several printed and electronic formats as a book or as an Internet page and given to students or to school or university officials and teachers as a means for the general understanding of the course, its goals, contents, and requirements. It specifies the tasks or achievements during a course, the literature to read in order to pass the course, plus the methods of assessment. The traditional ways of generating and representing curricula, despite the publication platform such as the Internet, can be said to have typically been static. The metaphor has been to *publish* and not to generate an interactive integrated system of tasks and resources for learning by collecting them all into one location as a tool for easy access through a single resource. In this new situation, rather than that of a static presentation of content, the metaphor for a curriculum could perhaps be more as an interactive, integrative, iteratively developed living tool that is applied in order to achieve certain goals (See e.g., Poldolskij 1997.)

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Without a more specific analysis of the ideologies enshrined within a curriculum (*such as e.g., PBL*) and the different view of education they impose, as well as the need for representative formats of a curriculum, it can be argued: In many cases, the present ways of producing a curriculum, curriculum epresentations, and the implications of Instructional Design based upon it, are quite well suited to traditional, rather static institutionalised and non-virtual types of learning, such as those forms of learning and teaching traditionally organized in schools and universities.

We have quite good tools, both mental (*e.g., well-defined and widely used concepts*) and many material tools, for the traditional type of educational activity. We have, for example, rather satisfying ways finding, distributing, storing, using, and representing traditional written material as books or handouts or other types of traditional media. We have generated systems such as libraries and library databases, publication data systems, or ISBN/ISSN numbering systems to easily handle such data; there are such things as traditional course readers, and ways estimating its reliability and value. (Cp. e.g. Velman 1997.)

The New Role of a Curriculum as an Interactive Online Element to Integrate all Resources

But the challenge is to produce curricula, curriculum representations, and Instructional Design for the modern situation in which an increasing amount of party or wholly location-free teaching and learning activity is present and in which the learning resource types that are used and the structure of learning activity (*the ways in which learning is organized*) are in many ways very different from the traditional format.

It can be said that in the present situation, where there are many new types of learning processes and resources behind all processes, the role and essence of a curriculum as an integrating and clarifying key element in the planning and realization of education is more important than ever before. However, how and by using which kind of tools could this be achieved? Based on that question we started a pilot research project at our university.

How and in which ways should an online tool metaphor curriculum to be generated and represented?

At our university, the University of Lapland, the curriculum for Technology Education for the years 2001 – 2003 has been developed as a pilot project for a new, primarily online curriculum / syllabus, electronic "*eCurriculum / eSyllabus*", that is located behind a Web (*World-Wide Web*) portal in order to integrate different post-modern computerized and networked means and resources together with the more traditional resources for learning into a coherent learning structure <URL:http://www.urova.fi/home/ktk/opettajankoulutus/tekninen_tyo/>. The ultimate aim is to develop an organizational-level application, a hierarchical tree of Web portals through which different courses can take advantage of the generated model.
The portal is primarily used in research projects related to use of different electronic resources and mental tools such as simulations within context of Technology Education (see e.g., Lehtonen 2001), thus providing the integration of those resources and virtual learning activities into a coherent part of student's daily learning activity.
At the beginning, the main question of the process was: What kind of curriculum and its representation would be needed in present post-modern age to integrate different parts of both the traditional and more modern electronic and computerized learning ways, resources, and materials into a meaningful integrative systemic tool for our students? The other main question was how we could integrate as well as possible the traditional ways of curriculum representation with the new ones in order to create as coherent a system as possible for the use for our students. A special interest was also the possibility to link easily the becoming Finnish Virtual University courses <http://www.virtuaaliyliopisto.fi/> as easily as possible to part of our programmes and possibility to offer parts of our programmes through Finnish Virtual University.

The realization of the process involved many phases and was mainly based on Cultural Historical Activity Theory ("CHAT") (e.g., Poldolskij 1998; Kapetelinin & Nardi 1997; Vygottsky 1978). The main questions were to plan and understand the structure of learning activity well enough in order to be able to create the necessary support tools.
The questions were divided into three main areas:

1. The users of the tool: Who is or who are the users?
2. The situation and goals the tool is used: For what purpose does the user use the tool and in which kind of situation?
3. The activity for which the tool is used and the logical structure of the tool: In which kind of (psycho)logical (activity) structure is the use is based on?

Definition of Tool Using Roles

The first task was to define for whom the tools, the tools area, and the portal was created. Through this analysis, we were able to define the student roles for the targeted users of the tool.
The main user roles were found to be:

- the basic course student,
- the optional courses student,
- the specializing course student,
- the student entering training,
- the continuing education student (*assumed to be mainly based on virtual learning activity*).

According to the analysis, these were the most important user roles of system (*the additional roles considered were, for example, resources for field teacher searches s, the person seeking a specialist, etc.*). Through this analysis, the tools and contents were generated to became as targeted as possible in order to fit suitably into the activity structures used by the learner during a specific part of a course. (See Fig. 1 and 2.)

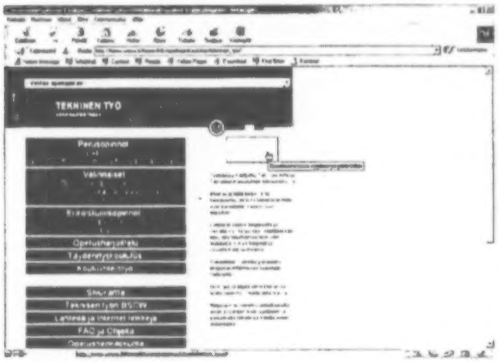

Figure 1 Main page of the beta testing portal, students roles and shortcuts to commonly used resources

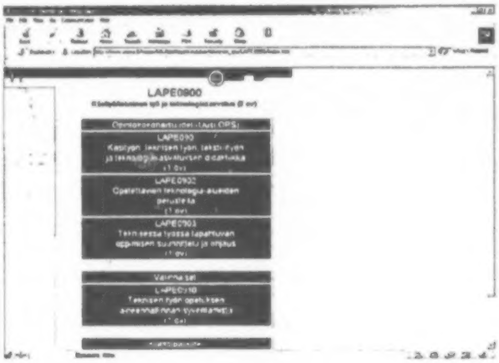
LAPE0800
LAPE0902
Opetettavien teknologia-alueiden perusteita
LAPE0903
Teknisessä työssä tapahtuvan oppimisen suunnittelu ja ohjaus
Valinnaiset

Figure 2 Second level, the course modules and navigation bar

Definition of the Situations and Goals in Which the Tool Is Used

The second question was in which situations students need the portal and the kinds of activities students performed with the tools.
The activity structure of the student analysed was simplified, in that the student wants to get all the necessary resources in order to study a certain course as easily as possible. What does he or she want to find, what does he or she want to do, and how does he or she want to do it?

We can emphasize that obtaining an overall representation for the general plan of achievement and gaining an overall view of what to do, plus obtaining easy access to the tools for the activity, is at least partly formed in the first critical step in a well defined pedagogical process (cp. E.g. Poldolskij 1997). In other words, to be able to say it should be easy to find what to do and where to easily find the needed resources in order to concentrate one's activity as much as possible on the core of the activity itself instead of on some other activity.

The primary answer to this question was that the course portal should be *integrative*. Integrate all the modern electronic and online resources as well as traditionally used resources in order to become as easily accessible as possible. Secondly, the portal should be *iterative*. Include primarily all such data that will be updated during the curriculum and which cannot or is not sensible to represent in printed format in a course catalogue. Such objects would obviously be online linked resources, computer programs, literature, and the more specific course contents that are updated regularly. Thirdly, the portal should be *interactive*. To offer as much as possible sensible interactive solutions to support learners learning activity.

The Logical Structure of the Portal

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The third question was upon which kinds of (psycho)logical structure use could be based? The answer was sought by analysing the present activity of students when they sought for similar data and resources from the more traditional representation of the curriculum and syllabuses. Because our students use a printed course reader, the logical structure of the portal was based as much as possible on the structure of the course reader and the terms and course codes found there. The navigation model is based on the following steps: the student role (*e.g. basic studies*) – a list of basic studies modules – and finally an interactive representation of the curriculum where all the needed resources are linked to the required places.

In addition, an attempt was made to achieve visual similarities between the course reader and the Web portal (see Fig. 3 and 4). The idea was that when one has once learned to use one type of representation or media, one could use that same psychological model in another media format. Because the use of www-material is more based on scanning than continuous reading the text structure contains e.g. clear titles and other helping elements (e.g. Nielsen 2001). Because according the observations the students do print the pages quite often, the format is also optimized for that. E.g. some the link resources contain also the URL section in printable format.

Figure 3 The visual outlook of the portal page

Figure 4 The visual outlook of the course reader

What has been retained as a key point is the attempt to provide a navigation model in which all unnecessary items are done away with in order to reduce the cognitive load of the student as much as possible (e.g. Nielsen 1999; Nielsen 2000a,b; Chandler & Sweller 1991; Sweller & Chandler 1994; Wilson & Cole 1996). However, this is done so that if the student is willing to go directly to a certain offered resources, the aim is to provide as much as possible support for that also by linking some of the most used tools and resources directly from the main portal page and in some cases from a side navigation bars etc.

Online Material Interaction with Traditional Resources

Because of the wide use of more traditional resources of curriculum representation, as course readers or other printed material, the attempt was made to keep the interaction between printed and electronic media as easy as possible. A course reader or any shared paper document (*or e.g. email messages to students*) contains only one link to a course portal page.

The course reader only contains the most critical parts of courses and the more specified contents and linked resources can be found only in the online version. The organization has made a commitment to store the main page address as long as the curriculum is valid. The most important part of the system is the idea of generating the curriculum and its primary representation into an online format and organizing all the resources and materials through the curriculum representation

Why HTML Content on the Internet Instead of a Special "Virtual Learning Tool"?

Why did we choose to put the portal onto the public Internet instead of using a special "*Virtual Learning Tool*"?
The reason for using the public Internet instead of an application was that it provides the possibility to avoid commitment to a single program or environment. It also provides the possibility of generating a one-address portal system through which all resources can be accessed easily and being on the public Internet, there is no need to log in. It has the benefit of integrating very different resources into an easy accessible part of a course. It holds one permanent

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URL address on the organization's server, thus providing easy access from any other organization without the fear changed or moved links, etc. Another benefit is that students only need to know one location in order to access all necessary resources. However, a portal is only a portal. It is only the general structure for integrating elements and tools. If a course needs a Web-authoring tool or a "*Virtual Learning Environment*", they are linked from the outside. The aim is to keep the portal as small as possible. The portal function is the skeleton for the overall structure of studies; the interactive curriculum representation serves the integration of all resources.
All the pages on the portal are linked from faculty's main page under "Course portal pages" and the structure of the portals (*and sub portals*) is the same as in overall structure of the courses in the course reader.

The Present Situation in the Integration of Resources Throughout the Portal

Currently, the portal serves as an integrating element for quite different resources. Dependent of the course module, the portal integrates most of the items listed in the course content:

- More specified course objectives and contents,
- Changes to course literature or articles (e.g. new book or article / required pages of a book or a journal),
- Links to required electronic resources for the course (e.g. Internet links or a link to "*Web collaboration spaces*" such as BSCW® or "*Web learning environment*"; many different alternatives are currently in use at our faculty) etc.,
- Registration form for Web learning resources (www-form),
- Readable / printable / downloadable material for the course (includes also e.g. steaming media),
- Links to a additional references for course content (such as external links, virtual galleries, or references),
- Course page feedback form (a html text entry box at the bottom of each page)
- Course feedback form button (standardized www-form in every module),
- Buttons to university library and city libraries,
- 'Search from library' buttons after each book to search and reserve each course book easily from the library (sends the book ISBN-number and starts the library information system opening it in a separate browser window)
- Link to course time tables etc.

The portal page contains also direct links for several most used resources; additional navigation elements e.g. site map and contact information and contact form for faculty personals, etc.

Conclusions

The Web portal based on curriculum representation has now been used for year as a pilot study. Despite its visual simplicity, according the beta tests and more precise usability testing, students have been quite satisfied with it
(e.g., see the beta version questionnaire
<http://www.urova. fi/home/ktk/opettajankoulutus/tekninen_tyo/koulutuspalaute/>)

The benefits of the system for our student were found to be:

- "*Everything can be found at one location*",
- "*Easy to find needed data up to date*"
- "*Links: E.g. especially library links!*"
- "*Easier to return essays and exams.*" (e.g. Linked BSCW® program) and
- "*The possibility to collaborate through Web tools*"

Some negative aspects of the system have been mentioned:

- "*Not enough computers on the campus, no networked computer at home*",
- "*The linked resources like BSCW are too difficult to use*" and
- "*More pictures*".

The possibility of updating iteratively course contents has also been a great advantage (which makes possible the iterative development of curriculum), otherwise it would have been very difficult to update the course contents or links to several Internet resources and to update or modify course literature easily. Probably the greatest benefit is that despite all modifications to program content, a place where the entire coherent content can be found still exists to students.

Research in the future shall be targeted at developing the students' tools and the overall function in order to support learning activity as much as possible. The plan for the future includes adding some new tools for students, such as search-functions (*requires also better content metadata format*, see e.g. Koper 2001), offering some contents also in mobile Internet (*like VML/XHTML*) format for mobile phones and PDA's and making it possible to use e.g. redundant mobile streaming audio format instead of text in some contents. No doubt, the future version will be generated using dynamic html with xml content base or a database rather than static html/JavaScript solution. What has been learned is the fact that online curriculum, "*eCurriculum*", and this kind of integrative tool have proven its essence from the pedagogical perspective. Future development will be carried out in order to develop and support students learning activity with as many easy accessible integrative, interactive and iteratively updated tools and resources as possible.

References

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, 8 (pp. 293-332).

Kapetelinin, V. & Nardi, B.A. (1997). [online] Activity Theory: Basic Concepts and Applications. *<URL:http://www.acm.org/sigchi/chi97/proceedings/tutorial/bn.htm>* [Searched 6.11.2000]

Koper, R. (2001). Modelling units of study from a pedagogical perspective. The pedagogical meta-model behind EML. *<URL: http://eml.ou.nl/introduction/articles.htm>* [Searched 20.8.2001]

Larson, K. & Czerwinski. (1998). [online] Web Page Design: Implications of Memory, Structure and Scent for Information Retrieval. Microsoft Research. Redmont. WA. *<URL: http://www.research.microsoft.com/users/marycz/chi981.htm>* [Searched 6.11.2000]

Lehtonen, M. (2001). Toward the Information Age Challenges in Technology Education. Modern learning methods & learning media supported and mediated learning processes as part of the new university technology education curriculum. Article. To be appear in: Congress publication of Jyväskylä International Technology Education Congress - Looking into Future. Jyväskylä. Finland. 28-30.9.2001. (Also available online: *<URL:http://www.urova.fi/home/hkunta/mlehton/Publications/HTML/Toward_the_Information_Age_Challenges.htm>*)

Nielsen, J. (1999). *Designing Web Usability. The Practice of Simplicity.* Indianapolis. New Riders.

Nielsen, J. (2000a). *WWW-suunnittelu.* [Designing web usability] Edita, IT Press.

Nielsen, J. (2000b). [online] Papers and Essays. *<www.useit.com>* [Searched 6.11.2000]

Poldolskij, A. (1997). Instructional Design for Schooling. Developmental Issues. In: S. Dijkstra et al. (eds.) *Instructional Design. International perspectives* Vol. 2. Lawrence Erlbaum. 1997.

Sweller, J., & Chandler, P. (1994). Why some material is difficult to learn. *Cognition and Instruction*, 12 (pp. 185-233).

Velman, K. (1997). Why Computers Are Transforming the Meaning of Education. Confrence paper. *Proceedings of ED-MEDIA 97 & ED-TELECOM 97.* World Conference on Educational Multimedia and Hypermedia & Educational Telecommunications. ED-media (1997). Calgary. Alberta. Canada. June 14-19. 1997.

Vygotsky, L-S. (1978). *Mind in Society.* Cambridge. Massachusetts. Harvard University Press.

Wilson, B. & Cole, P. (1996). [online] Improving Traditional Instruction. Cognitive Load Theory. *<URL:http://carbon.cudenver.edu/~bwilson/cog/sweller.html>* [Searched 12.12.2001]

Authentic Performance of Complex Problem-Solving Tasks with an EPSS

By Chet Leighton and Cynthia McCabe

Teaching People to Design

Just-In-Time Learning (ITEC 805) is a semester-long graduate course that teaches corporate trainers and instructional designers how to design performance improvement interventions. This course is part of a Master's program in Instructional Technology at San Francisco State University. The course has been offered three times and has been completed by a total of 38 people. Learners produce two major deliverables for this course-- a paper of about 20 pages describing a performance problem and the design of a system to address the problem, and a paper of about 5 pages explaining the design strategy.

Based on final grades for the course, participants in this class can be grouped into three broad categories. The A-level performers are 38% of the total students, B-level are 17%, and C-level are 45%. An Electronic Performance Support System (EPSS) was designed and implemented to help the B-level and C-level people improve their performance. (See Leighton, 1996 for a description of the EPSS model.) The JIT Learning EPSS was designed and developed by Infomark Software Corporation with CGM Communications and assistance from several graduate students in the SFSU ITEC Department in the first half of 2001.

The JIT Learning EPSS was implemented with 15 learners in Fall 2001. For this class the grade distribution was 53% in the A-level, 20% in the B-level, and 27% in the C-level. When compared with prior classes, all of the B-level performers improved to A-level and half of the C-level improved to B-level. A formative evaluation of the system was conducted in the winter of 2002. The results suggest that the remaining C-level performers do not have a sufficient mental model of the design task. The next version of the software will focus on helping users develop and assess their mental models before they begin the design task.

Performance Support Systems for Complex Problem-Solving

Designing a performance improvement intervention is a moderately-structured complex problem-solving task (Foshay, 1997; Jonassen, 1997). Typically, a performance problem can be defined clearly, it is clear when the performance problem is solved, and there are multiple ways to design a correct solution.

There are numerous examples of performance support systems used to teach complex problem-solving tasks. There is a subset of cases where the user performs a task primarily involving design, analysis, and/or planning and the output of the task is to produce a deliverable document.

- Broadcast News allows high school students to write news story on real current events (Schank & Kass, 1996). The system includes a tool for writing stories, background information on a story, and a library of information resources. Video advising is provided based on the concept of goal-based scenarios.

- Project-Based Learning Support System (PBLSS) allows high school students to plan and conduct a math or scientific inquiry project (Laffey, Musser, and Tupper, 1998). The system includes guidelines for organizing a project, a tool for writing a project plan, and the ability to publish a project plan as an HTML document. PBLSS is designed to support project-based learning, where students work in groups to define and investigate their own project ideas.

- Air Campaign Planning Advisor (ACPA) allows U.S. Air Force officers to author air campaign plans to attack military targets (Johnson, Birnbaum, Bareiss, and Hinrichs, 2000). A seven-step model is used to structure the process. Information resources, including video-based advising, are organized around questions to address in producing an air campaign plan.

- Tactical Readiness Instruction, Authoring, and Delivery (TRIAD) allows U.S. Navy officers to create tactical documents that are used to share information on tactical problems and solutions (Hannafin, Hill, and McCarthy, 2001). TRIAD includes an authoring tool for producing multimedia documents. An interview process is used to lead the user through writing the various sections of a document.

A common theme among these systems is support for two major activities. First, users must perform the complex problem-solving task that involves design, analysis, and/or planning. Second, users must perform the task of producing a deliverable document that contains the "output" of the problem-solving task.

Underlying the design of these systems is the concept of situated cognition and the Cognitive Apprenticeship framework (Brown, Collins, and Duguid, 1989; Collins, Brown, and Holum, 1991). The EPSS contains a tool for producing the deliverable and uses a series of guidelines and questions to scaffold task performance. Information resources are organized around sub-tasks in order to model performance. Coaching is implemented in several ways: the process is structured through an explicit task model, the guidelines and questions provide implicit structuring as performance occurs, and video-based advising appears in the context of authentic task performance.

The Just-In-Time Learning EPSS

The Just-In-Time Learning EPSS uses a six-step process to design a performance improvement intervention. The first five steps lead the learner through describing the problem situation and explaining the design of the proposed intervention. The last step reviews the design strategy of the intervention. This last step is used to support articulation and reflection on the current design effort, and to explore new design ideas for future efforts.

The format of a typical deliverable produced by the EPSS is like the format of this article. A paper is generated as a series of paragraphs with appropriate subheadings in HTML. The formatting of the document is simple, as the emphasis is on the content not on presentation. Of course, a user can import the HTML into a word processing program to improve the formatting.

Structuring the Performance and Learning Process

The opening web page for the EPSS shows the status of work on each step, or deliverable document. The web page for one of the deliverables is shown in Figure 1. The header across the top of the page reiterates all the steps in the process. Access to performance and learning resources are organized around producing the deliverable.

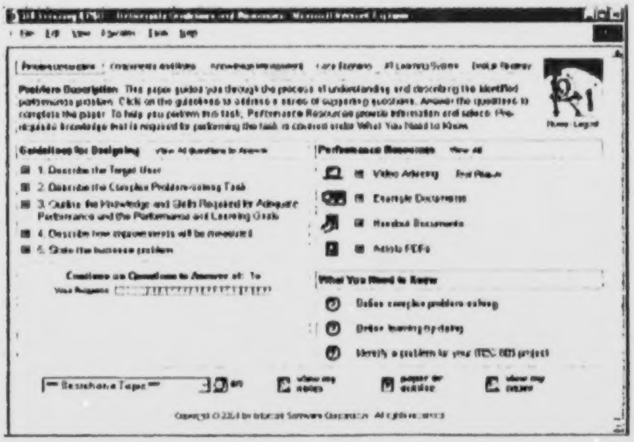

Figure 1 – Guidelines and Resources for Producing a Deliverable Document

Resources for a deliverable are organized into three categories, as noted below. The user clicks a ⊞ symbol to see the questions under a guideline or the documents for a type of resource.

- Guidelines and specific questions to answer in producing the deliverable document

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- Performance Resources– Advice on key design decisions, example documents, and information resources in the form of handout documents and articles to read
- What You Need to Know– These learning topics represent pre-requisite knowledge required in order to understand how to use the resources and produce the deliverable.

The items under "What You Need to Know" correspond to the learning objectives of the JIT Learning course. A learning topic has information resources like article readings, text discussions, and handout documents. It also includes exercises (self-graded) and assignments (graded by the instructor) for practice. These learning topics allow learners to review the information provided in class.

Scaffolding Task Performance

The combination of guidelines and questions structure the task of writing each deliverable document. By clicking on any question (or the question number following "Continue on Questions to Answer at:") the user can enter an answer for a question as shown in Figure 2.

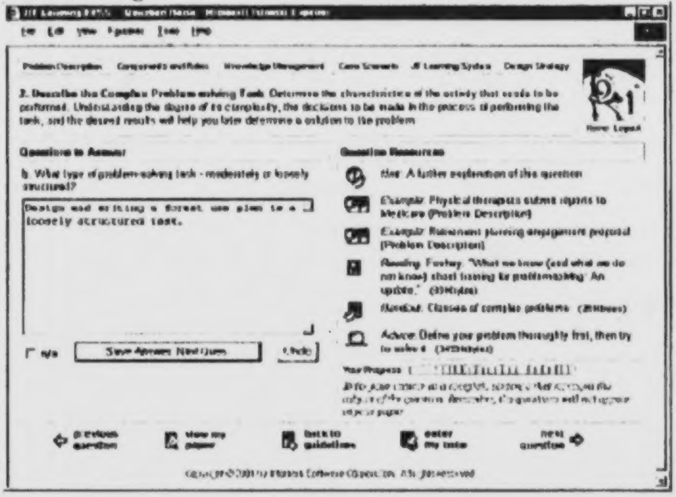

Figure 2 – Entering the Answer for a Question

The software simplifies the task of writing a document by prompting a user to answer a series of questions. When the user clicks "Save" an answer is saved in a relational database. Then the user is prompted to answer the next question. A progress meter showing how many questions have been answered for the deliverable appears on both the Deliverable and Question pages.

At any time the user may click "View My Paper" to produce the output document. All o f the individual answers are compiled into a series of paragraphs. Users can save documents in HTML format and import them into a word processing program for additional formatting or revision.

Another scaffold in the system concerns the ability to prepare an outline before writing a paper (via the "Paper or Outline" button in Figure 1). In outline mode, the user's answers are shown side-by-side in a two-column table with the questions. The learner can submit an outline version, get feedback from the instructor, and then revise the outline into a narrative paper.

There are multiple levels to fading these scaffolds. The learner can skip producing an outline and move directly to writing a paper. The learner does not have to use the question and answer page as the writing tool. The Deliverables page could serve as an external support facility and the user could work entirely in a word processing program. By design, the fading of the scaffolds is controlled by the user.

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Coaching and Advising

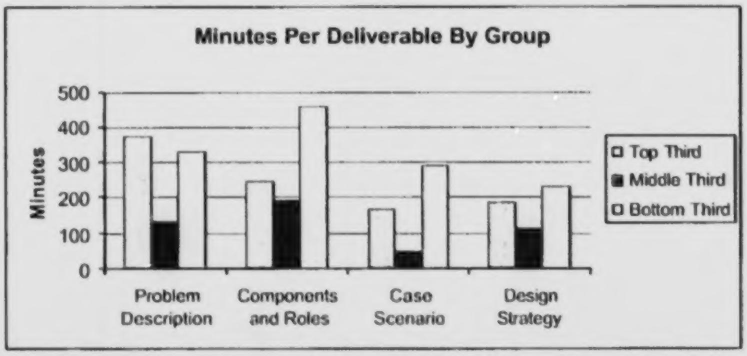
Video-based advising takes the form of 45 to 90 second video clips with advice on the most frequently encountered design problems for a deliverable. This advising is in the form of a story about a design problem. Most of the videos feature learners who have completed the course telling their own painful stories. They describe a problem situation and then discuss their solution. There are also clips featuring the advice of the instructor. The instructor describes a symptom, the underlying problem, and advice on how to solve that problem. For example, one video clip explains the trap of starting to design the solution before the problem is fully defined.

Formative Evaluation Results

A formative evaluation of the EPSS was conducted in the winter of 2002. Data was collected from twelve participants with a 70-point questionnaire, from database log files with details on how the software was used, and with follow-up interviews.

The average amount of time spent writing papers with the system was 927 minutes, or about 15½ hours. When the participants are ranked by final grade, the top third spent an average of 975 minutes, the middle third spent 494 minutes, and the bottom third spent 1,313 minutes. The following chart shows the average amount of time spent on each of the four major papers (Deliverables) by group. The differences are quite obvious between the three groups. The top group put most of their effort into the problem description, while the bottom group spent most of their time on describing the solution (the Components and Roles and Case Scenario papers). The middle group appears to be quite efficient in using their time. In contrast, given the low quality of their design efforts, the bottom group spent a lot of unproductive time in devising a solution.

On the questionnaires, the bottom group scored themselves higher than the top group in using the feedback from the instructor to improve their project designs. However, their final grades were lower primarily because they did not correct the design flaws identified in feedback on their papers. The Case Scenario papers by the bottom group revealed a weak understanding of the task being performed by their target users. Surprisingly, the bottom group claimed to have more experience doing task analysis than the top group. Even though this topic is covered in a prerequisite course on the ISD model, the bottom group appears to have a weak understanding of task analysis. This limits their ability to effectively use the instructor's feedback in defining problems and designing solutions.



Implications and Future Work

The approach of using guidelines and questions to scaffold the task of writing complex papers was successful in helping improve the overall performance of a class. However, there is still a group at the bottom of the class that needs more help than the EPSS provided. They spend too little time in defining the problem situation and too much time in creating a solution. At the same time, they do not make effective use of the instructor's feedback in correcting design flaws.

This suggests that users who perform poorly have weak mental models of the design task. In the next version of the JIT Learning EPSS we will add functions to help users develop and assess their own mental models before they begin producing a deliverable paper. This will include more emphasis on using the analysis of a target user's task to better understand the problem domain. We will also add a feedback-and-response function so that users explicitly acknowledge the instructor's feedback and articulate how they will correct design flaws.

Bibliography

Brown, J. S., Collins, A., & Duguid, P. (1989). "Situated cognition and the culture of learning." Educational Researcher, 18(1), 32-42.

Collins, A., Brown, J. S., & Holum, A. (1991). "Cognitive apprenticeship: Making thinking visible." American Educator, 15(3), 6-15, 38-46.

Foshay, R. (1997). "What we know (and what we don't know) about training for problemsolving: an update." Performance & Instruction, 36(3), 40-45.

Hannafin, M. J., Hill, J. R., McCarthy, J. E. (2000). Designing resource-based learning and performance support systems. In D. A. Wiley (Ed.), The Instructional Use of Learning Objects. Bloomington, IN: Association for Educational Communication and Technologies.

Johnson, C., Birnbaum, L., Bareiss, R., & Hinrichs, T. (2000). "War stories: Harnessing organizational memories to support task performance." intelligence: New Visions of AI in Practice, 11(1), 16-31.

Jonassen, D. (1997). "Instructional design models for well-structured and ill-structured problem-solving learning outcomes." Educational Technology Research & Development, 45(1), 65-94.

Laffey, J., Tupper, T., Musser, D., & Wedman, J. (1998). "A computer-mediated support system for project-based learning." Educational Technology Research and Development, 46(1), 73-86.

Leighton, C. (1996). "What is an EPSS?" NCR Information Products Journal, 11(2), 7-9. Online Version Retrieved October 24, 2001 from the World Wide Web: http://www.itec.sfsu.edu/People/Faculty/cleighton/whatisepss.htm.

Schank, R. C., & Kass, A. (1996). "A goal-based scenario for high school students." Communications of the ACM, 39(4), 28-29.

Addressing Biodiversity Problems Using Web-Accessible Data: A K–12, Hands-On Exercise

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Introduction

The new paradigm in science education calls for learning in which 1) students perform real science as they construct meaning and acquire understanding; 2) students develop thinking processes and are encouraged to seek answers that enhance their knowledge and acquire an understanding of the physical universe in which they live; and 3) students are presented with problem-solving activities that incorporate authentic, real-life questions and generalization to broader ideas and applications (North Central Regional Educational Laboratory; www.ncrel.org/sdrs/areas/issues/content/cntareas/science/sc500.htm). Concurrently, the rapid development in technology compels us to include computerization in the classroom. Web-based learning can provide a solution that incorporates all of these objectives.

One of the more common areas for incorporating Web-based discovery in science education is investigating biodiversity, the study of life on Earth. This knowledge is critical to science and society for managing natural resources, sustaining human health, maintaining economic stability, and improving the quality of human life. And the urgency for this knowledge increases daily as the destruction of natural systems accelerates the decline of biological diversity.

Several Web-based projects are dedicated to biodiversity education at the K–12 level. In fact, most museums have attempted to develop some project designed to encourage K–12 biodiversity education, including developing "virtual" museum exhibits, interactive exercises, and "Ask a Scientist" programs. Unfortunately, despite the excellent education programs that museums have developed, they have not taken advantage of their biggest strength—the research data that they collect and curate. Data associated with specimens document the biotic, geological, oceanic, atmospheric, and geospatial information connected to the world's estimated 1.8 million species. These data should be at the core of any educational endeavor that includes K–12 science education. With the development of robust database management systems and fast and accurate Web accessibility, we now have the ability to make collections data available for public access. This allows us to develop educational exercises that can bring the museum, and the data collected in the fight to preserve biodiversity, directly into the classroom.

Herein we describe an educational exercise for K–12 grade students that uses museum collections data to examine biodiversity problems in the Amazon rain forest. The goals of this exercise are: 1) to make students aware of current biodiversity issues, 2) to educate them about research data housed in natural history museums, 3) to motivate student interest in science, 4) to increase student proficiency with computers, databases, and Web browsers, and 5) to serve as a prototype for developing other exercises that use Web-accessible data to address real problems.

Using *Specify* Collections Data to Examine Amazonian Biodiversity

In this exercise, students use a straightforward Web interface to access data collected by natural history museums and apply them to understanding conservation issues in the Amazon rain forest. Students are challenged with making decisions based on data they have collected, and are asked to re-evaluate and summarize decisions once additional data are added.

Background.—The Amazon jungle is the world's largest tropical rain forest, with 2.5 million square miles. Presently, there are at least 500 species of mammals, 475 reptile species, and at least a third of the world's birds. This area is vital to the economy of many countries in South America, which send much of the natural resources (e.g., timber, petroleum, and gold) to the United States. Unfortunately, the practice of harvesting natural resources has caused severe declines in biodiversity in the region. Because of its importance to so many economies, it is unlikely that industrial practices will change, and therefore, conservationists are trying to compromise with industrialists to preserve as much of the area's biodiversity as possible. One popular suggested compromise is to sacrifice portions of the Amazon (such as the eastern or western half) for logging and mining, and leave other areas untouched to maintain their pristine biodiversity. By using the information stored in museum collections, conservationists can make informed decisions about which areas are more prone to extinction or survival.

Traditionally, museum collections data have been difficult to access or laborious to examine. However, recent technological advancements have made Web-accessibility of museum collections data a reality. One such development is the collections management software tool, *Specify* (www.usobi.org/specify/). *Specify* is a robust database application that is specifically designed for the management of specimen information. This software provides a single user-interface to all kinds of collections data (e.g., plants, birds, bacteria, etc.) and a single URL for Web-accessibility. Therefore, users do not need to learn different interfaces to examine heterogeneous databases housed in different locations.

Objectives.—Students access museum collections data using the *Specify* Web-query interface, then use the data collected to generate maps and charts of the number and kinds of species (i.e., *species richness*) in various regions within the Amazon basin. Students apply the data they uncover to determine which areas in the Amazon are most critical to preserve.

Teaching Strategy.—The presentation begins with an introduction on the topic of biodiversity. Students should understand what extinction is and how it can be both a natural and man-made phenomenon, and what a scientific natural history museum is and what kinds of data museums collect to study biodiversity.

The Amazon rain forest is then discussed as an example of an area with high levels of biodiversity, but that is also in decline. This might include a short history of the continent and discussions of how the Amazon rain forest became so biologically rich. Students then use a search engine to find information on the Internet about the Amazon rain forest and the different kinds of animals and plants found in the area.

Once students are familiar with using the Internet to collect information, and are familiar with the Amazon rain forest, they then access natural history collections representing different taxonomic groups using *Specify*. Students are shown how to run queries of species by locality to determine *species richness* (number of species) and *endemism* (areas of high concentration). Students break into groups, with each group searching for different kinds of organisms. They are then given outline maps onto which each group plots the data they discover. Once all data are collected, students combine the data they find onto a single map that describes species distributions. Depending on the level of computer proficiency, students may also develop charts and graphs of the data using a spreadsheet application. Working together, students can evaluate the data they collected to determine which areas should be conserved, and which areas may be sacrificed. Criteria to choose could include number of species and presence of rare species.

Once students have determined which areas to preserve, the teacher may want to access global climate change databases (e.g., edcwww.cr.usgs.gov/) and generate climate models that can be used to predict how climate changes may affect the Amazon rain forest in the future. The students may then elect to re-evaluate their choices based on possible future climate changes. Students conclude the exercise by writing a description of their findings in a lab report, or summarizing their findings on a poster (for possible presentation in a science fair).

Extensions of the Project.—In the near future we intend to use this same exercise framework with another, more sophisticated, data access tool, *WebFormulate* (J. Leopold, M. Heimovics, and T. Palmer, "*WebFormulate*: A Web-Based Visual Continual Query System", [in press]. Proceedings of ACM 11th International WWW Conference). This software will not only allow the students to query natural history specimen collection databases, but will also allow them to specify how often the database should be queried and the conditions by which they want to be notified of the results (e.g., whenever a new species of frog is added to the database). In addition, any user-specified *WebFormulate* computations or visualizations based on those query results will automatically be updated every time the notification conditions are satisfied. Thus, the students can monitor their analyses on an hourly, daily, weekly, or monthly basis.

Summary

Herein we have briefly described an exercise that addresses our aforementioned educational goals at the K–12 level. We hope that this endeavor not only accomplishes these goals, but also helps to foster the next generation of biodiversity researchers and bioinformaticians.

Teaching with Technology through Collaborative Interdisciplinary Instruction

Mr. Philip Lewis, M.S. and Mr. John Hildreth, M.M.

OVERVIEW:
Incorporating technology into the classroom is paramount at Radford University. Both administrators and faculty have seen pronounced increased in effective teaching through the use of multimedia technology when presenting difficult material. However, not all faculty can be expected to learn complex applications in a timely fashion that would enable effective instruction to any students. Therefore, a unique form of support has developed through Radford University library's . In a number of situations and courses, technologists and faculty members are teaching 'high tech' classes side by side. Increasingly, this support is giving better opportunities for students to learn and faculty to become more familiar with the technologies that dominate nearly every field.

This paper presents the findings of a class that became a case study in interdisciplinary academics. The course incorporated traditional collegiate education themes with technology through a collaborative, co-instruction effort between a university music professor and multimedia technologist. The course, entitled Introduction to Film Music (MUSC 373, Computer Music Composition), incorporated an historical survey of film music media including literature, recordings and film as well as compositional assignments. In these assignments, students were required to learn the parameters of a certain era's film music (including the limitations) and then create their own soundtracks.

Role of Faculty Professor	Role of Technologist
Define composition dimensions of coursework	Provide comparative analysis of various industry technologies, past and present
Prepare lecture materials	Prepare lecture materials
Program examples of media to present during class	Program examples of media to present during class
Present and discuss traditional composition practices of genre	Discuss technologies utilized during composition and production process

TIMELINE

Radio Silent Film Television Film

Technologies and composition practices of each medium and time period are presented chronologically and are studied, discussed and experienced through assignments. From Radio to modern film, each era (compositionally and technologically) is delivered.

ASSIGNMENTS: The process

Film excerpts were digitized using a digital video editing workstation. The audio element was removed, and the film was then compressed into a digital format (QuickTime) that the students could import into a software application used to sequentially develop their score to the film. In this manner, the students were able to score the musical and sound excerpts while watching them, just as composers working in the industry do. Assignments were handed in on CD or cassette media and evaluated in class by the professors and peers.

STATEMENT OF PROPOSAL

One way of achieving technology in the classroom is to have collaborative instruction. In this case study, the course was co-taught by two instructors, each an expert in their fields; one in music and the other in media technologies. The benefits of collaborative instruction are manifold:

1. Instructors do not bear the burden of 'learning it all' before they incorporate technology into the classroom.
2. Instructors are involved in faculty development as they simultaneously impart and absorb expertise in their relationship with the co-teacher.
3. The student benefits from the interdisciplinary delivery and application of course materials, part of which include the dual perspectives and expertise of the faculty. Moreover, students enjoy a fresh approach and are better informed as a result.

The course became an intuitive utilization of resources, and the student reaction made it an exceptional experience for all persons involved.

FILM

A 25-minute documentary film was produced from in-class footage of interviews and discussions, as well as instructor interviews, commentary and samples of student work. This film reveals in detail the efforts made by the instructors, outcomes of the assignments by the students and a candid discussion on issues of teaching collaboratively. The film will be screened following the presentation, and participants will be given a copy of the syllabus and class timeline. A discussion will follow.

An examination of the functional capabilities of different user environments in networked classes and the development of a school-based language lesson and self-study system based on this examination

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Abstract With the advent of high-speed networks, feasibility studies and development of network-based systems to support class work has been pursued with vigor, resulting in new education environments such as remote lessons and cooperative learning. These studies have largely been carried out by examining an existing environment and constructing one based on the desired functions. However, so-called network-based lesson environments contain many different factors, such as the different computational environments used by teachers and students, network configurations between computers, and a variety of subjects that serve as targets for study. Moreover, these studies largely focus on the actual classes, whereas in the real world of school education, revision of material after each class is vitally important. This aspect has received little attention thus far. This paper examines the function of different environments during the development of a support system for network-based classes. By examining the function of different environments, an actual system supporting language lessons and self-study has been developed, with appropriate self-study environments. This system is divided into a support system for network-based lessons, and a support system for self-study. The lesson support system mainly offers lesson support for teachers, while the self-study support system is geared towards students, providing aids such as the reutilization of data taken from lessons.

1. Introduction

In recent years, as downsizing has lead to notable advances in computational capabilities, multimedia environments based on computers have become commonplace. The lifelike expression of sound, video and animation media, unified on a computational platform, presents itself as an opportunity for effective use in education. Especially in the field of language education, this has enabled the creation of systems that deliver lifelike effects not previously available to the language learner. Numerous applications of multimedia in language education have been trailed and developed, the effectiveness of which is well attested [1,2].

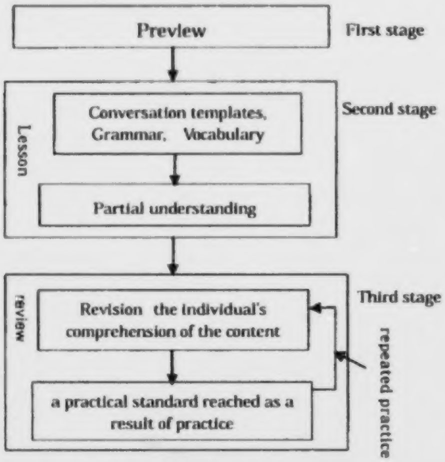
Preview
First stage
Lesson
Conversation templates, Grammar, Vocabulary
Second stage
Partial understanding
review
Revision the individual's comprehension of the content
Third stage
repeated practice
a practical standard reached as a result of practice

Figure 1: Model for language learning

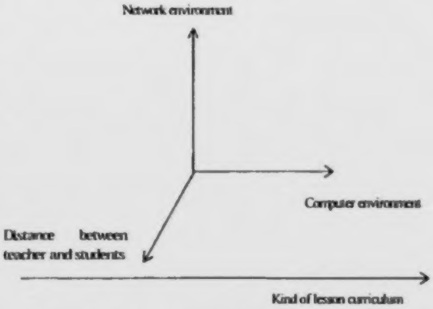
Network environment
Computer environment
Distance between teacher and students
Kind of lesson curriculum

Figure 2 The factors of Network base lesson support system

Also, with the realization of high-speed networks, lesson support systems using network capabilities have been brought under investigation and developed on a large scale. New education environments, such as remote lessons and cooperative learning, have been realized by use of the internet and intranet [3-6]. Research so far has mainly aspired to construct support systems for remote lessons, using exclusive connections or simply unprotected data exchange on the internet. They aim at re-creating a classroom environment as close to real life as possible, only network-based. These studies basically begin with an existing environment, proceed through to an examination of needed functions, and culminate in the realization of network-based systems for support of lessons. However, lesson support systems include many factors that need to be examined. For example, do the computers used by the teachers and students adequately handle sound and animation? Can the band area necessary for the sending of animation be provided for? Special needs may arise, depending on the nature of the target subject matter. For example, since the target subject matter in the present study is language lessons, one would need to consider the possibility of multi-lingual input and display. Hence, a thorough classification of the environment to be constructed is necessary, even before examining the various functions needed in a network-based lesson support system. It would be impossible to provide a trustworthy support system without following such a procedure. In addition, to achieve overall learning objectives for students in an educational setting, a three-stage model is proposed, basically consisting of preview, the actual lesson and revision. This is shown in figure 1. In this model, the teacher uses established principles to impart knowledge in stage 2. This stage corresponds to the procedures of current classes. There is a flood of information to convey to the students, but there is little feedback from the students to the teacher, because of the large size of each class. The third stage corresponds to self-study. Students, with the aid of notes they have taken in class and their own comprehension of the material, develop understanding of the imparted knowledge. A truly effective learning support system requires not only support for the lesson itself, but also a support system that includes self-study. To my knowledge, there are no examples of considered application of these matters.

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The authors of the present study aim to pursue the research goal of creating a comprehensive "integrated support system for the support of educational environments." In other words, a learning environment that covers the spectrum of "lesson to self-study, classroom to home." This paper presents a system supporting language lessons and self-study, developed by the authors. Chapter 2 below examines the functional capabilities of different user environments. Chapter 3 examines the actualization of environments and system architecture.

2. Examination of the functional capabilities of different user environments

2.1 Basic factors

Network-based lessons basically consist of the following three factors:

1. Network environment: This refers to how much network band is available between teachers and students. Satellite communication, exclusive connections and the internet may be used. The issue here is whether sound and animation can be sent from teacher to student and vice versa.

(Teacher to student)

	None	Sound	Video
Video & Sound	1	2	3
None	0	0	0

(Student to Teacher)

Table 1: Classification according to the network band and the computational environment used

2. The computational environment being used: One needs to consider whether the computers used by the teachers and students allow the transmission of sound and animation.
3. The distance between the teacher and students: This refers not to physical distance, but to whether the teacher and students are separated. Students may be gathered in one spot, or be scattered around different places.

In addition, there are differences among the requirements for different subject matter. For example, in language education, the subject matter currently under consideration, there may be a need for multilingual input and output according to content of each lesson. As figure 2 shows, the user environment consists of the 1) network environment, 2) the computational environment used, 3) distance between the teacher and students, and 4) the subject matter. Classification is done on this basis, but for the sake of simplicity, where the network environment has sufficient network band to enable the sending of sound and video from students to teachers, the computational environment used is assumed to be one where each student has his/her own computer, and that the computers are able to take in sound and video.

2.2 Classification according to the network band and the computational environment used

As shown in Table 1, the horizontal axis indicates the network band from the student to the teacher. The vertical axis shows the network band from the teacher to the student. The analysis has been simplified. It was found that costs would be relatively lower to provide an adequate environment for teachers only. Hence the categories only show "none," "video" and "sound." The results of this classification is summarized as follows:

0. Neither the teacher nor the student has access to a computer. The necessary network is not available. Note that even if the learner has a computer that sends out sound and video, it would be useless if the teacher had no computer. Hence, in both cases the category 0 is assigned.
1. The teacher can send sound and video information to the student, but the reverse is not available. This is typical of one-way transmission situations such as lessons in the classroom and satellite broadcasting. In this environment, the student does not necessarily need a computer, but equipment for receiving the teacher's information, such as projection screens and loudspeakers might become essential.
2. The teacher can send both sound and video to the student, but the student can only send sound to the teacher.
3. Both the teacher and the student can send and receive sound and video. In this case, cameras need to be installed on all computers.

The above classification is based on the network environment and the computational environment used. Cost considerations yield the hierarchy of 0<1<2<3.

2.3 Classification according to the distance between students and the teacher

Using the results from classification according to network environment and computational environment used, we may now obtain a further classification according to the distance between students and the teacher. "Distance between students and the teacher" refers not to the physical distance, but to whether the parties are gathered in the same place. As table 2 indicates, the horizontal axis shows 1) teacher and students in the same place, 2) students in the same place, and 3) students scattered. The vertical axis shows the results of classification according to network environment and computational environment used. In the current analysis, "teacher and students in the same place" approximates the traditional classroom situation. "Students in the same place" represents the situation where students are gathered in a classroom environment, while the teacher is elsewhere, possibly in a studio. The "students scattered" scenario refers to the situation where students are in their own homes. The results of the above classification are as follows:

(Classification according to network band)

	Teacher and students in the same	Students in the same place	Students scattered
3	2'	5'	7'
2	2'	4'	6'
1	1'	3'	3'
0	0'	×	×

(Distance between students and the teacher)

Table 2: Classification according to 1) the distance between students and the teacher

0' Both the students and the teacher are in the classroom, representing the traditional classroom situation with blackboards and textbooks.

1' This is basically the same as 0', only the teacher may use a personal computer and projector for presentation of material.

2' Both the students and the teacher have access to computers. This enables the transmission

3' Students and teachers are not in the same place. However students are unable to send information to the teacher. This results in a lesson type with only one-way communication, such as one-way transmission of material via satellite broadcasting or education broadcasts on television.

4' Students and teachers are not in the same place, but there is voice communication between the parties. Gestures and facial expressions cannot be sent.

5' Teachers can send both sound and video to the students, but students can only send sound signals to the teacher. Hence the teacher is unable to ascertain the students' facial expressions. However, if a moving image camera was installed in the classroom, the teacher would be able to observe the classroom environment.

6' Students are scattered over many locations, but two-way voice communication is available. The teacher is unable to monitor the actual learning environment.

7' Students are scattered over many locations, but two-way voice and video communication is available.

In the aforementioned table, the combinations of "0 - teacher and students in the same place" and "0 - students scattered" indicate situations where there can be no communication between the teacher and students. Hence an X has been assigned.

2.4 An examination of basic functional capabilities

The functional capabilities available in various environments are summarized in Table 3. An explanation of these capabilities follows:

1. Sound and video transmission from the teacher to students: Sound and video data taken by microphones and video cameras are sent to students. This function is essential when the teacher and students are not in the same place.
2. Transmission of handwritten information from the teacher to students: Information written on the blackboard during class is sent to the students. This function becomes very important when further explanation is needed, apart from the handout material prepared beforehand.
3. Sound transmission from one student to all other people: This function operates when students are scattered in different locations. When the teacher is asked a question by a student, this function enables all other students to hear and share in the same information.
4. Transmission of video from students to the teacher: By sending video from computers equipped with cameras, the teacher is able to monitor the students' learning environment.
5. Transmission of text information from the teacher to students: This enables the teacher to send text information beforehand. Being able to preview information is ideal, not only in situations where the parties are in different locations, but also when students gather in the same classroom.
6. Transmission of image information from the teacher to students: This enables the teacher to send prepared images beforehand, such as photographs.
7. Relay of classroom images to the teacher: This is achieved by cameras that take in images of the whole classroom, and relaying these images to the teacher. This enables the teacher to monitor the whole classroom situation.
8. Shared cursor: As the teacher explains material during class, this function enables all students to view the position of the mouse point at any given moment.
9. Easy-to-operate testing functions: When the teacher and students are in different locations, it is difficult for the teacher to ascertain understanding of the material. With easy-to-operate test functions, the understanding of students can be tested.
10. Note system: This function enables students to take notes on their own computer.
11. Virtual class list showing seating arrangements: This allows the teacher to check where the students are sitting, enabling the teacher to ascertain information about students.
12. A function that facilitates the asking of questions: When a student wants to ask a question, this function is used, which enables the teacher to receive questions.

As the above examination of basic functional capabilities indicates, we are concerned with the retention of two-way communication, which is fundamental in educational classes (functions 1-8, 12). At the same time, the merits of a computational system are also maximized (functions 9, 10, 11).

2.5 Language education and the functional assessment of systems supporting language lessons and self-study

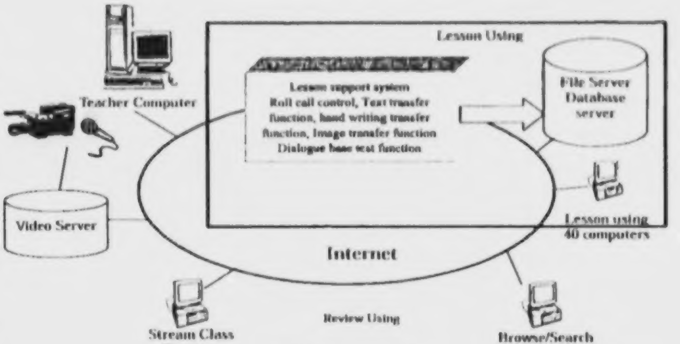

Figure 3 System construction

In language education, as the focus shifts from language ability based solely on reading to practical language proficiency, phonetic education has become an essential component. Especially in situations where the learner is not in a country where the target language is spoken, there is no environmental support, and one needs to learn the sounds of the language with cassettes or videotapes. Many institutions offering language education have made use of LL classrooms, and these have served their purpose well. However, with the advent of downsizing, many are shifting from LL to LL/MM classrooms. With the installation of computers in LL classrooms, cassette and videotapes in current use may be digitalized and made available by online retrieval. Also, the availability of online use combined with the use of multimedia language education software is seen as just one of many merits. However, as lessons have shifted to LL/MM classrooms, the size of classrooms has increased, making it hard to read handwriting on blackboards. Especially with languages such as German (with small umlauts) and Thai (with letters which only differ slightly) there are differentiation problems. Also, it would be ideal to have explanations delivered by teachers in the target language stored on the network for self-study, rather than relying solely on notes taken during class. For self-study, a student should be able to store notes taken in class together with stored data of pronunciation drills, enabling a reenactment of the actual classroom experience.

At this point, extra functions are presented in a proposed system supporting language lessons and self-study. These functions are expansions on the basic functions covered in 3' in Table 3. Below is a description of the added functions.

1. Teacher orientated: Virtual class list showing seating arrangements (roll call) Student orientated: Login function
   There is a need to store roll calls on a database, enabling unified treatment of the data. Consideration of teachers' needs, such as provision of class lists showing seating arrangements, is also a necessity.
2. Teacher orientated: The sending of text information Student orientated: The receiving of text information
   Text information prepared by teachers would be made available online. Multilingual display and multilingual input needs have to be addressed. Text information should be made available at the same time as the lesson contents (to be discussed below). This information would be used for self-study by the student.
3. Teacher orientated: Sending of handwritten information Student orientated: Receiving of handwritten information
   This function allows the teacher to send diagrams to students as they are drawn, via the internet. This should also be made available at the same time as the lesson contents (discussed below), to be used for self-study by the student.
4. Teacher orientated: Sending of video Student orientated: Receiving of video
   This function allows the transmission of video files to students via the network.
5. Teacher and student orientated: Dialogue-based easy-to-operate testing functions
   Testing functions are centred on the filling in of blanks. These tests are sent by the teacher to the students. After the completion of tests, students are able to compare their own work with the answers prepared in advance by the teacher. The data is then registered on the data server and made available to the user for self-study. Of course, all of this is available for multilingual display and multilingual input.
6. Student orientated: voice recording and replay functions
   These functions allow students to record their own pronunciation during class, and to compare this with the pronunciation in the teaching materials.
7. Student orientated: Note system
   This function enables the student to take his/her own notes in class and to save these.
8. The transmission of lesson contents
   This function enables the transmission of video of the lesson, voice data, text information given out by the teacher, and handwritten information. All the above types of information are to be simultaneously and automatically distributed to all students after each lesson.

3. Composition of the hardware and system architecture

3.1 Composition of the hardware

Figure 3 shows the overall image of our system supporting language lessons and self-study and the Table 4 shows all of the function. As the figure shows, one computer is made available to the teacher, with 50 computers made available to students. A video camera for recording the lesson and a cordless microphone is included. Two servers are provided. One is for the transmission of moving images, the other is a database server for saving all data used during class, as well doubling up as a file server.

(1) The teacher's computer

The teacher's computer is a windows machine which is connected to the network.

(2) Computers for classroom use

Computers for self-study can be existing ones, as long as an internet connection is available and Windows is running. It is also acceptable to use a telephone to connect them. Below are some specifications for the various parts of the configuration.

(3) Server for database and files

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This server has Windows NT as its operating system. Since it is used to store applications that are used in class, a large hard disk is installed. Microsoft Access 2000 database server is also installed, and all types of data used during class are stored here.

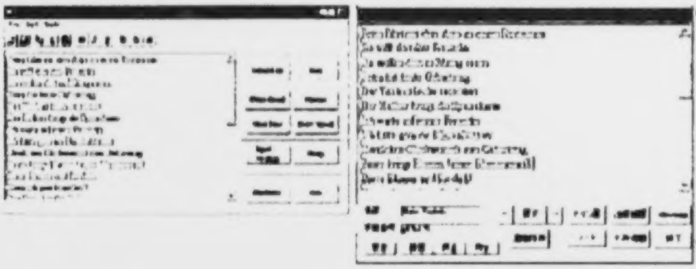
(4) Server for the transmission of moving images

This server has Windows NT as its operating system. A video capture card, cordless microphone and camera are installed for the purpose of recording video of the lesson. A tracking device ensures that the recording of the instructor's face remains at a constant size on tape. Real Server has been selected as the server responsible for distributing lesson contents.

		Functions supporting teachers	Functions supporting students
Functions used in class	1	Virtual class list showing seating arrangements (roll call arrangements)	Login function (*)
	2	The sending of text information	The receiving of text information (*)
	3	Sending of handwritten information	Receiving of handwritten information (*)
	4	Sending of images	Receiving of images (*)
	5	Dialogue-based easy -to-operate testing functions	Dialogue-based easy -to-operate testing functions (*)
	6	----	Note system (*)
	7	----	Voice recording and replay functions (**)
Functions used in self-study	8	Video recording of the lesson by the teacher	Transmission of lesson contents (**)
	9	Video recording of the text transmission information during class	Transmission of lesson contents (**)
	10	Video recording of handwritten information during class	Transmission of lesson contents (**)

(*) Basic functions based on Table 3. (**) Addition functions added for language education

Table 4 Functions available in a system supporting language lessons and self-study



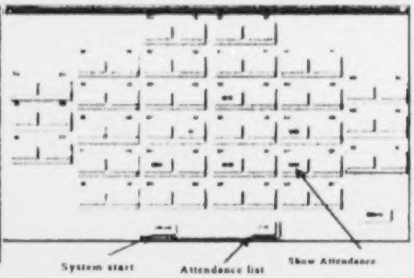


Figure 5 Virtual class list showing seating arrangements

3.2 The development of the environment

The present system was developed using VisualBasic, and the various types of data utilized in class were realized using Microsoft Access 2000. The server for the transmission of moving images was constructed with Real Basic Server. Access for self-study is served by Web Browsers, with Microsoft Internet Information Server.

3.3 Actual installation of the functions

Figure 4 indicates the main screens as seen by the teacher and the students. The following explanations pertain to this diagram.

1. The installation of the virtual class list showing seating arrangements (roll call system) and database access methods

   The attendance roll runs on a Jet database engine. The attendance database was created with Access. The roll call function begins as the instructor's EDLIN is started up. As the instructor starts up his/her side of the system, a seating diagram is shown, as seen in Figure 5. Students' reports of attendance are then accepted. Students login to EDLIN, and their data is transmitted to the teacher's computer. The IP address of the point of access is noted, and the name of the student is written onto the seat diagram and preserved as data. All this data is preserved, so that the user is free to check his/her own attendance with the attendance button on the student main window. The teacher can use the AttendList to check the names of attendees on that day.

2. The installation of the text transmission function

   In order to display multilingual data, this system uses the Rich Text format for text. Text entered by the teacher is saved on file at the touch of the return key, and automatically sent to all students. The time is recorded with the saved file, and the lesson contents transmission function (to be discussed below) uses this time to achieve simultaneity. On Japanese computers, umlauts in German are generally not available on the keyboard, hence the many multilingual input assistance tools, as shown in Figure 6. With the addition of these multilingual assistance tools, many languages can be dealt with. The text box in the main window of Figure 3 shows this function.

3. The installation of the transmission function for handwritten information

   This function allows the teacher to transmit to the students (in real time) the data drawn on his/her whiteboard window. When WhiteBoard is activated on the teacher's computer, whiteboards appear on both the teacher's and the students' screens. Data is then transmitted. Also, every ten seconds, information about time and the image on the whiteboard are saved as

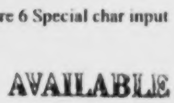


Figure 6 Special char input

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an image file. The lesson contents function also refers to this to achieve simultaneity.

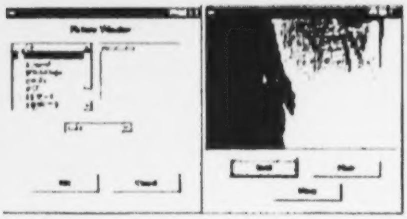
4. The installation of the sending/receiving functions for images
When the teacher loads a prepared image and presses the transmission button, the students' picture windows also start up automatically, displaying the sent image (Figure 7). The file types that can be displayed are JPEG, GIF and BMP.

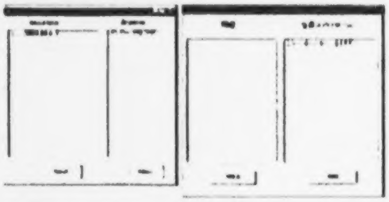
5. Dialogue-based easy-to-operate test functions
When the teacher presses the MiniTest button, a dialogue-based test window opens, which is simple to operate (Figure 8a). When the teacher enters the questions and sends these, a test window appears on the students' computers (Figure 8b). When a student completes the answers and sends them back, a student window with the name of the student appears (Figure 8a). If the teacher sends only questions, a question sheet appears on the student's window (Figure 8c). When answers and inserted and sent, a window with the answers appears on the student's screen. All this data are stored, and students may use this to revise the contents of the lesson during self-study sessions.

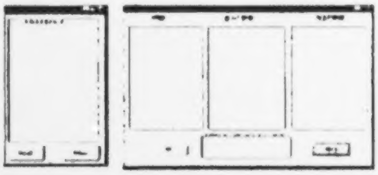
6. Voice recording and voice replaying functions for students
As shown in Figure 4, the student may use the record, stop and replay functions on the student screen to record his/her own voice and to replay this. This function can be used in times of self-study, or utilized to compare one's own pronunciation with that of multimedia teaching material.

7. When the Note Button is selected, a note window appears, which when utilized and saved, can be used in the next self-study session.

8 Transmission of Lesson Contents
This lesson contents system enables the simultaneous transmission of four types of data: recorded video of the lesson, sound, text and handwritten data. The camera used has a tracking system which focuses on a red mark attached to the teacher's chest, ensuring that the teacher's face is always recorded as the same size on tape. Sound is recorded with a cordless microphone, and this ensures the red mark remains unobstructed. Both sound and video data are recorded from the start of the lesson to the very end. When the lesson is finished, a Real Text file with time information is generated, referring to the time recorded on the saved text files. Handwritten data is made into Real Picture files with time information, again using time data on the saved files. Thus text data, handwritten data, together with sound and video data can be arranged for simultaneity. All these are sent simultaneously as SMIL files. Figure 8 displays a screen with lesson contents being transmitted. On the left is Real Text, in the middle is Real Picture, and on the right is a video screen.







4 Conclusion

In this study, the basic functions necessary for network-based learning environments were examined. In addition, further functions necessary for language education were added. We conclude that network-based learning environments must not only re-create the classroom environment, but also provide support for study sessions after class. In particular, language learning cannot take place just by understanding of concepts; repeated practice is necessary. It was for this purpose that the authors of this paper developed the current system. It is a system that supports language lessons and self-study, based on the transmission of lesson contents, and including provisions for self-study. As this system comes into general use, evaluation studies will be conducted as part of the next step in our investigations.

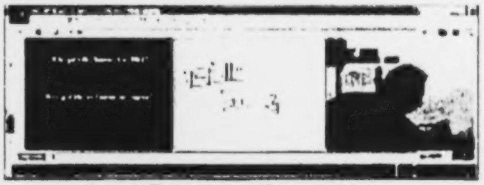


Figure 9 Transmission of Lesson contents

References

[1] Hiroshi SAKAMOTO, ChunChen LIN, Seinosuke NARITA: "The Development of G-MUSE: the German CAL System for University Education", Research Report of JET Conferences, JET 96-1, P7-12, 1996

[2] ChunChen LIN, Hiroshi SAKAMOTO, Seinosuke NARITA: "Long-Term Evaluation of German CAL System G-MUSE", Research Report of JET Conferences, JET 96-1, P13-17, 1996

[3] WAKAHARA Toshihiko, YUITOU Michihiko, etc: "A Study on the Configuration of the Remote Lecture System over ATM-Networks", Technical report of IEICE, OFC 96-279, P 31-36, 1996

[4] TAMURA Takeshi, KOJIMA Astuhiro, HATANAKA Hiroshi, SATO Fumihiro: "Implementing a Distance Education System with Emphasis on Interactive Communication", IEICE technical report. ET 97-82, P77-83, 1997

[5] MAEDA Kaori, AIBARA Reiji, KAWAMOTO Kayo, etc: "Multimedia Communication Environment for Distance Learning", The Transactions of the Institute of Electronics, Information and Communication Engineers. B-1, J80-B-1, P348-354, 1997

[6] YOSHINO Takashi, INOUE Yutaka, YUIZONO Takaya, etc: "Development and Application of a Supporting System for Distance Learning Classroom Using Personal Computers via Internet (<Special Issue>Networked Collaboration and its Support systems)", Transactions of Information Processing Society of Japan, VOLM: 39, NUMB: 10, P2788-2801, 1998

[7] SANO Hiroshi, ZAIMA Susumu, KURITA Hiroyuki, MINEGISI Makoto: "An Advanced Audio-visual Education Room at Tokyo University of Foreign Studies", IPSJ SIG Notes, VOLM96, NUMB93, P 1-8, 1996

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Integrating ICT in Teaching Chinese Language and Literature

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Abstract: Eight Chinese Language and Literature teachers participated in this research to make their first attempts at integrating information and communications technologies (ICT) into curriculum. They were provided training in common application tools and then paired up to develop ICT-based courseware for use in classroom teaching. Four units of courseware thus developed were field-taught to 169 students. Results of a questionnaire survey conducted after field-teaching indicate that most students prefer ICT-based lectures to conventional ones because ICT offers such benefits as making the lectures more interesting, enhancing the mood of the class, providing richer material than usual, and improving teacher-student interaction.

The Research Method

A school-university partnership was established in this research to enhance Chinese Language and Literature (CLL) teachers' computer competency and their use of information and communications technologies (ICT) in instruction. The partnership project was operated between the authors' department and Hai-San Junior High School, a typical junior high school located in northern Taiwan. Within this partnership, our department provided three computers and project-related software, set up network connection for these computers, and offered ICT training courses to Hai-San's CLL teachers. Reciprocally, the school provided full administrative support, the computer lab for the training courses, the conference room for seminars, and the equipment to be used for field teaching. The major participants included a professor, three graduate students, four undergraduate students from our department, and eight CLL teachers from Hai-San. All eight participating teachers are female. Their teaching experiences ranged from 8 to 28 years and they ranged in age from 33 to 51.

Considering that the participating teachers had limited prior experience in using computers, we decided to offer them an up front training course in ICT skills. The training course was also open to other interested teachers at Hai-San. The course was 36 hours in length and was divided into 12 sessions. Each session was taught by a graduate student as the lecturer and two undergraduate students as teaching assistants. Teachers were trained in common application tools, including Microsoft Windows (3 hours), Internet tools (email, web browsers, ftp, telnet, etc.) (6 hours), Word (9 hours), PowerPoint (6 hours), FrontPage (9 hours) and Excel (3 hours).

We took care to incorporate as many CLL-related examples and exercises into the training material as possible. For example, when we were teaching the use of browsing tools, we asked the teachers to search for web sites that provided good databases of Chinese idioms and proverbs or that contained a rich collection of famous Chinese calligraphic works; while in teaching Word's features, we taught them how to format a CLL exam paper; we also used a CLL lesson plan as an example in introducing formatting "tables" with Word. Our purpose was to keep reminding these teachers that ICT skills were not to be learned in isolation from the subject area. In addition, we arranged three tutorials to introduce these teachers to useful CLL-related digital resources, including CD titles and web sites. In the tutorials we also demonstrated exemplar cases of ICT integration in other subject areas.

After the training course was completed, the eight teachers paired up to design and develop ICT-based courseware. We assigned one of our students to assist each pair of teachers. Each team picked a unit from the textbook and wrote a lesson plan in which they embedded ICT-integrated learning activities making use of the courseware they plan to develop. The teachers generated ideas and developed the courseware with technical assistance from our students. Individual training on advanced ICT skills were provided to them on an "as needed" basis during the development process, which included skills in using web page design tools, video editing tools, etc.

Among the courseware developed by the four teams, one team focused their courseware on introducing students to an author who has been famous not only for his outstanding literary work but also for his love affairs with several beautiful women in the early 20th century. Another team used PowerPoint to present an article in a storybook-like fashion. They involved their students in the development of courseware by asking them to create illustration for the storybook. Yet another team of teachers asked each of their students to draw a picture to visualize what he/she thought an ideal world would be like. The teachers then scanned the pictures into the computer so they could be shown during classroom discussion. Teachers of the fourth team asked their students to collaborate in writing a play script based on a famous dialogue occurring between an emperor of the Song Dynasty in ancient China and one of his loyal military commanders. The script was then presented as PowerPoint slides and shown in the background while the students performed the play. Even though the learning activities supported by the four units of courseware were quite different from one another, all exhibited ingenuity in integrating ICT.

The courseware was used in field teaching to 169 students of six classes at Hai-San Junior High School in April 2001. We invited the principal, the director of the academic affairs, and all CLL teachers to sit in and observe. Six of the eight participating teachers used the courseware they developed in teaching a 45-minute class session each. The presentation equipment, including the computer, the overhead projector and the screen, was set up by our graduate students in advance. Our students also helped operate the computer during field teaching so that the teachers could concentrate on their planned teaching activities without worrying about possible technical problems. All field-teaching sessions were videotaped for later reviews and analyses.

Findings

A questionnaire survey was conducted right after field teaching to collect students' feedback. The questionnaire contained 19 questions. Eleven of them focused on contrasting the use of ICT in instruction with conventional lectures; three questions were related to students' attitude toward ICT integration in classroom teaching; and the remaining five questions concerned possible changes in students' motivation toward learning computer knowledge and skills as a result of experiencing ICT integration in subject teaching. The results indicated that most students preferred ICT-based lectures to conventional ones. A large majority of students agreed that integration of ICT helped make the lectures more interesting (97.64%), enhanced the climate of the class (92.91%), offer richer materials than usual (92.91%), and improved teacher-student interaction (83.46%). Most students would like to see the new teaching method used more often in the future (92.91%); they would like students of other classes to have the chance to experience the new teaching method (93.60%); and they hoped that ICT could be used by teachers of other subjects (94.82%). Moreover, 94.26% of students admired their teachers for their computer skills in creating the courseware, and 95.24% of students agreed that they would like to learn more about computers after seeing what their teachers were able to do. As to what other subjects in which the students would prefer seeing frequent use of ICT integration, the top three subjects were History (62.2%), Geography (40.94%) and English (33.07%).

Aside from students' positive feedback, the eight participating teachers took much pride in their own accomplishment, and they found the experience to be most rewarding. Furthermore, their achievements were well recognized by both the principal and the director of the academic affairs. In a seminar held for those teachers who came to observe the field teaching, the eight participating teachers shared their feelings and experiences with their colleagues about how they managed to overcome their own technophobia, how they came up with the idea for developing the courseware, their alternate feelings of frustration and self-fulfillment along the way, and their opinion of what distinguished teaching with ICT from teaching in a regular classroom. They encouraged other teachers to give it a try by emphasizing that "if we can do it, you can too." Most other teachers remarked that they were highly impressed by what their peers were able to do and that they had become much more convinced of the relevance and value of integrating ICT in CLL teaching.. They also felt more motivated toward learning computer skills and had more self-confidence in implementing ICT integration.

In the seminar the teachers also discussed about obstacles and barriers to the use of computers and the Internet for instruction. What was identified included lack of computers and Internet connection in teachers' offices and classrooms, lack of proper training for teachers to learn how to use computers or the Internet, lack of release time for teachers to develop useful courseware, insufficient class hours to incorporate frequent use of computer in classroom, and lack of information about useful digital resources for use in teaching or learning CLL. Some teachers were more concerned about the issue of technical support, while some others hoped that there could be one or more multimedia classrooms established and dedicated to CLL teaching to facilitate integration of ICT in the curriculum.

Conclusions

Chinese Language and Literature has long been considered the most "traditional" subject in our schools, and CLL teachers are often labeled as most reluctant to adopt innovative teaching practices. In this study we guided eight CLL teachers through their first attempts at ICT integration. They have succeeded in convincing themselves as well as their colleagues that integrating ICT into CLL curriculum is indeed practicable. They have also proved that all CLL teachers have the potential of utilizing ICT for enhanced effectiveness in teaching and learning if only they are provided with adequate training and, more importantly, if only they are willing to try.

Acknowledgments
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Collaborative Knowledge Building: A Learning Module in Shadow netWorkspace™ Learning System

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Abstract: Shadow netWorkspace™ (SNS) is designed and developed as a free, open source, network-based work environment specifically for use in K-12 schools to support schools and learning. In this paper, we describe a learning module utilizing features of SNS and articulate how teacher and students can collaboratively learn and work to build knowledge. The paper also proposes a collaborative knowledge building model that illustrates the significant phases in the learning module. Teachers in the local community are invited to evaluate the feasibility of learning module in terms of its benefits, challenges, the ease and appropriateness of use. Feedback from the evaluation will provide recommendations for the design and development of knowledge building activities.

SNS Learning Communities

Shadow netWorkspace™ (SNS) is an Open Source, network-based work environment designed and developed for use in K-12 schools by the Center for Technology Innovations in Education (CTIE) at the University of Missouri-Columbia. Open Source licensing provides a new framework for the development and evolution of software systems, and network-based learning systems enable schools to change from knowledge-acquisition institutions to knowledge-building learning communities (Laffey et al. 1999). Specifically SNS has developed a network-based software system and is building a community of developers committed to open source licensing and the SNS learning system.

We utilize features of SNS to build collaborative learning modules. They are designed to gain participation of an extended community of researchers, teachers, administrators, and tech coordinators in an effort to gain better understanding of network-based learning systems and their potential impact. Collaboration could happen in two main areas: 1) development and refinement of learning modules, and 2) research and assessment of learning modules. Because a widespread use of technology is to promote learning and facilitate lesson plans, these collaborative efforts can build the body of learning modules available to teachers as well as the information about the utility and efficacy of those modules.

Scardamalia and Bereiter (1993) describe how computer-supported collaborative learning (CSCL) systems can support and optimize both the process and the representation of knowledge-building, learning and collaboration. SNS provides a means for both educators and software developers to create sharable and continuously-improving software that can be easily and flexibly integrated to a local learning community.

Therefore, rather than a rigid learning application, SNS is more likely an adaptable operating system for collaboration and learning.

A Learning Module in SNS

Objectives and Method Review

One collaborative learning module is a note taking and critiquing module that outlines methods for using SNS to facilitate collaborative knowledge building. The objective of this module is to improve students' note taking and critical analysis skills and to encourage effective integration with the content lessons.

Each week, different students are assigned to be the "note-posters". They are responsible for taking their best notes for that given week and posting them into appropriate documents (Shadowdoc) to collaborate and brainstorm within their science class group. Each night, each member of the class is assigned to critique a manageable number (1-3 depending on volume) of note-sets by comparing the posted sets to their own and commenting via the discussion boards. Friday is review day. The class works together to guide the instructor (and vice versa) through the process of combining the note-sets into one document that represents all the key points that the instructor wanted to get across as well as the areas of detail that should be included. This final document could be used for preparing unit assessment.

This exercise aims to create a "progressive discourse" between the students and the instructor. This discourse embodies the concept of formative evaluation within the context of a knowledge-building task (Scardamalia & Bereiter, 1996a). Thinking can be shaped by writing and people tend to think more and write more clearly when they are producing content for others. Critical thinking happens in good discussions. For years, proponents of Writing-Across-the-Curriculum (WAC) have been saying that students learn when they formulate their ideas in writing (Lang, 2000). Writing is reviewable, revisable, and recorded. This effort to optimize the process of building expertise, requires students to be intentional learners. Analyzing their knowledge and organizing new information, with the understanding that their words will be under the scrutiny of their peers, should encourage thoughtfulness and learning. As the students contribute to build a collective knowledge, they will be required to adapt both their intentions and their methods. As they gain understanding they must quickly switch roles from learner to teacher, so that they can help their peers to learn and improve the group artifacts.

Assessment

Assessment of a collaborative activity might be the biggest challenge for teachers when using this teaching method. The reason why it is so difficult to evaluate collaboration is that teachers have to examine not only the process but also the final product of a group's work.

This learning module is intended to fit into a traditional curriculum, so the weekly note-sets could serve as review materials for quizzes or examinations. Concept-mapping assessment could be used as an alternative assessment method. A concept map is a node-link-node representation of content, where nodes represent concepts and links represent relationships between connected concepts (Dansereau, 1995; Jonassen, Beissner, & Yacci, 1993). When large numbers of concepts are connected, a concept map is formed which ideally represents the content and the structure of a student's knowledge framework. For a group of students, concept maps can be viewed as expressing the meaning shared by team members. The concept maps can be scored for (a) number of unique nodes, (b) number of links between nodes, and (c) number of levels based on adaptions of concept map scoring procedures (Ayersman, 1995; Novak & Gowin, 1984; Toro, 1995). As learning occurs from instruction, the growth of learners' knowledge should be reflected in the elaborateness and structure of the notes they construct (Jonassen, 1987). Analyzing the complexity and accuracy of pre- versus post-lesson concept maps can illustrate depth of students' understanding.

Learning and Knowledge Building in SNS

The Knowledge Building pedagogy envisions learning as a social process of collaboration that students can become active learners and more aware of their own and others' processes of constructing knowledge (Brown & Campione, 1994; Scardamalia & Bereiter, 1996b; Pea, 1993). This note-taking learning module, the significant phases of collaborative knowledge building are illustrated in Figure 1: cycles of personal understanding and collaborative knowledge building. This figure represents the processes of internal personal understanding, and socio-cultural knowledge building. This model illustrates the environment where individual's understanding can be adapted and enhanced collaboratively.

SNS Support for Social Knowledge Building Activities

Network-based learning system cannot provide support for individual cognition; Individuals must articulate their understanding and beliefs as public statements before they can interact within network-based learning system. Thoughts must be even more formalized for computer support than for interpersonal interaction (Stahl, 1993). In this module, students can use Shadowdoc to create documents with sections and images and to compile the class notes. The full-featured discussion board in SNS could also be used for representation and interaction.

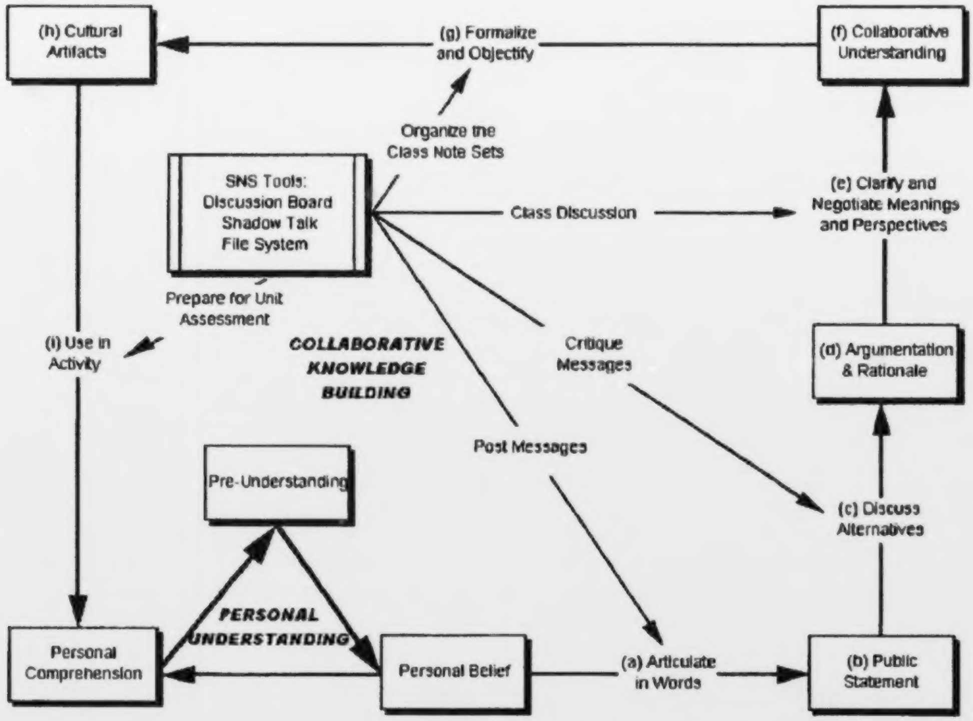
(h) Cultural Artifacts
(g) Formalize and Objectify
(f) Collaborative Understanding
Organize the Class Note Sets
SNS Tools: Discussion Board Shadow Talk File System
Class Discussion
(e) Clarify and Negotiate Meanings and Perspectives
Prepare for Unit Assessment
(i) Use in Activity
COLLABORATIVE KNOWLEDGE BUILDING
Critique Messages
(d) Argumentation & Rationale
Post Messages
Pre-Understanding
(c) Discuss Alternatives
PERSONAL UNDERSTANDING
Personal Comprehension
Personal Belief
(a) Articulate in Words
(b) Public Statement

Figure 1: Collaborative Knowledge Building Using SNS Tools (adapted from Stahl, 2000)

(a) ***Articulate in Words*** – SNS tools will facilitate the process of articulating ideas and preserving them in convenient forms. Posting notes will encourage the users to "verbalize" their thoughts in an appropriate expression and accumulate the text to the public statements.

(b) ***Public Statements*** – Public statements are the domains where one person confronts other people's perspectives. Posted notes can represent the different perspectives from which these statements emerge. It also makes explicit the important relationships among personal and group perspectives, as

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well as providing meanings for individuals and collaborative teams to articulate their own perspectives. The instructor or other users can co-construct and add/edit commentary or critiques on writing documents.

(c) ***Discuss Alternatives*** – The SNS tools provide an asynchronous, interactive communication that allows students to respond to notes posted by others. Unlike a tree of divergent opinions, the Shadowdoc or a scaffolded discussion forum can go beyond superficial aimless discussion to converge on shared understandings and acknowledged opinions (dePaula, 1998; Guzdial & Turns, 2000; Hewitt & Teplovs, 1999; Stahl, 2000).

(d) ***Argumentation & Rationale*** – One note might be against another or provide evidence to support the claim of another note. Donath et al. (1999) suggested the component that supported argumentation and rationale could contribute to participants' meta-level comprehension of their knowledge-building process.

(e) ***Clarify and Negotiate Meanings and Perspectives*** – Constructing group knowledge can be fostered by clarifying the meaning of important terms or key concepts (Stahl, 2000). The key concept discussion can make explicit how different participants understand the terms they use and should result in a group glossary of the agreed upon definitions of important terms. After the processes of clarification and negotiation, the key concepts or glossary could become the future debate or the topics for the assessment.

(f) ***Collaborative Understanding*** – The accumulation of negotiated-shared knowledge results in the establishment of a group perspective. Individuals can then build on this shared knowledge within their own perspective and even begin to critique it and start the whole cycle over.

(g) ***Formalize & Objectify into Cultural Artifacts and Representations*** – The shared knowledge can be further formalized. It can be represented in another symbolic system or combined into a more comprehensive system of knowledge. For example, the class can build a note-set to outline the key concepts of the unit. The note-set will provide the accepted base for building future knowledge. Other artifacts could include an annotated bibliography, like a knowledge repository.

References

Ayersman, D. (1995). Effects of knowledge representation format and hypermedia instruction on metacognitive accuracy. *Computers in Human Behavior, 11*, 533-555.

Dansereau, D. F. (1995). Derived structural schemas and the transfer of knowledge. In A. McKeough, J.

dePaula, R. (1998). *Computer support for collaborative learning: Understanding practices and technology adoption*. University of Colorado, Boulder.

Donath, J., Karahalios, K., & Viegas, F. (1999). Visualizing conversation. *Journal of Computer Mediated Communication, 4*(4).

Guzdial, M., & Turns, J. (2000). Sustaining discussion through a computer-mediated anchored discussion forum. *Journal of the Learning Sciences*.

Hewitt, J., & Teplovs, C. (1999). *An analysis of growth patterns in computer conferencing threads*. Paper presented at the Computer Supported Collaborative Learning (CSCL '99), Palo Alto, CA.

Jonassen, D. (1987). Assessing cognitive structure: Verifying a method using pattern notes. *Journal of Research and Development in Education, 20*(3), 1-13.

Jonassen, D. H., Beissner, K., & Yacci, M. (1993). *Structural knowledge: Techniques for representing, conveying, and acquiring structural knowledge*. Hillsdale, NJ: Erlbaum.

Laffey, J. M., Musser, D. & Espinosa, L. (1999) *Shadow Learning Systems Project*. University of Missouri, Columbia

Lang, D. (2000, September, 2000). Critical thinking in web courses: An oxymoron? *Syllabus, 14*, 20-24.

Pea, R. (1993). The collaborative visualization project. *Communications of the ACM, 36*(5), 60-63.

Novak, J. D., & Gowin, D. B. (1984). *Learn how to learn*. New York: Cambridge University Press.

Scardamalia, M., & Bereiter, C (1993). *Computer support for knowledge-building communities. Journal of the learning sciences, 1993-1994(3). 265-283.*

Scardamalia, M., & Bereiter, C. (1996a). Computer support for knowledge-building communities. In T. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm* (Vol. 1, pp. 331). Mahwah, New Jersey 07430: Lawrence Erlbaum Associates, Inc.

Scardamalia, M., & Bereiter, C. (1996b). Paradigm shifts and instructional technology: An introduction. In T. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm* (Vol. 1, pp. 331). Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

Stahl, G. (1993). *Interpretation in design: The problem of tacit and explicit understanding in computer support of cooperative design, Ph.D. Dissertation* , University of Colorado, Boulder.

Stahl, G. (2000). *A model of collaborative knowledge-building*. Paper presented at the Fourth International conference of the learning sciences.

Toro, M. (1995). The effects of HyperCard authoring on computer-related attitudes and Spanish language acquisition. *Computers in Human Behavior, 11*, 633-647.

Remote, Proximal and Simulated Access to Laboratory Hardware – A Pilot Study

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Abstract: This paper details a pilot study into alternative forms of access to laboratory hardware for final year undergraduate teaching. Students were given three different assignments to complete using an XY contouring table – the first proximally in the laboratory, the second by simulation of the hardware and the third by remote access to the hardware via the Web. The trial was evaluated using multiple tools, with attention paid to the differences in educational outcomes of the three alternatives. It was observed that students' performances on different criteria varied depending upon the form of access used. Performance on a targeted examination question was also found to be dependent upon the access method.

Context of the Project

This paper outlines the development and implementation of new laboratory classes within the final-year Mechanical Engineering subject 436-405 *Advanced Control Systems*. In this subject, students learn to design analog and digital controllers for complex mechanical engineering systems. A number of advanced control system topics, such as nonlinear control system analysis and design, multivariable control systems and optimal control are covered in the subject.

In previous years in this subject, the last four weeks of semester were devoted to a 'case study' project, in which students would reproduce the results of a relevant recent journal article, and report back to their peers. While this proved to be a useful exercise, it was thought that students would benefit more from direct, personal experience with system design, implementation and experimentation, using physical control system hardware. We also sought to expand upon our previous work in providing alternative access methods to hardware in laboratory classes (Lindsay, et al., 2000).

This paper reports a pilot study involving only nine students. No attempt is made, therefore, to attribute statistical significance to the results. Nevertheless, the results are indicative of meaningful differences in learning outcomes with different access modes.

Theoretical Framework

The development of new assignment material for the course allowed us to pursue a number of objectives. We shared many of the motivations of (Hahn and Spong, 2000), in that we wished to increase students' exposure to control systems, and also to increase the flexibility of this access.

The incorporation of web-based access offered a number of flexibility advantages, both immediately and also for potential future developments. Access to control laboratories via the Internet dates back to 1996 (Aktan, et al., 1996), with a number of studies since being published to show the feasibility of the paradigm, such as (Hahn and Spong, 2000), (Shen, et al., 1999), (Enloe, et al., 1999).

Of particular interest in our development of the projects was to maximise the transparency of the technology involved. (Givens and McShea, 2000) elaborates extensively upon the dual amplification/reduction effect of technology upon human experience. The beneficial effects offered by the access to the physical hardware could be partially or wholly offset by technical difficulties experienced in operating the hardware. The importance of a robust, reliable system is particularly emphasised by Givens and McShea, and was a design priority for this work.

Whilst Givens and McShea do address the issue of amplification vs reduction, the bulk of the literature on this topic does not concentrate on evaluation of learning outcomes. Positive feedback from students is often reported, and indeed is a desirable outcome. However, it is secondary to the students' acquisition of desirable skills and knowledge.

Constructivist theorists such as (Ausubel, 2000) tell us that the acquisition of these skills is dependent on the overall learning experience which the student undergoes – students create new meanings for themselves by assimilating new experiences into their existing cognitive structures. To promote the flexibility of access, we offered three different learning experiences – proximal access to the hardware, simulated access, and remote access.

In order to assess the effects of the different learning experiences, a number of different evaluation tools were developed – the assessment measures of the assignments and the final examination, as well as student journals, access logs from the hardware, and also direct student feedback.

The System Developed For the Project

In the past, similar work in the Department had been completed from scratch with a custom-built system. For this project, the approach taken was instead to integrate commercially available components to form an overall system. This approach was taken for the hardware as well as the software.

The Hardware

The hardware, illustrated in (Fig 1), consists of two linear positioning tables – a y-axis table mounted on the laboratory bench, and an x-axis table mounted perpendicularly on top of the y-axis. This arrangement provides two degrees of freedom for the "tool point" of the system. The linear tables are powered by servomotors, which are connected by custom-made flexible couplings that deliberately introduce torsional compliance and backlash into the system.

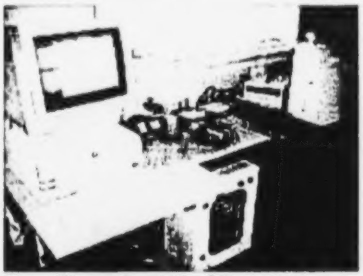

Figure 1: X-Y table system

The servomotors are each controlled by an independent servo drive, located in the cabinet under the bench. These servo drives are in turn controlled by a dSPACE ® DS1102 controller board, which is inside the PC on the table. The PC is used to define tool point profiles and controllers using MATLAB® and Simulink®, and also to provide the web-based control interface.

How the System Works

The system utilises the Simulink Real-Time Workshop® and dSPACE software to compile Simulink models into object code for the DSP board. These models represent the controller for the XY table system. Depending upon operation mode, the DSP board sends either velocity or current command signals to the servocontrollers. The servocontrollers power the servomotors which move the linear tables. See (Fig 2)

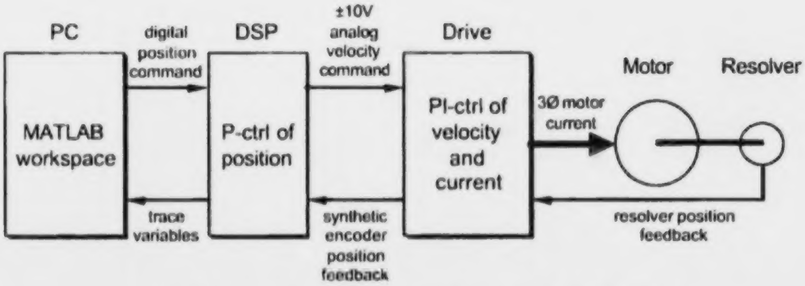
PC
digital position command
DSP
±10V analog velocity command
Drive
Motor
Resolver
MATLAB workspace
P-ctrl of position
PI-ctrl of velocity and current
3Ø motor current
trace variables
synthetic encoder position feedback
resolver position feedback

Figure 2: Schematic of the control system (in CNC mode)

When the system is in operation, the PC samples the memory of the DSP board and records the values of selected variables such as motor velocities, position commands etc. These variables are stored within the MATLAB workspace on the PC.

Students design their own controllers for the XY table system, implement them in Simulink and compile them to the DSP board. They then initiate data capture runs and collect and analyse the sampled data. The inclusion of Simulink in the software resources allows a wide variety of alternative control strategies to be readily attempted without the need for time-consuming and error-prone hand coding.

A comprehensive Simulink model of the XY table system was developed, including many of the non-linearities of the real hardware. This model was used in the place of the connections to the DSP boards to provide a simulation of the XY table system.

The MATLAB Webserver and the Apache server were also employed, allowing the MATLAB scripts used in controlling the XY table to be called remotely via the web. Specific input and output HTML templates were developed to pass the required commands to the Webserver.

Educational Materials Developed For the Project

Assignments

Three new assignments were developed for the course, each of which involved a different method of interacting with the hardware. The assignments accounted for 50% of the overall mark that students received in this subject.

Assignment One – Proximal

In Assignment One, students were provided the opportunity to control the XY Table within the laboratory. The controllers of the table axes were deliberately mismatched to introduce a correctable contouring error into the performance of the table.

Students began by investigating the response of the table to straight line command profiles. They tuned the feedback gains of the CNC controller to optimise this performance. They then investigated the behaviour of the optimised system attempting to reproduce more complex profiles, and examined the 'performance envelope' of their controller – the range of tasks for which the system provided adequate performance.

Assignment Two – Simulation

In Assignment Two, students were provided with a detailed Simulink model representing the XY table. This model allowed students to perform "experiments" as though they had direct access to the laboratory equipment, without the scheduling constraints of accessing a single piece of hardware. The simulated system generated the same sampled data as was available in the laboratory set-up.

Students were asked to investigate ways of improving the contouring performance with alternative control strategies. For some strategies, this required them to perform 'system identification' experiments. They were required to select an appropriate measure of performance, and to compare their alternative control strategies using this criterion.

Assignment Three – Remote

In Assignment Three, students were required to physically implement the controllers they developed in Assignment Two. This implementation was through the remote access interface, with feedback from the system provided via a webcam and the sampled output from the MATLAB workspace.

The students were also required to investigate the robustness of the controllers designed using the simulation model, and to tune them as necessary to adapt for the differences between simulation and reality.

Examination Question

Deep learning of the course material is important. This can be assessed by presenting students with problems similar to those encountered in the assignments, the effective solution of which relies upon the same theory and concepts. Question One of the examination for the subject was designed to address the key concepts covered by the assignment work, with sub-sections of the question specifically aimed at the topics in the three different assignments.

Outcomes of the Project

A number of different tools were used to measure outcomes of the project – the assessment of the assignment work, and a follow up examination question; students' self-reflections from study journals; analysis of access logs; and direct feedback from students, as well as our anecdotal observations of their work.

Assignment outcomes

To allow comparisons to be drawn between the three approaches, the same evaluation tool was used to assess each of the different approaches. To further reduce the variance in the marking process, a single marker was responsible for marking all of the assignments.

Eleven criteria were chosen for the purposes of evaluating the students' work. Each of the criteria is a desirable outcome of the assignment work. Some are generic skills, some are the application of generic skills to a specific task, and some are task specific. Comparisons between the outcomes for the task-specific criteria (such as criterion 1) are less meaningful than those drawn between the more generic criteria (such as criterion 4). Students were given a grade from 1 (very poor) to 5 (very good) for each criterion.

The three assignments were each assessed on the following criteria:

1. Familiarity with the system, and the components thereof.
2. Cognitive achievement – an understanding of concepts – rather than procedural achievement – just "turning the handle".
3. Identification of the important variables/parameters involved in problems associated with the hardware.
4. Generation of multiple viable solutions to given set tasks with the hardware.
5. Evaluation of the alternative solutions to choose an optimal solution.
6. Anticipation of possible exceptions, and formulation of methods of overcoming these exceptions.
7. Adaptation to unforseen exceptions in a professional way.
8. Understanding of the non-ideal effects of compliance, backlash and friction on control systems
9. Understanding and demonstration of multiple techniques for the design of controllers for MISO systems, and the strengths and weaknesses of both.
10. Demonstrated understanding of the limitations of the system
11. Fluency in the operating language of the control system

The mean performance on each of the criteria for each of the three access modes is shown in (Fig 3).

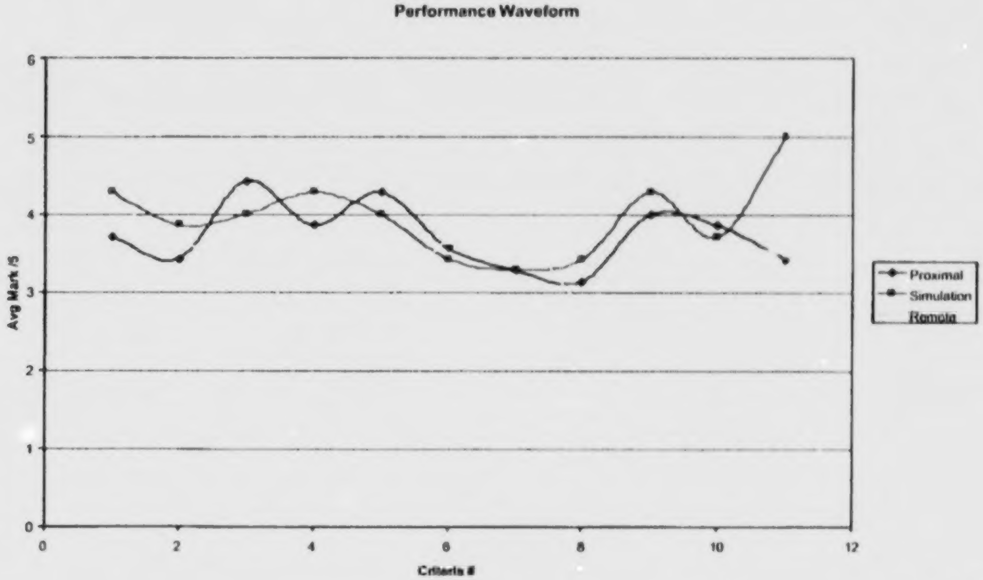

Figure 3:

Relative performance on assessment criteria

It can be seen that the Proximal approach and the Simulation approach produced similar outcomes for most criteria, but that the remote approach appears to differ substantially on some criteria. Outcomes are notably poorer on criteria 4 and 5 (the generation and evaluation of multiple solutions), and on criterion 9 (demonstration of multiple design techniques). The remote approach is stronger, however, on criterion 7 (the handling of exceptions). These results must be regarded as indicative only, because of the small class size and possible lack of uniformity of criterion skill requirements between the assignments.

Examination outcomes

The first question of the Examination was devoted to the same topics covered by the assignment work, with the question having five sub-questions each worth 8 marks. Again, all of the examinations were marked by a single marker to avoid any inter-marker deviation. The marks for each question were averaged, the mean mark for each question being as follows:

Question	Topics covered	Avg Mark (/8)
A	General / Proximal	4.11
B	Proximal	5.33
C	Proximal	5.44
D	Simulation	4.72
E	Remote	4.78

Again, the performance on the Simulation- and Remote-topic questions was similar. Performance on two of the three Proximal-topic questions was superior, but the performance on Question A was in fact considerably inferior. We suspect that lack of precision in the wording of Question A may have partially accounted for this outcome.

Journals

Students were required to keep a diary of their progress throughout the assignments in this subject, and were rewarded with bonus marks if they did so. This was intended as a tool to help with the cognitive development of students as they progressed, but most of the diaries submitted served more as a chronicle of the work that had been done. Significant also in all journals was the amount of time spent by students in completing the assignments – easily 40 hours over an eight-week period for a number of students. This represents a considerable assignment workload in a subject that has a scheduled contact of two hours per week.

Access Logs

Most of the students involved in the project chose to postpone their use of the equipment until as late as possible in the semester. Comprehensive logs of their access during the remote experiment were taken, recording each command that was sent to the system. These logs showed that the most common pattern of usage was to change the controller, run a single data capture with that controller, and then to change the controller to something different. Multiple data captures using the same controller architecture were rare.

Student Feedback / Anecdotal Observations

There was general consensus amongst the students that the project work required too much time to complete successfully. Students also expressed frustration at any technical difficulties that arose from the hardware or software not functioning as expected, although the complaints were somewhat minor when compared to those experienced by Givens and McShea.

Throughout the remote access assignment, many students displayed a desire to remain in physical proximity to the hardware. Despite having webcam feedback of the position of the table, and the output data files of their commands executing, students still felt the need to walk into the laboratory to visually inspect the hardware. This suggests that the laboratory experience provides a richer set of cues to system behaviour than is available from web-based access. Given the opportunity, students will seek access to such information. We suspect that auditory feedback would result in a worthwhile enhancement of the remote experience.

Overall, students expressed positive responses towards the introduction of the hardware into the course, and were appreciative of the opportunity to apply the theory that they had learned.

Conclusions / Further Work

This study serves as another demonstration of the feasibility of using web-based access to physical hardware for the teaching of control theory and practice at an undergraduate level, in this instance at a final-year advanced elective level. As with previous studies, students provided positive feedback about the value of such initiatives.

Further to this, the results were indicative of some differences in the learning outcomes of students exposed to three different modes of access to physical hardware. Proximal access generally lead to superior outcomes, although the differences from simulated access were small.

Learning outcomes, however, are the product of the overall learning experience, and the mode of access is just one dimension of this experience. Further trials are presently under development within the department to isolate this factor and to compare more rigorously the effects of the three access modes.

Acknowledgments
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Bibliography

B. Aktan, et al. (1996), *Distance Learning Applied to Control Engineering Laboratories*, IEEE Transactions on Education, v39, n3

D. P. Ausubel (2000), *The acquisition and retention of knowledge : a cognitive view*, Kluwer Academic Publishers

C. L. Enloe, et al. (1999), *Teleoperation in the Undergraduate Physics Laboratory - Teaching an Old Dog New Tricks*, IEEE Transactions on Education, v42, n3

N. Givens and J. McShea (2000), *Learning through Remote Practical Experiments over the Internet: a case study from teacher education*, Journal of Information Technology for Teacher Education, v9, n1

H. H. Hahn and M. W. Spong (2000), *Remote Laboratories for Control Education*, Proc. of 39th IEEE Conference on Decision and Control, Sydney

E. Lindsay, et al. (2000), *Web-based Telerobotics and Hardware-in-the-loop Simulations as Enhancements to Mechatronics Teaching*, in "Mechatronics and Machine Vision", Research Studies Press

H. Shen, et al. (1999), *Conducting Laboratory Experiment over the Internet*, IEEE Transactions on Education, v42, n3

Two approaches to enable the sharing and reuse of resources across institutions

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Over the past few years, the Scottish Higher Education Funding Council has supported a programme of pioneering projects examining staff development in the use of communication and information technology within Higher Education (http://www.scotcit.ac.uk/). Two of these projects have specifically focused on the sharing and reuse of resources, each taking a unique approach, but having the common aim of enabling institutions to adapt existing resources for use across the sector, while taking into account diverse institutional contexts and requirements (Alexander, 1999). The Scottish electronic Staff Development Library (SeSDL) created an online resources base that allows users to upload resources in granular format and to aggregate these resources to create lessons tailored to meet their own requirements. The Enabling Large Scale Implementation of Communications and Information Technology project (ELICIT) produced a series of modular courses that can be adapted to suit institutional needs.

ELICIT: Reuse and adaptation of modular courses produced by "expert" authors

Enabling Large Scale Implementation of Communications and Information Technology (ELICIT http://www.elicit.scotcit.ac.uk) was a 2 year project which aimed to address a shortage of high quality, electronic resources for staff development by developing a common core of short modules which could be adapted and reused across institutions. These resources examine underpinning, educational theories in the use of C&IT for teaching and learning and were designed for reuse in a variety of ways: within accredited courses, staff development workshops, or as online, supplementary information.

A core of modules was created, each consisting of a series of short units with resources materials. The resource materials include case studies, articles and texts, with associated tasks, which can either be linked to online discussions, or can be explored in face-to-face sessions. The modules include:

- an introduction to using and integrating C&IT in teaching, learning and assessment
- using virtual learning environments in teaching, learning and assessment
- using computer mediated conferencing in teaching, learning and assessment
- developing tutor skills for computer mediated conferencing
- developing computer aided assessment
- implementing computer aided assessment.

These modules are freely available for staff developers within the UK's Higher and Further Education sectors and can be downloaded from the project website in HTML or MS Word, edited to suit individual institutional require ments and implemented within a Virtual Learning Environment (Littlejohn et al, 2001).

SeSDL - Constructing courses from granular resources

The Scottish electronic Staff Development Library project (SeSDL http://www.sesdl..scotcit.ac.uk) takes a radically different approach. SeSDL developed an online resources base, which facilitates the retrieval and reuse of granular staff development materials focused on the use of C&IT for teaching and learning.

SeSDL provides users with guidelines on how to create granular, educational resources, often referred to as learning objects, and then allows them to upload these resources to the electronic library. All resources submitted to the library are described using IMS metadata and classified using an educational taxonomy (Campbell, Littlejohn & Duncan, 2001). Library users can search the resource base for other relevant resources using an advanced or a simple search tool, or a browse tree, which corresponds to the educational taxonomy classifications (see diagram1). Once users have located relevant resources these granules can be saved to a personal folder where they can be aggregated using a lesson builder tool to form lessons tailored to meet the users institutional requirements (see diagram 2). These lessons can be further customised by the addition of a range of interface styles. Finally, the lessons can be downloaded in the form of IMS content packages, which can be incorporated into the users chosen virtual learning environment, or alternatively they can be resubmitted to the electronic library where they can be re-used by others.

Despite being promoted primarily as a resource for Scottish HE staff developers, the Scottish electric Staff Development Library project has generated a great deal of interest both nationally and internationally. However, although an initial consultancy procedure indicated overwhelming support for the project, the staff development community has shown some reluctance in submitting individually authored resources to the electronic library. It seems that, while the staff development community may be willing to reuse and share resources produced by projects or expert authors, they seem less willing to share their own materials.

Institutional adoption of these approaches

The reuse and adaptation of modular courses, such as the ELICIT approach, is fairly traditional. It seems as if careful consideration of key design features, such as the development of tasks which are readily adapted for institutional use, may reduce the 'not invented here' syndrome and improve uptake (Haywood et al, 1999; Lee et al, 1999). In comparison, the SeSDL approach, the submission of existing resources by authors for reuse in granular format, is a relatively new method. It too appears to eliminate the 'not invented her syndrome', while reducing the problem of duplication of materials. However, this approach may be impeded by the reticence of staff to contribute resources.

Therefore, whilst the submission of resources by authors in granular format is a radical new approach to institutional sharing and reuse materials, present institutional culture and practice may need to evolve to encourage the adoption of this approach. The authors plan further research to examine factors, which will support the adoptionof multiple approaches to sharing, and reuse of learning resources.

References

Alexander, W. (1999), Talisman review of staff development courses & materials for ICT in teaching, learning & assessment http://www.talisman.hw.ac.uk/CITreview/cit_index.html

Campbell, L.M., Littlejohn, A.H. and Duncan, C, (2001) Share and share alike: Encouraging the re-use of academic resources through the Scottish electronic Staff Development Library, Association of Learning Technologies Journal (ALT-J), 9.2, 28-38

Haywood, G., Anderson, C., Day, K. and, MacLeod, H. (1999) Use of TLTP Materials in UK Higher Education: a HEFCE-commissioned study http://www.flp.ed.ac.uk/LTRG/TLTP.html

Lee, S.D., Armitage, S., Groves, P., and Stephens, C. (1999) Online Teaching: Tools & Projects, Report commissioned by the JISC Technology Applications Programme, Chapter6. http://info.ox.ac.uk/jtap/reports/teaching/chapter6.html

Littlejohn, A.H., Peacock, S., McAteer, E., Juwah,C., Bates, D., Bruce, S. (2001) ELICIT: Preparing staff for the changing learning environment, Association of Learning Technologies Conference, ALTC2001, Edinburgh

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WebQuest: an Innovative Way of Applying Information Resources to Furnish Performance Tasks

I. Introduction:

WebQuests are designed to offer interdisciplinary opportunities that enhance student skills of learning by performing tasks, and encourage collegiality and ability of information processing in the K-12 classroom. Through a multimedia presentation, the systems and implementation of WebQuest will be shown. Pros and cons of WebQuest on both the learners and teachers will be discussed. Participants will be facilitated with sites for the research supporting WebQuest in addition to sites on how to create WebQuest.

II. Definition by Dr. Bernard Dodge, the father of WebQuest:

A WebQuest is an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the Internet, optionally supplemented with videoconferencing. (Dodge, 1995)

III. Two Systems of WebQuest: (as Appendix I)

IV. Bibliography

Abbey, B. ed. (2000). Instructional and Cognitive Impacts of Web-based Education. Hershey, PA: Idea Group Pub.

Bernie Dodge, the Father of WebQuest. http://WebQuest.sdsu.edu/materials.htm

Cowles, S. (1997). Teaching and Learning with Internet-based Resources: A Set of Lesson Plans and Activities. Washington, D. C. National Institute of Literacy.

Dodge, B. (2001).Focus: Five Rules for Writing a Great WebQuest. ISTE-Learning & Leading with Technology. Vol.28. No.8. Available: http://www.iste.org/L&L/archive/vol28/no8/featuredarticle/dodge/index.html

Dodge, B. Dodge, B. J. (2000, June). Thinking visually with WebQuests [Online]. Presentation at the National Educational Computing Conference, Atlanta, GA. Available: http://edWeb.sdsu.edu/WebQuest/tv/

Felix, K. (2002). NetWatch. Multimedia Schools. January/February, 2002. Available: http://www.infotoday.com/MMSchools/jan02/net0102.htm

Khan, B. H. ed.(1997). Web-based Instruction. Englewood Cliffs, NJ: Educational Technology Publications.

March, T. (2001). What's on the Web: Sorting Strands of the World Wide Web for Educators. Available: http://www.ozline.com/learning/webtypes.html

March, T. (2001). Working the Web for Education: Theory and Practice on Integrating the Web for Learning. Available: http://www.ozline.com/learning/theory.html

March, T. (2000). The 3 R's of WebQuests, Let's keep them Real, Rich, and Relevant. Multimedia Schools, November/December 2000. Available: http://www.infotoday.com/MMSchools/nov00/march.htm

March, T. (1998). Thinking through Linking: Using the World Wide Web for Learning. Available: http://www.ozline.com/learning/thinking.html

March, T. (1999). The Ten Stages to Web-Use Nirvana. Available: http://www.ozline.com/learning/10stages.html

McCormack, C. (1998). Building a Web-based Education System. New York: Wiley Computer Pub.

Morrison, G.R., Lowther, D. L. & Demeulle, L. (2000). Integrating Computer Technology into the Classroom. Upper Saddle River, NJ: Prentice Hall

Munoz, J. M. (2001). A Quest for Effective Internet Practices. Available: http://www.teacheruniverse.com/profdev/features/WebQuest.htm

NIHS WebQuest Resources http://www.iss.k12.nc.us/schools/nihs/webq_res.htm

Schrock, K. (2002). Kathy Schrock's Guide for Educators. Available: http://school.discovery.com/schrockguide/WebQuest/WebQuest.html

Starr, L. (2000). Meet Bernie Dodge -- the Frank Lloyd Wright of Learning Environments! Available: http://www.education-world.com/a_tech/tech020.shtml

Starr, L. (2000). Creating a WebQuest: It's Easier than You Think. Available: http://www.education-world.com/a_tech/tech011.shtml

Tom March: WebQuest & Web-based education http://www.ozline.com/learning/index.htm

Watson, K.L. (1999). WebQuests in the Middle School Curriculum: Promoting Technological Literacy in the Classroom. Meridian: A Middle School Computer Technologies Journal. Volume 2, Issue 2, July 1999. Available: http://www.ncsu.edu/meridian/jul99/WebQuest/index.html

Yoder, M.B. (1999). The Student WebQuest. ISTE-Learning & Leading with Technology, Vol. 26 No.7. Available: http://www.iste.org/L&L/archive/vol26/no7/features/yoder/

V. Examples of WebQuest:

1. WebQuest on Plato, Confucius & Citizenship, by Juhong Liu (Christie), (2000). Available: http://students.etsu.edu/zjcl15/WebQuest/confu-plato/index.html

2. WebQuest World of Mrs. Jaskoski. Available: http://volweb.utk.edu/Schools/sullivan/colonial/quest.htm

3. Electricity WebQuest by Mrs. Jaskoski and Mr. Stephens. Available: http://students.etsu.edu/ztjs10/WebQuest.htm

4. WebQuest on Vincent van Gogh, by Juhong Liu (Christie), (2002). : http://students.etsu.edu/zjcl15/webquest//vangogh/vangoghwebquest.htm

Appendix I: Two Systems of WebQuest:

	Bernard Dodge	Tom March
Theory	**Some Thoughts about WebQuests** http://edweb.sdsu.edu/courses/edtec596/about_webquests.html **WebQuest: A Strategy for Scaffolding Higher Level Learning** http://edweb.sdsu.edu/webquest/necc98.htm	**Why WebQuest: An Introduction** http://www.ozline.com/webquests/intro.html **The Ten Stage to Web Use Nirvana** http://www.ozline.com/learning/10stages.html **Working with the Web for Education** http://www.ozline.com/learning/theory.html
Structure	**Building Blocks of a WebQuest** http://edweb.sdsu.edu/people/bdodge/webquest/BuildingBlocks.html	**Pre-writing your WebQuest** http://www.ozline.com/webquests/prewrite.html
Process & Taskonomy	**Chart of design process** http://edweb.sdsu.edu/webquest/Process/WebQuestDesignProcess.html **Chart of taskonomy** http://projects.edtech.sandi.net/staffdev/tpss99/tasksimap/	**Chart of design process** http://www.ozline.com/webquests/design.html **Uncovering the question/task** http://www.ozline.com/webquests/question.html
Process	**Process Checklist**	**Design for Success (Designer's**

control	http://projects.edtech.sandi.net/staffdev/tpss99/processchecker.html	**Checklist)** http://www.ozline.com/webquests/checklist.html
Rubric	**A Rubric for Evaluating WebQuest** http://edweb.sdsu.edu/webquest/webquestrubric.html	**Assessing WebQuest** http://www.ozline.com/webquests/rubric.html
Template	**Webquest Templates** http://edweb.sdsu.edu/webquest/LessonTemplate.html	**WebQuest Template** http://www.ozline.com/templates/webquest.html
WebQuest collection	**Matrix of WebQuest Examples** http://webquest.sdsu.edu/matrix.html **WebQuest Collection** http://edweb.sdsu.edu/webquest/webquest_collections.htm	**WebQuests and other Student Activities** http://www.ozline.com/learning/index.htm **About oz-WebQuests** http://rite.ed.qut.edu.au/oz-teachernet/projects/webquests/index.html **oz-WebQuests search engine** http://www.pa.ash.org.au/rite/projects/webquests/form1/engine.asp

Designing Interactive Multimedia Learning Environments to Support Cognitive Skills Development

Min Liu
University of Texas at Austin

Most of us will probably agree that developing cognitive skills is an important goal for education, and is of particular significance for life long learners. It is an area that requires continuous attention and further research. In this speech, I will examine the use of interactive multimedia technology to support cognitive skills development. Specifically, I'm interested in examining how to design interactive multimedia learning environments to provide necessary support for developing higher level cognitive skills. There are many different ways to create interactive multimedia learning environments. Here I will look at two approaches based upon my research and development experience:

1. Engaging learners as multimedia designers using a project-based learning approach. In this environment, students at high, middle, and elementary schools take on the role of a multimedia designer, learn state-of-art multimedia tools, and work in a group to create a multimedia product for others to use. Through the process, they are to acquire design skills and resource management skills as needed in producing a multimedia product.

2. Enhancing problem solving skills through a problem-based multimedia learning environment for middle school science, Alien Rescue. In this environment, sixth graders play the role of young scientists, and are engaged in scientific investigations aimed at finding solutions to complex and meaningful problems. Alien Rescue provides a rich set of cognitive tools for successful use of PBL in 6th-grade classrooms.

I will discuss the design, implementation, and research of each environment. I will share the factors contributed to successful implementations and challenges of designing such multimedia learning environments; and will explain the cognitive support built in each environment. After examining these two approaches and reflecting on our experiences, I believe the following factors are of critical consideration in designing such environments:

- The design of a multimedia learning environment must be solidly grounded in educational theories and research practice.
- Cognitive tools should be built in the environment and they must be included for a purpose.
- High-end cutting edge software tools should be used to create the environment.
- Interactions among the learners, the environment, and the teacher/facilitator must be encouraged and promoted for the environment to be effective.

By sharing our R & D experiences, and learning the audience's experiences (hopefully through the question-and-answer time), I hope we, the multimedia community, will continue to have our dialogs and search for new ways to design effective multimedia learning environments to support cognitive skills development for learners at all ages.

The Challenge of Being an Instructional Designer for New Media Development: A View From the Practitioners

Min Liu
Scott Gibby
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&
Elaine Demps

The University of Texas at Austin

THEORETICAL PERSPECTIVE

The rapid changes in the field of technology are redefining the process of developing technology-enhanced educational materials as well as the roles of developers involved in the process. As educators whose responsibility it is to prepare future designers and developers using new media, and as students who are about to enter the field of instructional design, we must continually update our knowledge and be aware of these changes. In our previous research (Liu, Jones & Hemstreet, 1998), we looked at the multimedia design process, and the different roles involved in the process from a practitioner's perspective. In this study, we chose to focus on the role of an instructional designer, one of the key players in new media development. We looked again to the practitioners in the field to find out how their roles are defined, how they handle their job challenges, and how they adapt to the fast changes of technology and market demands.

Instructional design refers to "the systematic process of translating principles of learning and instruction into plans for instructional materials and activities" (Smith & Ragan, 1993, p. 2). An instructional designer's task is to plan the instruction so that the student can use cognitive strategies to learn the material actively (West, Farmer, & Wolff, 1991). The term "instructional designer" is less familiar outside the field of instructional technology. Instead, one hears job titles such as industrial designer, curriculum developer, learning specialist, instructional technologist, or sometimes just project manager. Yet, people in these titles are often carrying the responsibilities of an instructional designer, especially if they are involved in developing new media-based instructional products. For some people, "instructional designer" does not say enough; "'multimedia producer,' 'webmaster,' 'developer of online learning' –these are much more muscular phrases"(Ganzel, 1997, ¶ 14).

The reality that an instructional designer might be called upon to get involved in different phases of producing an educational product could spark this confusion. As such, the instructional designer must understand the needs and wants of the client, the objective and the audience of the finished project, the capabilities of the programmer, graphic artist, and available tools; and must have design and project management skills (Liu, Jones, & Hemstreet, 1998). Job titles other than instructional designer reflect recent technological changes and new trends for creating instructional materials. If a person performing the role of an instructional designer is developing online courses, he or she may be classified as an online learning developer. Regardless of the job title, the role of an instructional designer "depends on the project, the composition of the team, and the skills of the team members. It's kind of a virtual job title for a very real job"(Jopson & Smith, 1997, p. 3). Since the role of an instructional designer has outgrown traditional textbook definitions, the perspectives of practitioners in the field will provide the information needed to accurately assess the evolving responsibilities of an increasingly popular position. Therefore, we are turning to the practitioners to provide this information for students who want to enter the field.

PURPOSE OF THE STUDY

The purpose of this study is to learn from the practitioners the roles and responsibilities of an instructional designer in developing new media enhanced instructional materials. We are particularly interested in the challenges designers are facing and how they handle these challenges. We hope the findings will provide useful and practical information to students who are about to take on the responsibilities of an instructional designer. Our guiding research questions were:

1. What are instructional designers' responsibilities in the field of new media?
2. What challenges do instructional designers face?
3. How do instructional designers meet these challenges?
4. What skills are important for being a good instructional designer?

METHOD

About Interviewees and Procedure

To answer the research questions proposed, we interviewed instructional designers working at various multimedia companies in Austin, Texas. Using the multimedia directory compiled by the Texas Governor's Office of Music, Film, Television, and Multimedia Industries, we identified a list of multimedia companies in the Austin area. We selected companies that produce multimedia educational or training programs, and excluded one-person companies. Since we were interested in the role of an instructional designer, we limited the selection of interview subjects to those who shoulder the responsibilities of instructional designers. A total of eleven interviews were conducted with these individuals. These interviews ranged from 45 minutes to two hours.

All eleven interviewees were actively engaged in instructional design at the time of the interviews. Eight were female and three were male. One designer had a doctoral degree. Eight designers had a master's degree and two had a bachelor degree. Some had as many as 20 years of experience in designing and developing multimedia products while others had as few as just one year. Some designers worked for large technology companies while others worked for small multimedia shops. It was our hope that by looking at the designers working in different settings, we could gain a good understanding of the common challenges they face.

The Development of the Interview Questions

The development of the interview questions began with a survey to the graduate students enrolling in the Instructional Technology Program at the University of Texas - Austin. The survey's purpose was to identify the information and tips that future instructional designers wanted from the practitioners. We also modified and selected relevant interview questions from our previous research (Liu, Jones, & Hemstreet, 1998), which examined the multimedia design and development process from the practitioners' perspective. Combining the two sources of questions, we created and refined the list of interview questions for this study and ensured they would address the four research questions. A total of 141 interview questions were used. Part I of the questions focused on the role of an instructional designers (N=70), which was our primary focus. Part II of the questions (N=71) were used when an instructional designer also performed another role, which is often the case in the field. The questions on instructional designers addressed the following ten aspects: (1) background information, (2) roles and responsibilities, (3) design and production process, (4) interface, instructional, and interaction designs, (5) formative evaluation, (6) teamwork, (7) client, (8) prototype development, (9) personal, and (10) evaluation of instructional designers. Sample questions included: "What are your roles and main duties as an instructional designer?" "What are some major obstacles you face in doing your job?" and "What aspects of your job do you like the most?"

Data Analysis

The analysis of the data followed the guidelines by Miles and Huberman (1994). The interviews were first transcribed, then chunked, and coded. Two researchers independently coded the data. Codes were generated directly from the data through multiple passes of data examination. Two researchers then checked each other's coding and resolved any disagreement in the coding. A third researcher went through all the data and coding for any gaps, missing codes or inconsistency. During this process of checking and rechecking, the codes were refined, revised, and newly developed as emerging themes were added. Patterns from the data were extracted, and the relationships between the coded segments were compared and contrasted. The data were then sorted into categories and sub-categories according to their common themes and shared relationships.

RESULTS AND DISCUSSION

Role and Responsibilities of an Instructional Designer

Responsibilities. Our previous research, examining the multimedia design and development process from the practitioners' perspective, showed that the development process consisted of six main phases: (a) funding, (b) planning, (c) designing, (d) producing, (e) testing, and (f) marketing (Liu, Jones, & Hemstreet, 1998). The findings of our current study indicated that in this entire process of shaping an idea into a finished product, an instructional designer is heavily involved in the phases of planning and designing. They are also involved in the phases of producing and testing. Sometimes designers may also take on the responsibility of writing proposals and seeking funding. There are four major responsibilities an instructional designer performs: (1) working with a client; (2) working with a subject matter expert (SME); (3) working on the design; and (4) working with other members in a team. An instructional designer is often involved in the project from the beginning. He or she interacts with the client to understand what the client wants and works with the SMEs to understand the subject matter of the materials to develop.

Sometimes an instructional designer, working in another role such as a project manager, helps to secure a project. "Generally, I'll get the first contact with the potential client, so there's pre-work involved and just talking to them, finding out what they want, answering their questions, you know, up to the point where we actually have a proposal. 'This is what we propose to do for you' and they say 'yes.'" With a good understanding of the client's needs and the content, an instructional designer will develop a blueprint to be executed by other team members, such as programmers, artists, and video/audio specialists. Such a blueprint comes in the form of a design document which specifies the breakdown of the content, what will appear on each screen, and what media will be used. In short, the role of an instructional designer is to translate the client's needs into a plan that will be used to produce a product which meets the client's needs.

A Typical Day. What a typical day is like for an instructional designer working in the field of new media? We asked the interview subjects this question. Although it is clear that the days could vary from one project to another, some "typical" tasks they do in a day include: checking emails, having meetings, and working at a computer using some software. Here are a few responses to this question that capture what a day is like:

> First thing I do in the morning is check my email. Then I'll work on a project or start a project or maybe attend a meeting. Around [the] midday, [the] changes that I've made I either upload to the servers or I update the system that I'm working on. In the afternoon it's basic development. I'll do some research on what I'm doing. I'll try to collect documents, maybe read some material that's necessary for me to do my job, meet with people, things like that.

> First thing I do is check email before anything else, and usually voice mail at the same time. I might have some meetings based on that. Somebody's researching a project and I've worked on it so I've got to get them some information. Maybe there's a client meeting. Maybe I'm working on the proposal or a piece of the design.

Work Environment. "Fast-paced," "collaborative," "casual," and "flexible" are the adjectives the practitioners used to describe their work environments. Most designers are young, in their 20's and 30's. Their work is mostly driven by the projects and is fast-paced. When they are working on a project and facing a deadline, they typically work long hours as much as 60 per week or more. A designer must be a team player and a true collaborator, as these practitioners emphasized. A designer needs to be able to work with other designers and team members such as programmers, artists, and video/audio specialists. The work atmosphere is casual in general; few wear suits or ties. Some work in a large, open, studio-like space with music playing in the background. Others are allowed to play games as part of their workday to relax. Some work in physical offices while others work in a virtual office meeting face-to-face only when needed.

Job Satisfaction. What is the reward for being an instructional designer? For some, job satisfaction comes from the interaction with clients. "I love the clients, actually. I mean they cause the most frustrations but I love them." For some, it is the challenge of learning new tools and keeping up with the rapid changes. Others found it rewarding to be in a position where they had an opportunity to deal with multiple aspects of the development process. For many, however, their greatest gratification is in their ability to be creative--to develop a finished educational product from just an idea. One stated, "You have to be creative every single time to give the clients [what they're looking for]. That's a good spot to be in."

Approaches in Design. Although designers follow different models in their work, many emphasized the importance of "learning by doing," "providing experience," and "learning from mistakes" in approaching design. Some employ the techniques of simulations, scenarios, and storytelling, while others create games and puzzles. Engaging a learner through various interaction designs is emphasized. "[We] focus on providing software that will give the adults an opportunity to interact, where they're not just reading about it and clicking on the next button."

Software Tools used. Students in instructional technology often asked "do we need to know how to use software tools? If we do, what tools do we need to learn?" Our findings showed that it is not only necessary to have some hands-on experience with popular software tools, but it is also important to be proficient in a few. Although instructional designers use simple software such as *Microsoft Word* to write design documents, it is clear some designers, especially those who graduated more recently, are also able to use more sophisticated tools such as *Macromedia Director, Flash, Adobe Photoshop, Premiere, Java*, and *HTML*. Some pointed out that knowledge of these kinds of tools can help them quickly put together a prototype to demonstrate design ideas to the client. "We have at least one designer who is very well versed in *Flash*, and no matter what she does, she's going to put it together in *Flash*. She puts together a model of instructional design in *Flash*. I tend to be a *Director* guy. If I'm trying to say this is what I want to be animated, I'll slap it together....I can show that to an artist or show it to an audience member or learner and say do you understand this, does this get the message across?" Others said that such knowledge enables the designers to participate in other tasks such as programming or creating graphics when needed. Being flexible and versatile proves very valuable in a small company when one person often wears multiple hats (Liu, Jones, & Hemstreet, 1998).

Challenges of Being an Instructional Designer

Based upon the interviews, it appears that three of the biggest challenges confronting a new media designer arise in dealing with clients, balancing multiple roles, and adapting to rapid technological changes.

Working with a Client. An important task of being an instructional designer is to determine what clients really need, since they may not be familiar with the design process itself. Some clients need assistance in producing a clear definition of the problem they are trying to solve. Other clients may not be aware of the steps and tasks that a designer takes to get to the end product.

Some clients expect the designer to start from scratch and create a polished product within a short time, without providing necessary input. "One of the biggest challenges is… that the people… only want to see the end product. And they expect you to develop something out of nothing. They sometimes don't have the understanding of the development time necessary…" Being able to get feedback from the client and the SMEs about the product throughout the design process is a skill an instructional designer must acquire. Many clients new to the field of new media have an oversimplified view of the design process necessary to tailor a traditional product into a new media concept.

Many of the designers we interviewed keenly felt the responsibility of walking the clients through the process and teaching them along the way. "You have to continue to educate others in what's involved in doing this job," noted one. This education includes explaining the design and production process, helping the clients define the scope of the problem, learning goals, audience, and outcomes. A designer should be able to ask a lot of questions. In addition, a designer should be aware that the client may not be familiar with the industry jargon. Designers should explain the terminology to the client, or simply use everyday language. When instructional designers speak of objectives, goals, entry-level skills and the like, clients often need to hear these terms clarified. As one designer stated, "There's some kind of bridge building time where you figure out what are you really saying."

Another important aspect of this educational process is to help the client make the right design decisions depending on a project's needs. Clients sometimes do not understand the difference between an instructional/training module and merely information presentation. They may want to use multimedia when there is no need to do so. A designer should be able to discuss knowledgeably the possibilities of various technologies and help the client make the appropriate choice. "Sometimes my process in working with a client is to say, I don't think you really need training. I think you're just talking about documentation here." A client also needs to be informed that design decisions will have an impact on the production. For example, a decision of what media to use in the product will affect the cost, and a change in such a decision later in the process may increase the production cost.

When resources and budget are limited, a designer should help the client prioritize what is most important for the instructional value of the product and not be constrained by what media to use. Although the clients usually have the final say in any design decisions as they pay for the development and often know the market better, the designers should offer their "best judgment" based on their expertise, and make sure the clients understand their position, especially in the case of disagreement.

Balancing Multiple Roles. Although many textbooks on instructional design often separate the roles of instructional designer and project manager, the practical experience of the interview participants showed that seldom is one's role limited to that of a designer. About half of the participants were also project managers or performed duties normally associated with that position in addition to being an instructional designer. One stated, "my heaviest responsibility is in … getting teams up and running, …." Another said, "…depending on what the project is, how big it is, I'll start assembling the people who I want to work on that one…But I'll continue to be the primary client contact as far as letting them know how it's going."

As part of a team, designers are often called upon to review others' work, find clients, write scripts for video and audio clips, write programming codes, write technical documents, create animation and graphics, work on character development, and train others. That is, an instructional designer in new media often performs multiple roles depending on a project's needs. Many smaller companies require designers to have different skills to maintain efficiency and low cost of operation. Some designers feel it is important to "be able" to do everything, even if they do not end up doing it all. It is interesting to note that within all of these responsibilities lies a main objective

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that may tie all the roles together. As one participant put it, "I'm trying to help people understand where we are now, and where we need to go, and help arrive at a formula for getting there."

Adapting Oneself to Technological Changes. Rapid technological advances continuously bring changes and new requirements to the field of instructional design. "[Instructional] design is going to evolve as technological capability evolves." One designer commented, "designers [in her company] will need to be extremely proficient in *Adobe Acrobat*, some *HTML* and [*Microsoft*] *Access*. We will need to understand technology on a higher level because our business is changing and expanding so rapidly." A designer must not only be able to meet multiple responsibilities and perform different roles in a team, but also keep abreast of these technological changes. He or she must stay very flexible in order to adapt to changes quickly and continuously gain new skills to be competitive. A good designer is a life long learner, who sees the changes, and is willing to adjust herself to the changes so as to produce better products for the audience. The participants mentioned the challenges they faced daily in producing educational products using new technological tools, and the need to stay on top of the field. Their education and experience prepared them to some extent. However, as they emphasized, they must keep learning to stay current. "Really in keeping up with the field is just hard work...You just gotta read and read and read, and you have to care about it."

Meeting the Challenges

Staying on Top of the Field. An important question to these designers is "How do you address the challenges and stay current?" Their formal education in instructional design equipped them with some needed knowledge with hands-on courses being particularly valuable. Their varied backgrounds in graphic art, video production, programming, and teaching helped lay down a solid foundation for being a good designer. Some pointed out that the experience gained from working on numerous projects, and performing different roles in a project helped them learn to be flexible and adapt quickly to new situations.

While on the job, these practitioners try to keep up with changes by taking additional college classes, attending conferences and training, having informal meetings within their company where people share what they have learned, studying products from their competitors, maintaining university connections and involvement, and even learning from the clients.

Attributes of a Good Instructional Designer. The practitioners discussed different qualities a designer should possess. Of those mentioned attributes, there is a consensus that a good designer should be (1) a quick study who is willing to learn new things; (2) a team player who can work with others well; (3) attentive to details; and (4) a good communicator both orally and in writing. Apart from these, the practitioners mentioned they would also look for people who have experience and are self reliant, resourceful problem-solvers. Finally, they want to hire individuals who not only "know what they're talking about," but also are "passionate about what they do."

Advice to Newcomers. Given the challenges of being an instructional designer, what can students do to prepare themselves for the field of instructional design? Besides taking classes and getting a degree, the designers offered the following practical advice:

- Seek out to gain a variety of experiences.
- Be open to new ideas and familiar with the capabilities of technological tools.
- Learn to write well.
- Enjoy what you do.

CONCLUSION

It is clear that an instructional designer plays a critical role in developing new media-based instructional products. In support of other research (International Board, 1998; Le Maistre, 1998;

Liang, 1999; Liu, Jones, & Hemstreet, 1998; Moallem, 1998), the findings of this study identified four essential competencies for being an instructional designer in new media development:

1. Communication: A good designer should have excellent "people" skills and be able to communicate effectively with clients, SMEs, and other team members both verbally and in writing.
2. Instructional design: A good designer should be well-versed in several instructional design models and strategies from which to choose a case-specific process. He or she should keep up with new education or training theories and research to apply them in the product development.
3. Problem-solving/decision making: The process of developing a quality new media product is full of challenges along the way. A good designer should be able to perform multiple responsibilities, step into new roles when necessary, and overcome obstacles under a deadline. A good designer is a problem-solver.
4. Knowledge of technology tools: A good instructional designer should have a basic knowledge of important software tools used in the field and be aware of newly advanced tools as they become available.

The job market for instructional designers will continue to grow and expand, and with it, the definition of an instructional designer will evolve at the same pace that the technology changes. Since the role of an instructional designer is affected by the possibilities that new technologies create daily and how technological tools aid communication, so shall each instructional designer contribute to the task of defining their profession. Therefore, it was to these practicing instructional designers that this study turned in order to understand the evolving responsibilities, expectations, and challenges of today's instructional designers.

REFERENCES

Ganzel, R. (1997, November). Winner take all. *Training*. *34*(11), 40-54, Retrieved March 29, 2001, from http://www.texshare.edu/ovidweb/.

International Board of Standards for Training, Performance, and Instruction. (1998). Instructional Design Competencies. Retrieved July 10, 2001, from http://www.ibstpi.org/98comp.html.

Jopson, J. & Smith, H. (1997, June). A job by any other name. *Training & Development*. *51*(6), 28-31.

Le Maistre, C. (1998). What is an expert instructional designer? Evidence of expert performance during formative evaluation. *Education Technology Research and Development*. *46*(3), 21-36.

Liang, C.C. (1999, December). Benchmarking competent instructional media designers in the corporate world. *Educational Media International*. *36*(4), 317-320.

Liu, M., Jones, C. & Hemstreet, S. (1998). Interactive multimedia design and production processes. *Journal of Research on Computing in Education*, *30*(3), 254-279.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Smith, P. L. & Ragan, T. J. (1993). *Instructional Design*. NJ: Prentice-Hall, Inc.

West, C. K., Farmer, J. A., & Wolff, P. M. (1991). *Instructional Design Implications from Cognitive Science*. MA: Allyn and Bacon.

AWS: Bridging the gap between awareness and proactive Tutorware

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Abstract: The design and implementation of advanced tutorware applications is a complex issue requiring detailed information about the studied system, and a solid knowledge base enabling suitable tutorship actions. In this context, existing learning systems do not provide suitable hooks for studying and reacting to information produced in the environment. This restrains research work in the area and produces hard-coded proprietary applications involving raw log analysis.

Our approach is to create a distributed awareness infrastructure providing standard hooks for awareness actuators and tutorware agents reacting to events in the learning environment. We cover different steps in the awareness life cycle: event persistence, information filters, data analysis, knowledge base, and tutorware Bots. In this article we present the overall architecture, outlining the services offered by the platform and explain them in an example that provides intelligent knowledge sequencing in course navigation.

Introduction

The impact of computers and network technologies upon the educational process has been considerable. The possibilities of this new medium are open-ended and richer interactive scenarios have emerged under the umbrella of distance learning environments. In this context, traditional Teacher centred scenarios has been easily mapped to a computer medium in web based learning systems. The traditional lecture/textbook/exam scenario has been broadly implemented in learning environments using Audio or Video broadcast lectures, web contents, and computer evaluation tools.

Whereas traditional approaches have been widely adopted; richer interactive scenarios involving group-centered design and collaborative learning are also being supported and thus benefits from the communication possibilities of network computing. All these learning scenarios have created a fruitful arena for multi-disciplinary research. Nevertheless, proprietary technologies and systems have precluded interoperability between different environments. This has provoked proprietary non-realistic research efforts that suffer the lack of a common technology base for contrasting and comparing results.

Fortunately, standardisation efforts are creating open specifications that set the base for future learning environments. In this line, standardisation efforts have succeed in establishing standards for indexing and packaging contents (LOM and IMS content packaging), and also for defining evaluation tools (QTI). Unfortunately, advanced topics like system monitoring, tutoring systems, or collaborative learning are beyond the scope of existing standard specifications.

We aim to create a generic monitoring awareness service that considerably facilitates data acquisition in distributed learning environments. The system also provides standard hooks for creating filter agents and information bots getting information from the information bus and reacting in different ways according to their task. The system is based on open technologies and provides standard hooks for obtaining and reacting to information in the environment. Although we do not aim to create a standard specification, the overall model could be mapped to create a standard distributed awareness service. The system is constructed on top of available free middleware and is publicly available as an open source project.

As a proof of concept implementation, we have created a prototype intelligent tutoring system that uses the Awareness infrastructure to obtain information from the system and react accordingly to events produced in the environment using tutorware bots. In this paper, we present AWS: a generic distributed awareness service that aims to provide a common base for monitoring applications and proactive applications and agents getting information from a common bus. In section 2, we define the services provided by the Awareness infrastructure; in section 3 we explain a system that benefits from the Awareness Service: a prototype intelligent tutoring system extending standard platform hooks. In section 4, we apply the tutoring system to possible simulated scenarios. Finally, we draw interesting conclusions and future trends for the ANTS Awareness service.

ANTS AWS

The Awareness service is a server-side infrastructure supplying the required services to capture and react to information events produced in a distributed learning environment. ANTS AWS is a key component of the ANTS CSCL framework (Garcia, 2001) and thus benefits from applications and components developed for the ANTS System. AWS is however application independent and can thus work with any learning environment.

Based on existing CSCW Awareness systems (Prinz, 1999), AWS include an event repository, a notification service, and an infrastructure to filter or get information from events in the distributed bus. Every application in the monitored system should trigger events to the Information bus (Notification system) following some standardised notation. In an ideal scenario, all these event fields should be standardised by an international committee. This would imply that all chat tools, all question tools, or all content navigation tools should trigger events in a specified compatible format. Monitoring applications could thus directly listen to the information bus and know what is happening in any learning environment.

An initial attempt to achieve such standardisation was accomplished by the initial IMS specification and prototypes (Instructional Management Systems). IMS proposed to use the CORBA Notification system, and defined standard programmatic hooks (Event Agent) for triggering events to IMS groups. Furthermore, it also proposed an initial draft for defining field notation for events thrown by learning tools. Unfortunately, these standardisation efforts did not succeed and IMS spent more efforts in other specifications like LOM, QTI, or content packaging. Due to these lack of standard initiatives, our approach aims to be open and flexible. We do not impose any special notation but require that every application must provide an XML file containing event information about triggered events to the bus.

AWS Services

The overall system is based on *sensors/mediator/actuators*. The mediator is the central point of the server-side awareness system and is responsible of binding sensors and actuators. We consider two kind of sensors: event sensors and time sensors. Event sensors are activated in response to application events produced in the information bus. An event sensor is created using a subscription following the constraint filter language available in the Notification system. Time sensors are activated by the ANTS time scheduler; we can create a time sensor for a specified date "Sat Jun 23 18:31:06 CEST 2001" or even set repetitive dates "all mondays at 16:00". The time scheduler notifies the awareness service when a time sensor has been activated.

Actuators represent applications that must be triggered in response to AWS sensors. We provide a set of possible actuators including: Persistent actuator (database), mail actuator, Bot actuator, EJB actuator, CGI Actuator, XMLRPC Actuator and Event Actuator. Nevertheless, the system aims to be extensible and it is straightforward to create new actuators.

In a possible scenario, we could create a subscription telling that we are interested in events produced by the user called "pedro" (event sensor) and we want to make them persistent (actuator). This would log each event coming from user Pedro occurred in the environment. We could also create our own infoBots that would react to events specified by our subscription.

The most important aspect of the AWS is its extensibility; its set of actuators enables us to create different monitoring applications over the information bus. As we will see, the system is a powerful alert tool and establishes the base for filter agents and information bots getting information from the bus and reacting in different ways according to their task.

From awareness to tutorware

As explained before, the ANTS AWS infrastructure supplies the required services to create and use software actuators reacting to events produced in the information bus. In this section, we explain how we have extended the AWS system in order to create a prototype tutorware system. The knowledge of what is happening in a running environment is a hot issue that enables users to interpret the context of their own activities. Being aware of user and activity events, is the base to perform proactive reactions in order to improve the existing scenario. Awareness information thus represents the required feedback that facilitates the iterative incremental process of refining a running scenario. Nevertheless, raw data stored as event logs or in a relational database is useless as is; it is necessary to extract relevant knowledge in order to understand what is really important and what is not.

Intelligent Tutoring systems (ITS) represent a challenging problem involving a knowledge-intensive process that requires a significant amount of engineering to encode knowledge into a usable form. This process can be quite complex, expensive, and time-consuming. In fact, the knowledge acquisition bottleneck is one of the major challenges for real-world AI systems like ITS (Wenger, 1987).

We believe that our overall awareness model and distributed services can be used to smooth and alleviate the knowledge acquisition bottleneck in many learning environments. Furthermore, we have create a prototype tutorware system extending AWS services that demonstrates our overall approach.

Intelligent Tutoring Systems

Whereas "intelligent" tutors may be far to be achieved, machine-learning techniques can be applied as a useful tool for facilitating the knowledge acquisition task to educational practitioners. We find essential the combination of a domain expert and machine learning algorithms to create useful ITS systems. This kind of supervised learning can devise interesting results difficult to achieve without these powerful tools.

We will follow the Wenger's structure of a classic ITS model. Wenger's three main components of an ITS are: an expert module that represents domain expertise, a student model that represents the student's knowledge state and expertise, and a tutor, or pedagogical module that structures the interaction between the tutor and the student (Wenger, 87). In this article we concentrate on the knowledge acquisition problem of intelligent tutoring systems by "pushing the frontier" of technology for distributed awareness services. The major goals of our prototype tutorware system are:

1) Benefit and extend AWS services in order to receive and store selected event information from a running learning environment.
2) Use machine-learning techniques to isolate key feature knowledge from the stored data.
3) Develop a tool to automatically generate simulated scenarios for training.
4) Implement a prototype tutorware example that benefits from the available infrastructure.

Information retrieval: Using AWS subscriptions the user can specify which events he is interested in, and how they should be persistently stored. AWS provides a persistent EJB actuator that stores events in a database. We can thus specify that we are interested in events in a concrete workspace, and that we want those events to be stored using the Persistent Actuator. From this point, all events in that workspace will be saved in the persistent event store transparently to the user.

Data Analysis: Using data filters and machine learning algorithms (Clustering, classificators) the user must identify key variables that produce seamless groups. From the stored event data is thus obtained a knowledge base or trained algorithms that can onwards classify users from their behaviours. Raw data stored as logs or in a relational database is useless as is; it is necessary to perform filters in the data to retrieve key classification variables. We have created data filters for six grouping variables:

1. Time connected to the system or to a specific workspace for each user.
2. User activity (number of events) in the system or in a specific workspace.
3. Tool activity (number of events for this tool) in the system or in a specific workspace.
4. Thing activity (number of events for this thing) in the system or in a specific workspace.
5. Used tools in the system (total) or in a specific workspace.
6. Navigation time (specific for the contents tool) or time navigating a specific course.

Of course, it is possible to develop more filter variables depending on the specific problem to study. As possible filters to develop, we have considered the possibility of specifying different strengths for events triggered by a concrete tool.

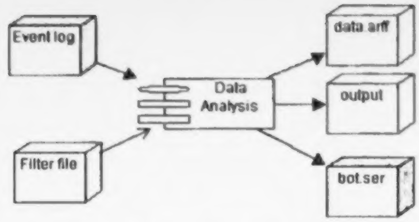

Figure 1. Data Analysis module

The data analysis module receives two input data sources and generates three output files. The input sources are a persistent event log and a XML Filter file defining what filter variables should be used, what clustering algorithms should be applied, the number of resulting clusters, and the date range where events should be studied.

We are using the freely available WEKA (Witten, 1999) machine learning algorithms and tools. "Weka" stands for the Waikato Environment for Knowledge Analysis and provides Java APIs for accessing to algorithms as well as a visual environment for studying and processing data sets. WEKA algorithms require a standard file format called arff using a special notation; our data-analysis phase extract key variables found in the XML filter file, and generate a WEKA compatible arff file. Using this file, we apply clustering algorithms to the data set in order to obtain student grouping. The results are stored in the output file with a comprehensive format.

Output data generated by clustering algorithms give us information about prior probability, Normal Distribution Mean, and standard deviation for each variable in every classified cluster. This is important to define what variables are important in each cluster, and also permit us to know prototype data about existing clusters. We obtain information for each cluster regarding each studied variable, as well as a correspondence list of student to clusters. We can thus know in which cluster every student is located using these filter variables. Finally, we can also know what is the prototype student in every cluster. A pedagogical expert should conveniently study all this information in order to find relevant variables that produce seamless groups. Once the expert find a seamless classification, this knowledge can be used to later categorise other group of students in the same scenario. The third output file generated by the Data Analysis module is a Java serialized trained algorithm that our bots will use to classify students in the running learning environment.

Data analysis is the most important phase in the overall model. If the pedagogic expert can choose the key variables that create seamless groups, this information can be later used to categorise students in the same scenario. Useful tutor reactions can thus be accomplished using this important information. In a context where massive information is stored about a high number of students, it is a hard task for educators to study raw logs even with the help of visualization interfaces. Machine learning algorithms can facilitate this task by telling the educator what students fall in a specific group. This information can be later used to perform appropriate reactions in order to improve the learning scenario.

Scenario simulation: In order to demonstrate the usability of the framework we have created a tool that generates simulated event data. We also tested AWS using real data with the assessment of educational experts. We aim to provide a technological infrastructure that is ready to be used by pedagogical experts. It is thus an interesting research work for educational experts to use such tool in running scenarios. Furthermore, the commercial EduStance learning environment is including AWS as its standard monitoring and knowledge analysis system.

In our case, we wanted to provide simulated tests as a proof of concept implementation. The tests should incorporate user guidance as well as provide a random generation factor. Our approach is to employ filter variables found in the data analysis module in order to define the generated output data.

Tutorware example: intelligent contents

Once we have developed the required infrastructure to obtain knowledge from the running environment, our major aim is to create a simple Tutorware sample that benefits from the overall infrastructure. Among other efforts to bring ITS to WWW, we have found relevant the technique called *intelligent knowledge* *sequencing* and problem sequencing (Brusilovsky,1992). Intelligent knowledge sequencing implies adaptative selection of the next topic to be learned using the student model and the knowledge about the learning material. In hypermedia systems, this technique is mapped in a straightforward approach by sequencing hypermedia pages or hypernodes. Normally, the student is provided with dynamic "intelligent buttons" that activate the knowledge sequencing mechanism.

Because our approach is to work with open standards, we decided to benefit from IMS content packaging specification. More concretely, we have used the IMS Table of contents (TOC) that is included in every packaged content unit. In the specification it is specified that one content unit can include several tables of contents. These TOCs can be used to create different paths in a course and thus provide different navigational alternatives for a packaged material.

```
<organizations default="TOC1">
      <tableofcontents identifier="TOC1">
                  (...)
      </tableofcontents>
      <tableofcontents identifier="TOC2">
                  (...)
      </tableofcontents>
</organizations>
```

Figure 2. IMS Table of Contents

In general, when a course is designed and developed by domain experts and educational experts, different content paths can be defined depending on student's skills and knowledge state. In our prototype tutorware system, the expert model of Wenger 's categorization is comprised in the course's table of contents.

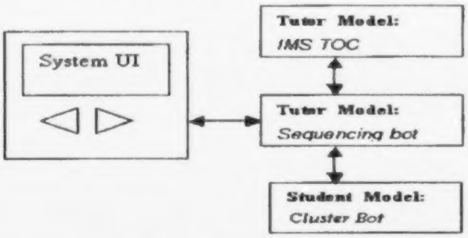

Figure 3. Tutor Architecture

The Student model is obtained from the data analysis phase as a trained algorithm, ready to classify students related to their previously studied behaviours. The Tutor model is in fact quite simple: every clustered group correspond to a content path defined in the course TOC. For each student, the tutor module ask the Student model in which group is included, and consequently redirects the sequence to the appropriate path found in the IMS TOC.

In order to make the system more realistic and broaden our test case, we have created an adaptative cluster bot that periodically revises the knowledge base to be always up-to-date. If one or several students change their behaviours and thus belong to another group, the bot will redirect them to the appropriate knowledge sequence. The system is not static and provides adaptative revision of the Student model. Finally, we outline that AWS services have played an essential role in the Tutorware sample:

- In the data acquisition phase, binding an event sensor subscription with a persistent actuator provides the needed server-side logging mechanisms for the distributed learning environment. In our case, however, events are generated by the event simulation tool and directly stored in the database.
- In the knowledge acquisition phase, the filter component is a very important service that pedagogical experts can use to obtain key variables that construct seamless groups. The knowledge acquisition phase can be combined with the use of visualization and data-analysis tools such as WEKA data exploration interface.
- Bot development can also be facilitated using event and time sensors. In our case, the adaptative cluster bot, must periodically reprocess event data in order to decide to what group belongs every

student. Using a repetitive time sensor the bot is triggered and can thus re-evaluate knowledge in order to classify users according to their actions.

Conclusions

One of the hot issues in future learning environments will be how to extract and interpret useful knowledge from the running systems. This required information feedback is the base for system improvements as well as a key information source for Intelligent Tutoring Systems.

Data mining and machine learning algorithms can alleviate the knowledge acquisition bottleneck inherent to these complex environments. Nevertheless, such environments require powerful distributed awareness and monitoring services enabling fine-grained monitoring and reactions over a plethora of heterogeneous learning tools.

We have created a technological infrastructure providing a well-defined event repository, a time scheduler, and a server-side Mediator enabling to bind event and time sensors with generic Actuator agents. We also created a Data acquisition component using clustering algorithms that permits to filter data and produce a suitable Student Model. At last, we have implemented a prototype example of a intelligent knowledge sequencing ITS that extracts information from the Student model and the standard IMS table of contents to dynamically define content paths.

We focus on the data and knowledge acquisition bottleneck existing in nowadays learning environments. We provide a technological solution that can considerably facilitate the development of monitoring and proactive agents working in the running environment. We believe that such infrastructure can be useful in a number of learning scenarios. First of all, alleviating knowledge acquisition over massive logs is a considerable service for educators; technology can help them to identify groups or student profiles. Furthermore, Intelligent Tutoring systems supported by human expert intelligence can really improve and refine learning scenarios.

We are collaborating with commercial vendors and educational experts in order to validate and use these systems in real life experiments. Furthermore, we find interesting to include domain expertise and pedagogical information on well-defined data sources such as LOM and IMS content packaging. Tutorware bots can thus access well-defined information using standard widespread specifications. To conclude, we find very interesting to apply machine learning techniques and tutoring systems to collaborative learning scenarios with richer interactions and collaborative communication tools and interactive simulations.

References

Brusilovsky (1992) . *A framework for intelligent knowledge sequencing and task sequencing*. In [Frasson et al., 1992], pp. 499-506.

Brusilovsky P. and Pesin L. (1994) *ISIS-Tutor: An adaptive hypertext learning environment*. Proc. of JCKBSE'94, Japanese-CIS Symposium on knowledge-based software engineering. Pereslavl-Zalesski, Russia, May 10-13, 1994. Tokyo. 83-87

Garcia Lopez, Gomez Skarmeta, Rallo Molla (2001), "*ANTS: a new Collaborative Learning Framework*". In Proc. of Euro CSCL 2001, pp. 253-260.

Instructional Management Systems (IMS). http://www.imsproject.com/

Prinz, W. (1999), *"NESSIE: An awareness environment for cooperative settings"*, in Proc. of 6th European Conference on Computer Supported Cooperative Work, S. Bodker, M. Kyng, and K. Schmidt eds., Kluwer Academic Publishers, 1999, pp. 391-410.

WEKA. http://www.cs.waikato.ac.nz/ml/weka/

Wenger, E. (1987). Artificial Intelligence and Tutoring Systems: Computational and Cognitive Approaches to the Communication of Knowledge. Los Altos, CA: Morgan Kaufmann Publishers, Inc.

Case Study

The Human Touch: Incorporating Service-Learning into an Online Course

Can a student learn how to build rapport with an older adult through an online course? Can students' firmly held stereotypes about what being old is like be affected by a web site? Can a distance education student coordinate a warm hug between a third grader and a frail older adult in an electronic chat room?

Technology has made access to many types of learning possible. In courses that focus on human service, where field experience has been a widely used element in constructivist learning, the online distance education student misses the opportunity to learn from the rich, often unpredictable interactions of the physical and social world of human service. (Wulff, Burke, & Hurley, 2001) Virtual reality and simulations, still technologically inaccessible to many, are also limited by the perceptions and understandings of the author and instructional designer. No one could program the many unexpected challenges of 12 students at a distance responsible for setting up a three part service-learning project with older adults in their local communities!

This project, funded by the Corporation for National Service, Learn & Serve Higher Education, through a grant to The Association for Gerontology in Higher Education in partnership with Generations Together/University of Pittsburgh developed a service-learning model that extended service-learning to gerontology distance education students. The project integrated a service-learning component into the online course "Therapeutic Interventions with the Elderly."
http://www.hper.indiana.edu/lehuber/r366r566/service/index.htm

Service-Learning is an experiential learning opportunity that integrates community service into students' academic learning. Service-learning gives students an opportunity to apply disciplinary practices, theories, and concepts in real-world contexts. Students in the community interact and learn from people in social service-agencies, schools, cultural centers, and grass roots organizations. (Jacoby, 1996)

The services provided by students in this class included welcoming older adults to the community, one on one student/older adult interaction, introduction of gerontological curriculum into an elementary school, an intergenerational activity with the older adults at the elementary school, and recognition by the community of the uniqueness and potential contributions of its older citizens.

Important Features

Important elements of any service-learning class include:

1. Service is clearly connected to the academic component, treated as a text via readings, discussions, speakers, etc.

2. A reciprocal relationship between the university and the community makes each a partner in the education of students.
3. Service meets a genuine community need as defined by the community-based organization.
4. The philanthropic and civic content of the students' service is discussed and examined. It is the practice of citizenship, broadly defined, that distinguishes service-learning from practica or internships, which focus more on professional preparation. (COPSL, 2000)

Important elements specific to this online class include:

1. ***Overcoming barriers to distance education.*** Distance education students frequently report feelings of isolation and lack of connectivity. While web-based courses offer flexibility for the already-employed or student at a distance, these students miss out on class activities and field trips that offer opportunities for guided hands-on practice with older adults. Adding a structured service-learning component greatly enhanced the understanding of course concepts through application and critical reflection.
2. ***Increased understanding of course concepts.*** This course is about applying knowledge about aging to therapeutic activity intervention with older adults. This project was effective in taking students' understanding of the assessment, analysis, planning, implementation and evaluation elements of therapeutic activity intervention to a deeper, more holistic level. By becoming completely immersed in an extensive project, students had the opportunity to apply concepts and knowledge from each content area of the course.
3. ***Increased understanding of aging and the aged.*** This project offered the opportunity to develop two different one-to-one sustained relationships with older adults. Past experience in this course, as well as reports from other faculty, report a positive affective experience from ongoing one-to-one relationships with older adults, as opposed to students coming in as a group to offer a one-time activity with a group of older adults. The rationale behind selecting two different older adults of varying functional abilities was to give students an appreciation of the difference between aging with disease as opposed to normal, or even successful aging. Students with limited experience with older adults often underestimate the individuality and heterogeneity of the older adult population.
4. ***Building competence***. Besides the ability to work knowledgeably with older adults, practicing activity directors need to be able to offer intergenerational activities, develop community partnerships, and obtain media recognition for facility events. This project went beyond requiring student contact with older adults to building student competence in areas of needed expertise.

A description of the problem

Pedagogical Needs

In any learning environment, there is a need to engage the student. Theoretical constructs in web-based learning have particularly focused on the need for learning to be problem-based, and the importance of learner-centered instruction. (Bonk & Cummings, 1998) After a semester pilot-testing the course "Therapeutic Interventions with the Elderly," it was clear that incorporating principles of learner-centered instruction would benefit what was learned and how it was learned. Of particular importance in this course which focuses on human service were building in opportunities to learn communication and interaction skills with older adults.

Of Bonk and Cummings' Twelve Learner-Centered Web Recommendations, the most salient for this course were:

- ***Facilitate don't dictate.*** Students at a distance were responsible for every aspect of the service-learning assignment. I facilitated where possible with phone calls, letters, and additional materials. In contrast, two students were local IU students. I had set up their project in advance over the summer so that I had a model to use for trouble shooting community partner relationships at a distance. These two students were the **least** engaged in the project, showing the importance facilitation of student ownership and leadership of the project over dictating project elements.
- ***Use public and private forms of feedback*** Students posted all reflective journals and analytical papers in public spaces. I gave both public and private feedback on assignments, giving students a shared understanding of expectations as well as the opportunity to learn from students already employed in the field.
- ***Varying the forms of electronic mentoring and apprenticeship.*** Students learned from each other, through peer feed back, but also learned from older adults, activity directors, family members, and grade school teachers. The best lessons were those learned from the older adults with whom they partnered; achieving the ultimate goal of the course, an appreciation and respect for the dignity of the aged.
- ***Employing recursive assignments that built on personal experience.*** In addition to asking for personal memories of experiences related to aging, students shared barriers and successes in their common service-learning experiences. All assignments asked students to integrate and synthesize course concepts with personal experience, and students learned from peer application of theory to practice.
- ***Varying the forms of electronic writing, reflection, and other pedagogical activities.*** Students wrote journals, participated in asynchronous discussion forums, wrote press releases, and one page analytical papers in addition to service-learning activities.
- ***Provide clear expectations and prompt task structuring.*** Before the beginning of the semester, students were mailed a "Course in a Box" including:
  - ✓ 56 page booklet outlining every detail of the service-learning assignments and analytical papers.
  - ✓ A video showing an associate instructor completing one of the service-learning assignments with an older adult

Community needs met by the service-learning activities in this course

- ***Integrate older adults into the community.*** Bloomington has been identified as one of the top 20 places to retire in the US. In the past 3 years, 4 new residential facilities for older adults have been built; previously there was only one such facility. Many of the residents of these facilities are new to the area. Because they live in a facility, many remain uninvolved in community citizenry.

While many of the communities of the DE students might not have experienced the in-migration of older adults that Bloomington has, older adults that are in facilities are segregated from the greater community. Most experience a sense of isolation and disconnect from community life. Many have few contacts with other generations. The community loses a potential active, interested citizen. Thus, the primary community need addressed by this project is the integration of facility-residing older adults into community life, benefitting both older adults and their respective communities.

- ***Provide intergenerational opportunities to three different age groups.*** Because of changes to the nuclear family and an increasingly mobile society, many adults and children have few opportunities to interact with those of other generations. This project provided interaction opportunities to three generations: older adults, college students, and elementary school students.
- ***Integrate gerontology into grade school curriculum.*** Today's children are ill-prepared to live in a world where 1 out of every 4 people are over 65. Very little material about aging is available in the K-12 curriculum, and many children hold misconceptions and stereotypes about aging and the aged. This project provided one unit from a series called "Positively Aging" developed by the University of Texas. The unit is called "All About Them," and describes the diversity of the older adult population. It address stereotypes and myths about aging, and engages children in critical thinking activities to develop their understanding of the aging process.

Who, What, When, Why, How

At the beginning of the semester, students identified a facility in which older adults reside, and working with the Activity Director, identified two residents with whom to work during the semester. Working with Newcomers Club or similar community partner they assembled a "Welcome Basket" for each resident, welcoming and introducing the resident to community life. When they brought the basket to the resident, they collected a narrative autobiography as they heard the story of the resident's life. On their next visit, the student and older adult created a "Visible Lives" storyboard, introducing the resident to the community as well as to staff and residents within the facility. "Visible Lives" is a collage of artifacts from a person's life, a way for a person to tell their life story as they would like to tell and share it. (Nguyen, Hill, & Cole, 2000). Photos of the class project are available at *http://www.hper.indiana.edu/lehuber/r366r566/service/pictures_1.htm*

The resident was then "introduced" to the community by participating in an intergenerational celebration at a local grade school facilitated by the DE student. Grade school students and teachers prepared for this activity through a curriculum packet, "All About Them" from the "Positively Aging" curriculum project (*http://salud.uthscsa.edu:8900/public/posag2/*) which led students to appreciate the diversity among aged individuals.

Students then prepared a media release for their local media about the project, which further integrated the older adults into the community, as well as providing project dissemination.

After each activity, students used web-based communication to reflect on their experiences. At the end of the semester, the class had a weeklong asynchronous class "party," complete with jokes, snacks, Christmas wish lists and reflections on the experiences of the semester.

From class party, 12/8/01
http://ssf.indiana.edu/lehuber/dispatch.cgi/module17/docProfile/100004/d20011207203350/No/t100004.htm

Joke punchline: Dad says, Where's Susie?
The little girl says, Susie ran out of gas about halfway down the block and there's another dog pushing her home.

Hope that was not too bad, my grandfather told me that one.
Anyway, my favorite snack is cashews and I am eating them now.
My greatest barrier that I ran across while taking this class was definately using the Internet for communication purposes. I have had tremendous difficulty with this but thats it. The class itself was great.
The greatest success that I received from this class was gaining new friends and learning more about myself and how growing doesn't bother me.
What I want for Christmas up until yesterday was a guitar but I received that yesterday for my graduation present. Now I guess I will ask for a Red Rider B-B GUN! Don't worry I won't shoot my eye out. HA,HA.
Great party

Implications for the local setting

Building a service-learning component into an online course makes something already time-consuming (online teaching) even MORE time-consuming! At the beginning of the fall semester I had decided this type of model to increase student involvement in a human services online course was just too problematic. As the semester ended, overwhelming positive student feedback made me reconsider. Over the previous summer, I had developed substantive materials to guide students in their service activities and online reflections. I will continue to use those materials, but give students a choice about service-learning. Students who are already employed will find this type of project useful in accomplishing learning and professional objectives, and can implement the assignment in their place of employment. Some undergraduates, themselves not well integrated into their community, might find it easier to write a long paper than develop community partners. From an instructional time management point of view, it might be easier to grade those long papers than try to develop and maintain community partners at a distance. From the learner's perspective, developing community contacts might be more frustrating than rich with learning opportunities.

Implications for others outside the local setting

Service-learning is a valuable concept for online learning as well for traditional brick and mortar learning environments. Human services can hardly be adequately taught solely through electronic communication. Many courses involve a field experience, but that places an unrepaid obligation to mentor on kind souls at-a-distance. Service-learning asks for mentoring, but promises student service in return.

Like many ideas in instructional technology, this model program deserves consideration by others inspired to provide the best possible learning environment and opportunities for students. Also like many ideas in instructional technology, this program comes with the caveat that it is time consuming, potentially frustrating, and not guaranteed to succeed for each student.

The turning point in my decision to continue to include this component came with the following email from a student: (http://oncourse.iu.edu/fal2001/oncourse.asp)

Dr. Huber, first let me say thank you for this project! It was great! Both my Buddy and I had such a good experience. I don't know who's more excited about the outcome, her or me! ...Some of the nurses came to me tonight to tell me what a difference they had seen in the resident known as Buddy One. They had been worried about her withdrawal associated with the deterioration of sight. They had to tell me what a difference the Visible Lives project made in this Resident, who by their accounts, is now eager to greet the day and filled with enthusiasm to finish our projects. She talked a lot this past week about how she can still do things that matter. Just thought you might enjoy that tidbit as much as I do. Thanks again, Cheryl.

References

Bonk, C. J., & Cummings, J. A. (1998). A dozen recommendations for placing the student at the center of Web-based instruction. *Educational Media International, 35*(2), 82-89.

Community Outreach & Partnerships in Service-Learning. (2000). A Guide to partnerships in service-learning at Indiana University. [Brochure]. Bloomington, IN: Author.

Jacoby, B., et al (1996). Service-learning in higher education: Concepts and practices. San Francisco: Jossey-Bass

Nguyen, T., Hill, J., & Cole, T. (2000). Visible lives: Life stories and ritual in American nursing homes. In S. Long (Ed.) Caring for the elderly in Japan and the U.S. (pp. 289-302). New York, NY: Routledge.

Wulff, S., Burke, E., & Hurley, J. (2001, August). Guided self-directed learning strategies for distance and on-site education. Paper presented at the 17th Annual Conference on Distance Teaching and Learning, Madison, WI.

Viewing the Reviewing

An observational study of the use of an interactive digital video to help teach the concepts of Design Inspection Reviews

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Abstract: "Design Inspection Reviews" are structured meetings in which participants follow certain rules of procedure and behaviour when conducting detailed readings of design plans to identify errors and misunderstandings. The technique is widely used in the software engineering industry, where it is demonstrably more effective than testing at identifying errors in software, but it is by no means restricted to this domain. Similar practices can be found in many other creative industries.

This paper reports on an interactive multimedia program used to reinforce the teaching of the technique to software engineering and computer network students. The results of the end-of-studies examination papers of the student group that used the multimedia program are compared to those of the previous group. The results appear to show an improvement of over 7% for the Review topic question for exams that were otherwise comparable in standard. The quality of the research data and the validity of it's conclusion are discussed.

Introduction

A common saying is "prevention is better than a cure". In the industrial design environment this is certainly true. It is known to be far more cost effective to take extra time to identify problems at the design stage rather than try to work around the problems at the product installation or user operational stages. For example, this has been a central tenant of the quality assurance movement of the last two decades, as typified by the ISO 9000 standard.

The truth of the saying has been known to the software development industry for many years. Fagan [1976] describes the application of Design Inspection Review techniques at IBM. Recent surveys of industrial practice show Design Reviews are today very widely used for ensuring quality of software. Indeed [Love, 1999] found that the reviews are the top-most used approach for ensuring quality, more widely adopted than internal quality audits and statistical quality control procedures.

Using lectures to teach the basics of Design Inspection Reviews can be 'dry' and for the student a rather passive experience. This paper describes the concepts and technologies of an interactive video that was developed to allow students to "chair" a Review meeting for themselves, giving individual viewers the opportunity to judge when the rules of the technique are being broken. The author makes observations on the success of the use of the interactive video, drawing upon data from examination results. However, these are only observations – the difficulties of drawing empirical conclusions are noted.

Although the paper uses examples from software design to illustrate Design Inspection Reviews, the principles of the Review technique - and of multimedia program used to teach it - can be applied to many other situations.

Design Inspection Reviews

The premise of the Design Inspection Review technique is that the author / designer / originator is often too 'close' to their own piece of work be able to properly and objectively judge its fitness for purpose or technical qualities. Instead a small group of people assist the author to find all significant errors, omissions, inconsistencies and areas of confusion in the product [Kelly, 1993]. Research has shown that an effective Inspection Review regime is more than paid back by reductions in the subsequent test-and-correct phase [Freedman, 1990].

The Design Inspection Review technique has three central tenants

- The inspection team must be knowledgeable about both the product requirements and about the tools and methods used to design it. They must also have a vested interest in wanting to find problems before the product design is released. Typically this means that the team is comprised of direct peers of the author, plus the author him/herself. Fagan [1976, 1986] and Freedman & Weinberg [1990] recommend that anyone with line management responsibilities over the other team members should not be present as this could inhibit the open discussion of problems. Crawford-Hines [1996] dissents, pointing out that in industries such as software where seniority of position often is based on technical prowess, an immediate supervisor may have valuable expertise to share.

- The Review is carried out according to schedule typically comprising of six phases: planning; participant briefing; individual preparation; inspection and defect recording; rework; and, if necessary, re-inspection. Each phase is structured towards the efficient use of time and towards the successful identification (rather than the solving) of problems. For example, the use of checklists of common errors is strongly recommended (together with a department-level process to review those lists to help Inspectors learn from other reviews about likely sources of problems). To ensure breadth of consideration, the team members are each allocated specific view-points from which to review the product: accuracy of working, ergonomics, and future maintainability, etc.

- A number of conduct rules apply to the Inspection meeting itself. Two examples are:-

  In the months leading up to the Review the author will have invested many hours in their work. It represents, and reflects, their skills. At the Review meeting it is perhaps natural for the author to want to show to their colleagues f the complex or inventive parts of the solution. However, an author-lead discussion may not identify that the author either misunderstood or completely overlooked parts of the requirement specification. A rule of the meeting is that the Chair leads the discussion and the author just responds to questions.

  The product should only be inspected when the author believes it to be defect-free and ready for release. It can be a significant challenge to his/her "ego" if the reviewers do then finds serious errors. The author may become defensive and attribute problems to others. Alternatively, they might even counter-attack and question the technical skills of the reviewer. In either case the effective, free-flowing discussion of potential problems would be lost. To prevent this the Chair of the meeting must ensure that all communication ~ verbal, and non-verbal too ~ must suggest that "there is a problem with the product" and not "there is a problem with the producer".

This paper refers to the technique under the general title of "Design Inspection Review". Over the years a number of variants - Fagan Inspections, Formal Technical Reviews, Active Design Reviews, Phased Inspections - have been proposed. Interested readers are referred to Freedman and Weinberg [1990] as the most comprehensive printed work. The Software Inspection and Review Organization web site has useful information though is a little dated [SIRO, 1996]. The WWW Formal Technical Review Archive [FTRA, 2001] is a further source of online information. Trainers may find Powerpoint presentations of Design Inspection Reviews [Johnson, 1998] useful.

Previous approach to teaching Design Inspection Reviews

Students on one of the undergraduate computing degrees at Sheffield Hallam University, England, are taught a version of Design Inspection Review based on Freedman & Weinberg. Students attend a lecture that describes the principles, and (prior to the development of a multimedia teaching tool) then attended classes in groups of around twenty where six volunteers would read aloud the dialogue of a "play" written by a course tutor. In the play the "characters" break many of the procedural and behavioural rules described in the lecture. All the students – the readers and the others - were encouraged take the perspective of the Chair of the meeting, and to interrupt when they identified transgressions. The tutor led the class in discussions as to the likely consequences. The class would then resuming with reading the script.

These classes appeared to be popular with the students, with lively discussions in most sessions. However, there were some notable problems with the format:

- Tutors found it hard to get all students involved equally. Typically, a few noisy or confident students would dominate the discussions.

- An educational aim was that the "play" should help inculcate in the students a sense of appropriate use of tone and language when making criticism. As with many issues of chairing a meeting, it is a matter of judgement knowing how far to let a discussion run before interjecting. However, the first student to interject pre-empted the other students from making this judgement.

- Students found it hard to revise the topic when preparing for end-of-year examinations. Perhaps because they were actively involved in reading and discussing the script, few took notes. Although the scripts themselves were available for aiding their revision, if a student did not pick up on a particular issue during the class session it is believed unlikely that they would spot it when re-reading the script weeks later.

A modified approach to teaching: A multimedia program

A multimedia program was created to address the problems identified above. A re-scripted version of the Design Inspection Review play was enacted, videoed, digitised and placed onto a CD, together with a media-controlling program to manage the interaction. The intent of the program was to permit individual students to take the role of "chair" of the meeting. They could interrupt the video whenever they thought that one of the Inspection rules was being broken and then use clickable buttons to identify the problem. The program would confirm the correctness or otherwise of the interruption, and give further feedback on the features of that class of problem. An important part of the design of the multimedia program was to guide students towards noticing problems that they had missed on the first viewing.

The original concept for the program interaction was to create a 'network' of navigation paths through the video presentation. After students had interrupted the video and used the buttons and menus to identify what rule they thought was being broken, the program would supply a little further information (as text or extra video) about the consequences of this problem and where to get further information. It would then restart with a different video clip that showed a corrective action being taken. For example, if the viewer, in their role as "chair", indicated that the language of criticism was too harsh then the next clip would start with an unseen voice (the "chair's" voice) asking for more moderate tones. The subsequent clip would then progress towards a desired outcome. However, if the interjection was made at an inappropriate time the next clip would have a similar start, but the subsequent language might be so polite as to fail to uncover the next defect. In this design, not all the restart clips led to desirable outcomes.

The network concept was not used in the final version of the program. It turned out that too many scripts were required for the time available to the project. It was also hard to find "natural" ways of giving feedback about the correctness of student interjections, especially if students selected faults that were not intended to be the primary problem at that point. A further problem was that the student might undermine the value of the package by navigating a route that missed all the important teaching points. Instead the program was designed to reflect that Inspection meetings have six sub-phases, and that most errors are most likely to occur in specific phases. For example, the attendance of an inappropriately skilled reviewer is likely to be detected at the meeting start-up phase.

In the modified program design the student were presented with a predefined sequence of six video clips of between one and two minutes. They could interact to identify problems either as they came across them or at the end of the clip. If they interacted during a clip the video would be paused and feedback given as above, but on restart the same clip would be shown. Students could opt to see the clip again from its beginning, or from just before where they left off. To handle unexpected interjections, the machine would respond that "this problem can happen, but it isn't happening here". A central part of the interaction was that the program did not tell the viewer whether or not they had identified all the problems present in a clip. This was to encourage the student to be critical in their interactions rather than routinely identifying, say, two problems per scene, and simulates "real life", where some sections of Design Inspection Meetings might run smoothly and require little correction, whilst others might require many interjections.

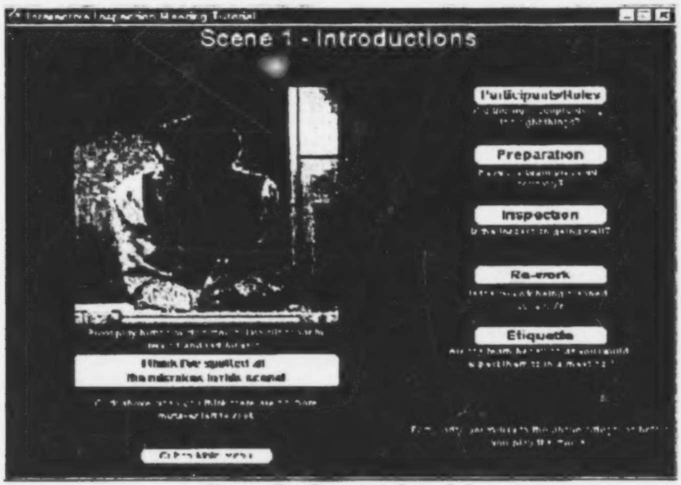

Figure 2 – Screenprint of the program

At the end of the whole program, the package lists which errors had been detected and which had been missed. Students then have the choice of watching again extracts of clips that contained identified or missed problems. The program concludes by giving a "score" based on the percentage of problems identified on the first viewing of the scenes. This "score", though, is not considered a strong metric of performance (it takes no account of whether the problems was spotted during the showing of the clip or at the end, for example) and is not collected for evaluation purposes.

Technical details of the creation of the Multimedia product

A standard home VHS-S video camera was used to film a group of students role-playing an inspection meeting. Scenes from the video were played back through the camera and saved in AVI digital format by a computer (a Pentium II with 256Mb RAM and 4 Gbytes of unused disk space – a fairly standard specification machine, but equipped with a digital video capture card). Adobe Premier software was used to edit together different 'takes' of the same piece of script, either to remove errors and hesitations in the acting or to give different camera angles such as close-ups on individual speakers. The resulting sections of video film were saved in Real format. This editing and re-encoding into Real format reduced the storage size of the clips from several gigabytes to a few hundred megabytes.

A computer program written in Macromedia's Director language was used to control the playing of the video to a computer screen. A series of menu buttons were displayed beside the video (see figure 2). Director allows both the buttons and the actions taken when they are pressed to be varied by the program, so the buttons could be made to be appropriate to the content of the video being shown at the time.

The video clips and program were written to CDs, which students could borrow to watch on a home or university machine. Alternatively they could download a copy across a network to watch on a university machine (downloading across a standard modem to a home machine would take prohibitively long). The two delivery formats gave identical results when watched. We did not try to stream the video because with current technologies there can be a significant delay – often around 20 seconds – before sufficient video is received to start the viewing. Eventually, advances in technologies may overcome this difficulty, and allow on-demand access to interactive learning materials without any administrative overheads.

None of the above technical steps were found to be difficult. They were all within the leaning capability of the program's author, a Final Year undergraduate Software Engineering student. It is noteworthy, too, how little attention needed to be paid to the filming environment. Acceptable results were gained using just the normal fluorescent lights of the meeting room and the camera's built-in microphone. We did use a room with carpets to soften the sound and reduce the noise of chairs scraping.

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Evaluation of the learning from the package

Learning from the multimedia teaching tool, measured eight weeks after the use the video, was evaluated by repeating the same examination question given to the cohort prior to the use of the video onto the examination paper of the cohort that did have it available. This is shown as Q1 in the tables below. To check that any change in performance levels was not due just to question familiarity, a question from an unrelated topic was also repeated (Q2). The other questions were from different topics or gave a different emphasis to the same topic, and were not directly comparable. This is emphasised in the tables by labelling them Q3-Q7 and Qiii-Qvii respectively. The two papers each required the students to answer four questions from a choice of seven.

The same group of tutors taught and examined the course, and the teaching approaches were broadly the same except for the topic of Inspection. The author of this paper was not a tutor on the course for either year, do direct experimenter influence is reduced. It is stressed, however, that still this was not intended to be a strict experiment and a number of important variables were not controlled. For example, students in the later year group had access to any new literature published during the later year. For this reason, this research paper makes observational findings based on data, it does not claim that these are empirically derived results.

Tables 1 and 2 respectively show the examination results from the year before the use of the video and for the year of use. For each question they show the number of student answers, the question's "popularity" (i.e. the percentage of students choosing to answer the question) and the mean of the marks given to the students' responses. Similar data is shown for the exam overall, and for overall but excluding the Inspection question. To make the tables simpler to understand Q3-Q7 and Qiii-Qvii are presented in decreasing mean-score order. The questions did not appear in this order on the examination papers.

	Q1 Inspection	Q2	Q3	Q4	Q5	Q6	Q7	**Overall Exam**	**Overall Excluding Inspection**
NO of ANSWERS	**92**	85	46	27	23	107	94	**122**	**122**
POPULARITY(%)	**19**	18	10	6	5	22	20		
MEAN MARK	**51.2**	55.9	55.2	52.4	49.9	48.4	47.6	**51.1**	**51.1**

Table 1 Results for cohort previous to video

	Q1 Inspection	Q2	Qiii	Qiv	Qv	Qvi	Qvii	**Overall Exam**	**Overall excluding Inspection**
NO of ANSWERS	**170**	158	137	83	126	57	72	**202**	**202**
POPULARITY(%)	**21**	20	17	10	16	7	9		
MEAN MARK	**58.7**	55.7	52.9	51.9	50.7	48.4	46.8	**53.4**	**51.9**

Table 2 Results for cohort that had video available

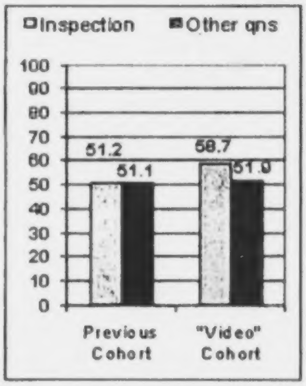

Figure 1 : Comparison of results

Tables 1 & 2 show that mean mark for the Inspection question (Q1) for the cohort before the video was 51.2 and was 58.7 after. It can also be seen that the mean mark for the "control" question (Q2) is only 0.2% different, suggesting that repeating a question does not itself explain the rise in mark for Q1. It can further be seen that the exam overall excluding the Inspection question is only 0.8% different between the two cohorts, suggesting that the two examinations were of more-or-less comparable levels of difficulty. Hence it might be concluded that the change in Q1's result from 51.2 to 58.7 is due to the change in method of teaching, i.e. due to the introduction of the interactive video CD. Under the United Kingdom examination system, a 7.5 mark improvement represents not far off a whole degree-classification difference, and is a worthy achievement.

(A less favourable interpretation could also be postulated: perhaps it was not the use of the video that lead to the improvement in answers to Q1, but that the previous use of the "play" so confused the students that their 'previous-cohort' mark was actually depressed. The research does not have the evidence to refute this conclusion. It can only be stated that the professional judgement of the teaching team is that this was not the case.)

An examination of the data was made to see if the profile of marks *within* the Inspection question had changed for those students who declared that they had watched the video. A total of 51 students out of 202 either told staff that they had downloaded a copy or signed as having borrowed a CD. Figure 2 presents a comparison of the exam results in graphical format. In the previous year the score for the Inspection question, at 51.2, was nearly equal to the mean of

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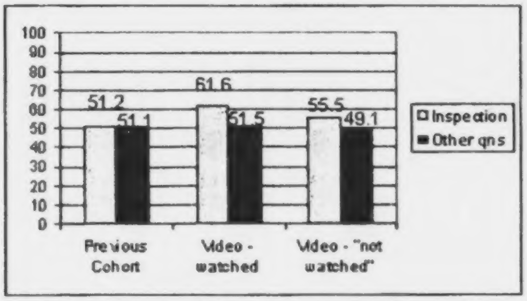

Figure 2 - Analysis of mean question results

all the other questions. The Students who are known to have used the multimedia programme scored a mean of 61.5 for the inspection question, an improvement of over 10 marks. However, the "not watched" figure also raised by 5 marks, to 55.5. We consider it likely that many students watched the video but did not notify the staff, and the "not watched" column should really be labelled as "not reported as having watched the video". Although the graph shows that students that did watch the video did marginally better on their other questions (51.5) than the non-reporters (49.1), this is not considered to be a significant difference.

Conclusions

The "headline" conclusion of this paper is that eight weeks after teaching of a topic was supplemented by an interactive video, the marks for the relevant question on the examination paper were raised from 51.2 to 58.7 (and to 61.5 for those who explicitly said that they had seen the video). This is after discounting factors such as experimenter influence, differences in the overall standard of the examination papers, or the re-use of a question leading to students being better prepared.

The author is careful to state that whilst the above conclusion is based on numerical data this does not amount to empirical evidence, and has pointed out many factors that invalidate the results from being a correctly-formed "scientific experiment".

On a different aspect, a second finding of the research was the ease with which the interactive video was conceived and implemented. The researchers were surprised how few technical difficulties were met in the filming and digitising of the video, or in writing the presentational program. The largest difficulty was a pedagogic issue, namely of deciding the program's content.

The overall conclusion is that the apparent gain in retained learning of over 7% is noted, and that the project does merit the design of a carefully structured empirical study.

References

Crawford-Hines	Software Inspections & Technical Reviews http://www.izdsw.orf/projects/FTR/dogma, June 1996
Fagan, M.E (1976)	Design and code inspections to reduce errors in program development. IBM Systems Journal 1976 Volume 3 pp 182-211.
Fagan, M.E (1986)	Advances in software inspections. IEEE Trans in Software Engineering 1986 Volume 7 pp744-751.
Freedman; Weinberg	Handbook of Walkthroughs, Inspections and Technical Reviews. Dorset House Publishing, 3rd Edition, 1990
Kelly, J	Inspection and Review Software Inspection and Review Organisation newsletter, Vol 2, April 1993
Johnson, P	Link from the WWW Formal Technical Review Archive http://www2.ics/hawaii.edu/~johnson/FTR, Jan 1998
Love, M; Siddiqi,J; Kay,N	Commitment to Quality: A survey of South Yorkshire software producers. Procs of Int. Conf on Software Process Improvement (INSPIRE), London, 1999.

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Promoting Student Learning through Peer Tutoring – A Case Study

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Abstract: The literature abounds with information about peer tutoring and the benefits that it can bring to student learning. This case study sought to explore ways of using peer tutoring to enhance the learning experience of a group of higher education students in a multimedia course, who had access to learning resources in an on-line environment. It illustrates how easily and effectively the basic principles of peer tutoring can be adapted and implemented following explicit guidelines from the literature.

Introduction

It is ironic that schools and tertiary institutions are often chided for not providing a real world experience for students, yet they can provide a perfectly realistic learning environment for students to tutor others. This permits authentic practice of a number of useful generic skills like working collaboratively with peers, which can enhance teamwork and interpersonal skills. This study presents support for using peer tutoring and peer assessment for students in higher education. After all, evidence suggests that peer tutoring can greatly enhance the learning experience of both the student tutor and learner(Goodlad, 1999; Topping, 1996).

At a time when there is a push for higher education institutions "to do more with less" and promote the development of students' generic skills (Australian National Training Authority, 1998; Bennett, Dunne, & Carre, 1999; Candy, Crebert, & O'Leary, 1994; Dearing, 1997; Mayer, 1992), peer tutoring can provide an effective system which not only assists student tutors and tutees to learn better, but also helps promote the development of generic skills, as well as freeing up time for tutors (Topping, 1996). This provides an alternative teaching and learning approach in which students take a pro-active role in thinking, questioning and sharing knowledge.

In this paper, we examine design issues needed when implementing a teaching program using peer learning, and also present the results of our evaluation. We begin by considering some theoretical underpinnings and design aspects of implementing peer tutoring and learning.

Peer Tutoring – theory and design aspects

The concept of learning through peer tutoring is based on a social constructivist view of learning that emphasises the role of the students to generate learning where students coach peers through social interaction within their zones of proximal development (Vygotsky, 1978). Rather than applying a stimulus/response process, users are actively engaged in making meaning through cognitive accommodation and/or assimilation (Piaget, 1969). Vygotsky argued that learning comes about through social negotiation within a cultural context, with language as the primary enabling tool. This social constructivist philosophy has been expanded on recently, introducing the notion of cognitive apprenticeship (Brown, Collins, & Duguid, 1989) through which students learn in a manner similar to traditional apprenticeships. The students access expertise through mentors, whose role is to facilitate rather than teach, and the aim of learning is to solve realistic and practical problems in an authentic setting. For a peer tutor, this setting is a very realistic human setting. Just as in traditional apprenticeships, learners engage in activities 'on-the-job' rather than through the didactic teaching of abstract concepts. The argument is that students are better equipped to approach non-familiar problems and produce solutions that are appropriate to a given culture. Peer tutoring is aligned with these aspects of social constructivist theory by enhancing social negotiation with the student tutor and tutee, where knowledge construction is promoted through communication and dialogue, which is helpful for the tutees.

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Peer tutoring is also valuable for the tutor, ie "learning is enhanced through teaching". In an evaluation study conducted by Hartman (1990), a reported outcome of peer tutoring was an increase in student motivation toward learning. These results are supported by Whitman (1982), Annis (1983) and Benware & Deci (1984) who argue that peer tutoring can be the most intellectually rewarding experience of a student's career, and that they perform better on higher order conceptual understanding scales than students who read the material simply for study purposes. The benefits of peer tutoring are summarised by Goodlad (1999) as follows:

- Student tutees found lessons more interesting, easier to follow, more enjoyable and seemed to learn more;
- Student tutors practiced communication skills, felt that they were doing something useful with their knowledge, got to know people from different social backgrounds, gained insights into how other students saw subjects, increased self-confidence and reinforced subject knowledge;
- Teachers found lessons easier to handle, teaching was more enjoyable and reported that pupils seemed to learn more.

Implementing a peer-tutoring program is not a trivial process, as there are many salient issues. Topping (1996) describes nine different peer tutoring formats suiting different circumstances ie cross-year small-group tutoring, a personalised system of instruction, supplemental instruction, same year dyadic fixed-role tutoring, same year dyadic reciprocal peer tutoring, dyadic cross year fixed-role tutoring, same year group tutoring, peer assisted writing and peer assisted distance learning. In our case study, the personalised system of instruction was akin to type seven, ie implemented at the same year group level, where tutors assisted tutees who were working at their own pace on set exercises.

Even though different formats meet different needs, there is a commonality of purpose as well. Goodlad (1999) lists seven "golden rules" as criteria for designing and implementing peer-tutoring schemes. His criteria are:

1. Clearly define the aims of the tutoring scheme by writing a statement of intent which shows "who is teaching what to whom and for what purpose";
2. Define roles and responsibilities in the scheme being implemented, which may include rules for matching or pairing students by sex, friendship or ethnicity;
3. Train the tutors in task/content requirements and also in tutoring techniques such as "pause, prompt and praise";
4. Structure the content so that there are clearly defined, meaningful tasks for the tutees which involve maximum participation and reinforcement;
5. Support the tutors with regular feedback through de-briefing sessions and well structured materials;
6. Keep logistics as simple as possible ie make the scheduled time and space for meetings convenient to all parties;
7. Evaluate the scheme.

Context of Study

"IMM 1122 - Publishing on Web", was designed as an introductory unit to teach media students at Edith Cowan University how to publish information on the web. Students were required to create web pages that incorporated graphics, sound and animation, design suitable media for web delivery and use a variety of web development tools to build well-designed sites. An outline of the weekly topics included: Introduction to HTML, Designing a Web Page, Tables, Frames, Creating Forms, Programming with Javascript, WWW Images, Bandwidth and Compression, Flash and using Word, PowerPoint and Acrobat for on-line publishing. All notes, exercises and the syllabus were made available to the students through the use of a web site.

There were 110 students from a wide variety of backgrounds in the course, which comprised of a one-hour lecture and a two-hour tutorial. This required four academic tutors to run five classes, with about twenty-three students in each class. The unit is an elective in the "Communications and Multimedia" course, and can be taken by first, second or third year students. Also, students taking this unit are from disparate backgrounds ie some students in the program have the intention of majoring in Media Studies, Film & Television or Photomedia, while others would be majoring in Multimedia, Computer Science or Information Systems. So, in the same class it is possible to have a third year student majoring in Multimedia and Computer Science alongside a first year student majoring in Media Studies and Photomedia. This large discrepancy in student expertise and background created a great diversity of abilities, which suggested implementing a peer-tutoring program.

The students were required to complete three assessment tasks. Two assessments were based on developing web-based portfolios, showing their "digital achievements" which could serve as potential CV's for employment opportunities. The peer tutors were involved in the third assessment block of weekly tasks which required students to complete ten tasks (worth 3 marks each), based on the previous week's work. Academic tutors would then assess each student's work during the tutorial session, which was a time intensive task and took up most the academic tutors' time during the two-hour tutorial. Tutors would discuss the task with students and give them a mark and justification. Students could ask questions, but generally the amount of time spent on each student was only five or ten minutes. While this was in progress, it was difficult for students having problems to ask their normal academic tutor any questions.

So, given that there was a great discrepancy in student abilities, and also that academic tutors were busy assessing weekly tasks, it seemed appropriate to implement a peer-tutoring scheme in this context.

Implementation

Within the syllabus, clear guidelines were given to students about peer tutor responsibilities and assessment of these. Four peer tutors were required in each class, which had 20-25 students. The scheme commenced in week three of the semester, which allowed time for nominations, and was based on a short competency test given by the academic tutors.

What was the incentive for peer tutors wanting to take on this responsibility? Simple - they were "bribed"! Successful peer tutors would be exempt from doing weekly workshop activities (worth 3 marks each). However, to remain as peer tutors they were expected to obtain positive feedback from their peers. This was acquired through an on-line database at the end of each tutorial session. If they obtained two consecutive weeks of poor feedback they were warned that they could be taken off the role. This commitment was established through a "Student Contract" which had these criteria and was signed by both peer tutor and lecturer.

Goodlad's (1999) "seven golden rules", were generally adhered to except for training tutors in tutoring techniques and supporting tutors with regular feedback. Over the semester, it was found that all the tutors across all the classes were keen to maintain their role and worked hard at maintaining a high standard of delivery. However, as time was always limited in the tutorial sessions, not much feedback was given to the peer tutors. This was largely due to weekly student feedback being so positive in the early weeks, and then gradually tapering off.

Student Feedback – Tutees

Student tutees were asked to complete a post-course questionnaire, of which thirty-five were collected. Students were asked to rate a range of questions using a Likert scale (0_2_4_6_8_10) from 0 (low) to 10 (high). Key results are shown in Figure 1 and summarised as follows:

- "I think the peer tutors were successful" had an average of 6.4, and is clearly bi-modal. Students were largely strongly positive or strongly negative about the peer-tutoring program. By closely examining the responses, it appeared that students who were capable and didn't need help felt that peer tutoring was a waste of time. Also, a small number of weaker students also criticised the peer tutors, who felt that peer tutors should have done more for them. However, the majority of weaker students rated the peer tutoring system highly, and felt that it supported their learning
- Students who needed help rated the peer tutoring system highly (10 or close to 10), whereas the more able students who didn't need as much help rated the peer tutoring system low (0 or close to 0), and considered it irrelevant or of little use
- "I think that peer tutors can explain concepts better than academic tutors" had a wide range but an average score of 5.0, which implied that there were probably multiple diverse feelings about this issue
- "This unit helped me learn the subject content" and also "I would recommend this unit to other students" both gained high scores of 8.0 and 7.3 respectively, which implied that overall the unit was perceived as being useful. We attributed a good part of that success to the support provided by the peer tutoring system.

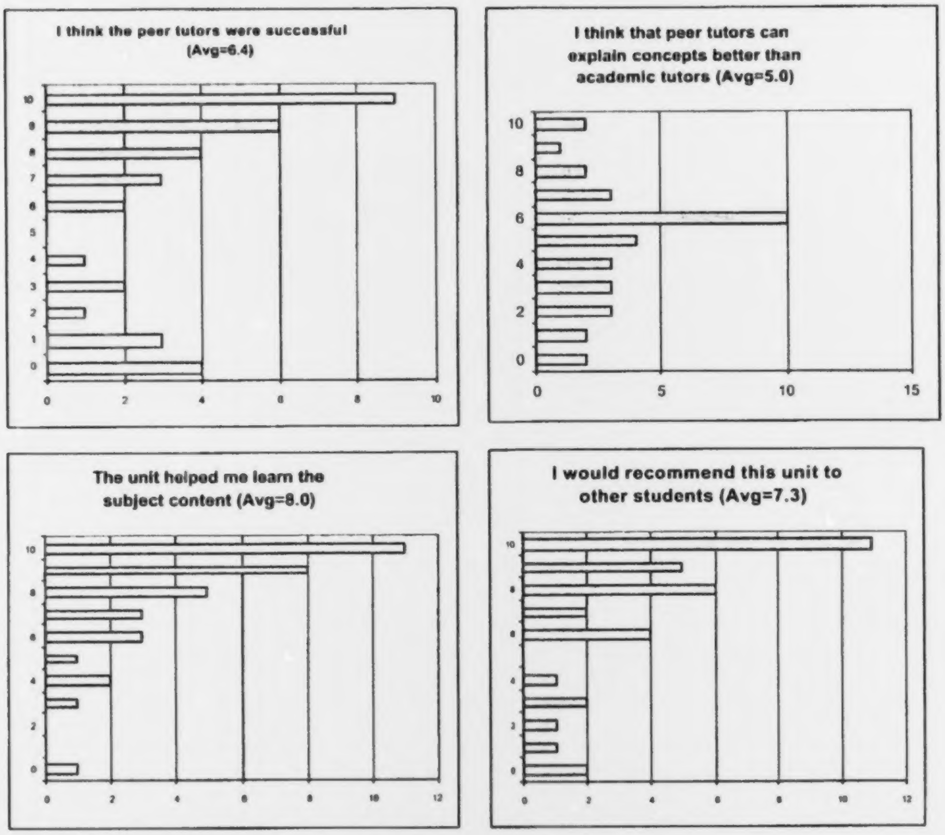

Figure 1: Results of four questions from the post-questionnaire survey

Students were also asked to give written opinions about what they thought about the peer assessment program. Positive comments included:

- *Peer tutoring was a good idea. Less wait for help and they did the same work as us so they knew the material*
- *Peer tutors were an effective concept. Offers a less formal way of problem solving on a more personal and intimate level. Also, it doesn't hinder the tutors marking of weekly tasks*
- *they did a good job. I think in helping others, they also learn new stuff, too. Very co-operative in helping to solve problems..*
- *the peer tutoring system worked well for the students who were struggling. Our peer tutors very patient and spent time explaining things to students*
- *peer tutors are an effective concept. They offer a less formal way of problem solving on a more personal and intimate level, also it doesn't hinder the tutor's marking of the weekly tasks*
- *I think using the peer tutors was excellent, as the tutor cannot be in two places at once*
- *:> good, cool thing!*
- *peer tutors are good for a go-between student and tutor. Sometimes if the peer tutor doesn't know the answer we work on it together to solve it.*

Negative comments included:

- *it would have helped if the peer tutor ever came. First few weeks were good but then it dropped off*

- *no-one knew who they were; the system died without a sound. While they did a good job, there wasn't any real definition of they were supposed to be doing, and a lot of them were just plain bored!*
- *They need to do more – offer more help to people*
- *They need to be more prominent. Also, maybe we should be able to email them!*
- *I found I did not need much basic help. I tended to work problems out myself*
- *I didn't use a peer tutor, the books were easy to follow*
- *Good idea, but maybe need to make it clearer who they are and what they are there for*

Considering some of the negative comments given by the students, it appears that Goodlad's (1999) "seven golden rules" were not applied as well as we had wanted. Clearly some students were unsure about who the peer tutors were and what their specific roles were. A closer analysis of the data, showed that these comments were class dependent, ie how the academic tutor in each class introduced and promoted the peer tutoring system probably affected its implementation.

Student Feedback – Peer Tutors

Peer tutors were also asked to complete a post-course questionnaire. Ten responses were collected which represented about two thirds of the peer tutors. These students were asked to rate questions using a Likert scale from 0 (low) to 10 (high). The results are shown in Table 2.

Question Asked	Average Score /10
Being a peer tutor helped me learn the subject content ie HTML, Flash etc..	10
Being a peer tutor helped me practice and develop communication & interpersonal skills	10
Using peer tutors would be useful in other units	10
The idea of assessing the peer tutors with an on-line database was successful	4

Table 1: Average scores of post-course questionnaire

Participants were also asked to give written opinions about improving the system. Comments included:

- *Not a bad idea in theory, although many people possibly didn't use us enough and it got boring*
- *More feedback on our performance would have been useful*
- *I didn't know if students were filling out feedback on our efforts, so I wasn't sure if my help was satisfactory?*
- *Would have liked more information about how the system worked before we started*
- *Have the peer tutor tied with the same students all semester. This way it would be easier to help them, as you know where they are at, their history and motivation. This also would help in developing some trust between the peer tutor and the student which would help smooth things out at assignment time when both are stressed*
- *The tutors need more tasks to perform. The students were not using us enough.*

Clearly, all the peer tutors felt peer tutoring had been a useful exercise and the experience had helped them learn the content and develop better communication and interpersonal skills. Also, they felt that peer tutoring should be implementation across other units. However, they were not so content with the level of feedback received, as they were unsure if they were "doing a good job". Clearly, it is critical to keep tutors well informed of their progress to maintain their motivation and level of success. This is stipulated by Goodlad (1999) in point five "Support the tutors with regular feedback through de-briefing sessions…".

Conclusions

Both peer tutors and tutees, as other studies predicted, tended to enjoy the peer tutoring process and were largely supportive. It is difficult to determine if tutor support was based on the "rewards" attached to being a peer tutor (ie not having to do the weekly tasks), or a case of being intellectually and interpersonally stimulated by the exercise. To avoid problems it seems evident that Goodlad's (1999) principles are worth following when implementing peer-tutoring strategies. Also, in larger implementations such as this, where there were over 100 students and multiple academic tutors

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required, clear instructions, regular follow-up and even training sessions are needed to ensure an on-going peer-tutoring implementation. This should reduce inconsistencies across classes, as noticed in the student feedback where some students were unaware of the role peer tutors. In the next implementation, we would be more specific and procedural about giving peer tutors training and support with clear feedback about their progress.

In summary incorporating peer tutoring into this tertiary course was not taxing when we used the "seven golden rules" outlined by Goodlad (1999). Further, the rules appeared to be robust criteria. The results in this case study showed strong positive feedback for and support from the peer tutors, high student satisfaction with the course, and, obviously, satisfaction for the academic staff. It demonstrates how easily peer tutoring can be integrated with reasonable success into an existing unit of work with tertiary students.

References

Annis, L. F. (1983). The processes and effects of peer tutoring. *Human Learning, 10*(1), 39-47.

Australian National Training Authority. (1998). *Australia's National Strategy for Vocational Education and Training 1998-2003*. Canberra: Commonwealth of Australia.

Bennett, N., Dunne, E., & Carre, C. (1999). Patterns of core and generic skill provision in higher education. *Higher Education, 37*(1), 71-93.

Benware, C. A., & Deci, E. L. (1984). Quality of learning with an active versus passive motivational set. *American Educational Research Journal, 21*(4), 755-765.

Biggs, J. (1999). *Teaching for Quality Learning at University*. Buckingham: Open University Press.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Candy, P., Crebert, G., & O'Leary, J. (1994). *Developing Lifelong Learners through Undergraduate Education*. Canberra: Australian Government Publishing Service.

Dearing. (1997). *Higher education in the Learning Society*. London: HMSO.

Gibbs, G. (1992). *Improving the Quality of Student Learning*. Plymouth: Technical and Educational Services Ltd.

Goodlad, S. (1999). *Never Knowingly Oversold: a watchword for tutoring and mentoring schemes?* Paper presented at the 2nd BP Regional Conference on Tutoring and Mentoring, Perth, Western Australia.

Hartman, G. (1990). Peer learning and support via audio-teleconferencing in continuing education for nurses. *Distance Education, 11*(2), 308-319.

Mayer, E. (1992). *Employment-related key competencies: a proposal for consultation*. Melbourne: Australian Government Publishing Service.

Moses, I., & Trigwell, K. (1993). *Teaching Quality and Quality of Learning in Professional Courses*. Canberra: Australian Government Publishing Service.

Piaget, J. (1969). *Science of education and the psychology of the child*. New York: Viking.

Ramsden, P. (1992). *Learning to Teach in Higher education*. London & New York: Routledge.

Topping, K. J. (1996). The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. *Higher Education, 32*, 321-345.

Vygotsky, L. S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

Whitman, N. A. (1982). *Peer Teaching: To Teach is To Learn Twice*. Washington DC: ERIC Clearninghouse on Higher Education.

Turning a Current Trend into a Valuable Instrument: Multidimensional Educational Multimedia based on XML

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Abstract: This paper gives an overview on the work of the joint project „Wissenswerkstatt Rechensysteme“ (WWR, engl.: Knowledge Factory for Computing Systems), that is done by twelve German universities under leadership of the University of Rostock. The project is based on an innovative and multidimensional module concept. Its primary goal is to offer a large number of widely scalable teaching and learning modules in the field of computer engineering, which may be easily combined to courses. Moreover, an infrastructure for the management and use of the educational material is developed. The concept is completely based on the Extensible Markup Language (XML).

Introduction

The integration of computers and networks into education has led to the creation of numerous educational multimedia systems, reaching from isolated solutions (Mayer et al. 1998) and combined platforms (Neumann et al. 2001) up to complete studies via internet (Open University 2002). Projects like these are now followed by several current works, which are trying to develop complex, flexible, expandable and easily usable educational multimedia material based on the existing experiences.

There are a lot of tools for the realization of educational contents. For the presentation via internet, HTML and dynamical elements like JavaScript or media plug-ins are well suited. Moreover, authoring tools allow to create material with a high amount of interactivity or dynamical multimedia components. Programming languages like Java or C++ are rarely used for the implementation of educational software. A new possibility is the integration of different multimedia elements into a XML description (Pawlowski 2001) and their transformation into different output formats.

The goal of the (mostly expensive) production of multimedia courseware is the development of flexible platforms, which are suited for several methods of learning. Within the project „Wissenswerkstatt Rechensysteme“ (Lucke et al. 2001b), these requirements are fulfilled by use of the Extensible Markup Language (XML).

Project Overview

The work was started in April 2001. Recently, the conceptual phase has been finished, and the implementation of educational material and tools is going on. The following paper gives an overview on the whole WWR project: the structure of modules and courses, their implementation, and the architecture to develop and deploy this material. Some further aspects of this project are presented in more detail in other Ed-Media papers: the integration of our module concept and didactical aspects into existing XML description languages (Dettlaff-Günther et al. 2002), the criteria and results of an evaluation of existing learning environments and content management systems (Wiesner et al. 2002), and an inquiry of the integration of external simulators and experiments into the project's run time environment (Kalfa et al. 2002).

Compared to other works, there are mainly the following differences to WWR: The innovative concept of multidimensional modules simplifies the reuse of modules, since the extent of a module is not statically defined by the author, but dynamically by the teacher. A module can be simply adapted to different didactical strategies. In contrast to other projects, WWR is distinguished by the consequent use of XML technology and a very large group of developers and users (teachers as well as learners).

Concept of the educational material

The content to be implemented within the project has been structured into 150 modules, each for 4 weeks of lessons and exercises or practical training. A module has the following characteristics (Lucke et al. 2002):

- It is scalable in size respectively intensity. That means, basic, advanced and expert versions can be generated from a single description.
- It contains special elements for learners (for example exercises and tests) and for teachers (for instance sample solutions and didactical or pedagogical instructions).
- From an abstract description, several output formats can be generated, e.g. HTML for interactive use, PDF for printable manuscripts or PPT for a presentation with slides.

In this way, three dimensions of a module are achieved, as visualized in figure 1. This leads to 18 potentially different variants of each module. For the generation of a specific output from the internal data representation, the value of each dimension has to be specified.

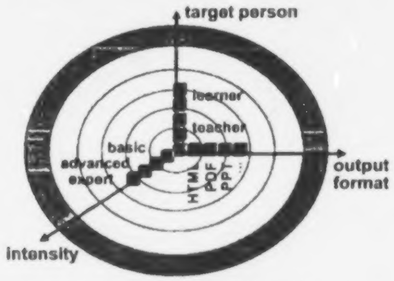
target person
learner
teacher
basic
advanced
expert
HTML
PDF
PPT
...
output format
intensity

Figure 1 Module dimensions

In order to ensure the reuse of the developed modules, a metadata set following the IEEE Learning Objects Metadata standard, LOM (IEEE 2000) is generated for each module. There are 35 attributes defined as obligatory, because otherwise users are not willing to fill out optional fields (Monthienvichienchai et al. 2001). 18 attributes are fixed due to the project context, 13 can be automatically extracted from the module description, and 4 have to be specified by the author. Furthermore, 4 attributes can be completed by own values. The generation of metadata is done during the upload of a module to the system.

Teachers are able to compose individual courses from this modules. To define a course, a combination of modules with their intensity (basic, advanced or expert) has to be specified. From this description, documents in different output formats and for both target groups (teachers as well as learners) can be generated (see figure 2).

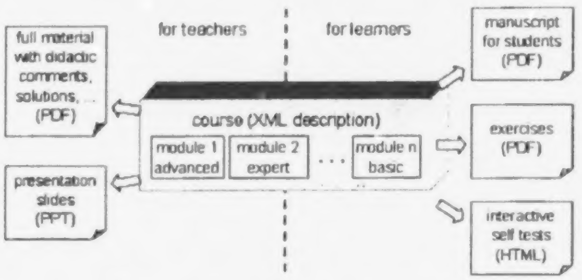
for teachers
for learners
full material with didactic comments, solutions, ... (PDF)
presentation slides (PPT)
course (XML description)
module 1 advanced
module 2 expert
...
module n basic
manuscript for students (PDF)
exercises (PDF)
interactive self tests (HTML)

Figure 2 Generation of course material

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Additional information resources are generated from the module and course descriptions, e.g. table of contents, index, glossary, list of abbreviations, list of cited persons. This is done by examining appropriately marked text elements in all modules and sorting them into the corresponding index.

Module implementation

To apply this high amount of flexibility to the implementation of modules, we have chosen document processing based on the Extensible Markup Language, XML (Harold et al. 2001). In contrast to other projects, XML is not only used for modelling of metadata or protocols, but for the whole encoding of a module. The description of documents is splitted into their syntactical structure (Document Type Description, DTD), the contents (described in XML), and its semantical interpretation (described with the Extensible Stylesheet Language, XSL). Because of the separation of content and its presentation, several kinds of output may be generated from a single XML file. For example, all elements can be marked with attributes to specify the dimensions mentioned above. Furthermore, XML files are completely independent from any hardware or software environment and may be handled easily in web-based applications.

The creation of the XML description language did not start from scratch. Existing languages have been evaluated, their concepts have been partially integrated and combined with the project's innovative concepts, e.g. flexible definition of module dimensions and different didactical contexts (Dettlaff-Günther et al. 2002). This allows a conversion between the formats by application of appropriate stylesheets.

The XML encoding of educational contents is done by the author of a module, using available XML editors or special tools. Since a lot of educational resources are already existing in other formats, import mechanisms (e.g. from word processing software) are an important topic. Many of the common tools are able to create XML files, which need to be converted into files following the project's DTDs. Currently, converters from MS Powerpoint, LaTeX, Adobe FrameMaker, and MS Word to the WWR document format are available.

In order to evaluate and to improve the XML concept, it has been validated by several test implementations. Firstly, an example module on workstation cluster architectures has been developed. It realizes all characteristics of the DTDs, for instance elements with different intensities, multimedia components with alternative definitions for distinct output formats, several types of exercises, didactical markings, and so on. Furthermore, the project's XML working group has provided a specific XML tutorial as well as the documentation of the project's DTD set following the DTD itself, and gained a lot of useful hints from this. A step-by-step transformation of the local educational material into this format is currently going on at all partner universities. In figure 3, parts of the source files and different output types of a developed sample module are shown.

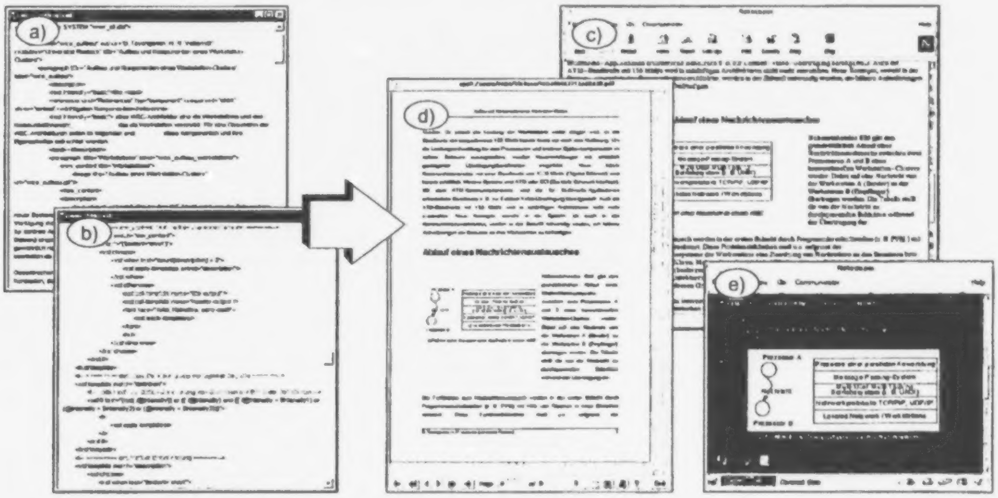

Figure 3 Input and output files of a sample educational module (in German language)
a) XML, b) XSL, c) online manuscript, d) printable PDF, e) presentation slides

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Interesting aspects of XML and stylesheet implementation are, for instance, the definition and interpretation of a multimedia component's attributes. It is necessary to offer a conversion mechanism between dynamic and static media types (as used in interactive and printable manuscripts), e.g. sound, video or animations. Another topic is the description of didactical intensities for the elements of a module, which have a strong influence on the extent of the generated material. Finally, the integration of external programs like simulators is subject of current work, too (Kalfa et al. 2002).

An important point that is often neglected is how to enable authors to produce quality content. Within our project, a special training of involved authors, e.g. for transformation of existing manuscripts into multimedia scripts, took place. Additionally, the DTD requires the specification of important didactical information, like the educational objectives or the explanation of used terms. All universities regulary give reports on and discuss their results in the project meetings. Finally, all modules are evaluated regarding to content, design and didactics by other partners (from universities as well as external partners) before publication. This assures maximum quality of each module.

A more XML-oriented description of this project has been given in some further publications (Lucke et al. 2002).

System architecture

Three aspects need to be considered to define the system architecture:

- typical user groups of the system
- the data which needs to be stored
- the processing of this data

Existing educational systems are distinguishing between the following types of users: administrator, author, teacher, tutor, student, and guest. Thereby, guests and tutors are subsets of other roles with restricted permissions, and therefore they do not need to be considered for the identification of architectural components.

Regarding to the storage components, there are two main groups of data: Unstructured, large objects like modules, multimedia elements or DTDs are better stored in a conventional file system; whereas smaller or fine-grained information like user data, module metadata or course descriptions should be managed in a data base system, in order to guarantee fast access and comfortable search.

Moreover, the following steps of data processing can be identified within such a system:

1. content production:
   An author is downloading the DTD set and additional instructions. Based on this information, he encodes his educational content in a module using a converter and/or editor.
2. content upload:
   The author is uploading the module with referenced multimedia elements on the server. It is verified against the DTDs, and the metadata is generated. Further evaluation, e.g. from didactical or content point of view, can take place here.
3. course definition:
   Teachers identify, parameterise and combine the modules needed for their courses, based on the metadata information. The course description is stored on the server.
4. course delivery:
   Teachers and learners are now able to request target group and media specific course material, which is generated from the module and course descriptions.
5. feedback management:
   Answers to exercises, questions for teachers, or remarks for authors need to be collected and redirected to their destination.

This leads to an architecture, which is simplified depicted in figure 4.

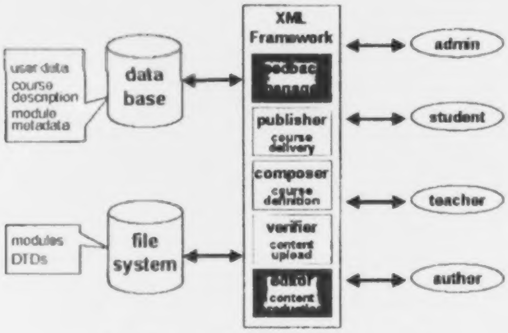

Figure 4 Architecture of the system

Unfortunately, we did not find a platform that fits our requirements (Wiesner et al. 2002). For this reason, several existing tools are currently combined and integrated into an overall solution for our project. Feedback manager, publisher, composer and verifier can be integrated in a web-based interface, which is mainly realized using tools like teaching and learning platforms or content management systems. They need to be adapted to the project specifics, e.g. DTD descriptions, XSL transformations or specifics of workflow management. Finally, any existing XML editor can be used to produce the modules. Project specific support for authors will be given, too.

This architecture not only implements the principles of *content on demand*. It could also be called *format on demand*, because it allows the online generation of course material, which is adapted to a specific educational intensity, target group and output medium. Furthermore, the distributed architecture is able to handle large amounts of data as well as users, which is a strong requirement in this field.

Conclusion and further work

Within the joint project „Wissenswerkstatt Rechensysteme", about 150 multimedia teaching and learning modules for the field of computer engineering will be developed. All modules can be combined together to generate specific courses, according to given educational objectives. Trough the use of the Extendable Markup Language (XML), each module is scalable in three dimensions:

- intensity: for basic, advanced or expert users
- target group: for teachers or learners
- output format: e.g. HTML, PDF or PPT

A platform has been presented, which will be used for deployment of the educational modules. The results will be used by all project partners. Furthermore, the partners from the industry and special interest groups will evaluate the modules relating to their content, design, and didactical aspects. The concept to define multimedia educational material completely in XML in order to achieve more flexibility in the dimensions named above is adaptable to any fields of education.

Current work is done on module development, on filter implementation, and on the integration of interactive elements like simulators. Further research will be done on the implementation of a real-time extension for the teaching and learning environment. The objectives of such a system are to allow the users to access applications from one or more central servers via the web, and to manage data and applications shared between many users. In this way, cooperative education using the material developed within the project can take place (Lucke et al. 2001a).

All mechanisms mentioned above are valuable instruments to further improve the quality of education, not only in the field of computer science.

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References

Dettlaff-Günther, C.; Lucke, U; Tavangarian, D.; Voigt, D.; Zeidler, H.-C. (2002). Teachware aspects and their description particulary through XML. *World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA), 2002*, Association for the Advancement of Computing in Education, Charlottesville, Virginia.

Harold, E. R.; Means, W. S. (2001). *XML in a Nutshell: A Desktop Quick Reference*. O'Reilly, Beijing.

IEEE (2000). *Draft Standard for Learning Object Metadata*. IEEE Learning Technology Standards Committee, New York. (http://ltsc.ieee.org/wg12/)

Kalfa, W.; Kroeger, R.; Koehler, F. (2002). Integrating Simulators and Real-Life Experiments into an XML-based Teaching and Learning Platform. *World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA), 2002*, Association for the Advancement of Computing in Education, Charlottesville, Virginia.

Lucke, U.; Tavangarian, D. (2001a). Gestaltung verteilter Lernsituationen mit dem Distributed Ubiquitous Desktop (DUD). *Arbeitsplatzcomputer (APC), 2001*, VDE-Verlag, Frankfurt, Germany.

Lucke, U.; Tavangarian, D. (2001b). Wissenswerkstatt Rechensysteme: Eine aktuelle Entwicklung in der multimedialen Lehre. *it+ti Informationstechnik und Technische Informatik*, 43/4, Oldenbourg Verlag, München, Germany.

Lucke, U.; Tavangarian, D.; Vatterrott, H.-R. (2002). The Use of XML for the Development of an Adaptive Multimedia Teaching and Learning System. *World Congress on Networked Learning in a Global Environment (NL), 2002*, Natural and Artificial Intelligence Systems Organizations, Sliedrecht, Netherlands.

Mayer, R.; Koch, M.; Tavangarian, D. (1998). A Multimedia Learning and Design System for Microprocessors. *European Workshop on Microelectronics Education (EWME), 1998*, Kluwer Academic Publishers, Noordwijkerhout, Netherlands.

Monthienvichienchai, R.; Sasse, M. A.; Wheeldon, R. (2001). There's trouble in paradise: problems with educational metadata encountered during the MALTED project. *World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA), 2001*, Association for the Advancement of Computing in Education, Charlottesville, Virginia.

Neumann, O; Borcea, K. (2001). *JaTeK: Java Based Teleteaching Kit*. (http://telet.inf.tu-dresden.de/Englisch/JaTeK-e.htm)

Open University (2002). *The Open University home page, UK*. (http://www.open.ac.uk)

Pawlowski, J. M. (2001). An Architecture of an Electronic Education Market Using XML-Standards. *World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA), 2001*, Association for the Advancement of Computing in Education, Charlottesville, Virginia.

Wiesner, A.; Weitl, F.; Kelp, E. (2002). XML based content and its integration into existing eLearning solutions: results and consequences of a survey. *World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA), 2002*, Association for the Advancement of Computing in Education, Charlottesville, Virginia.

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CaSA: A Technology-Based Solution to Improve Learning

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Abstract: Immediate feedback and assessment, active and interactive learning, and timely changes to adaptively deliver the curricular objectives within an integrated environment promote effective learning. This paper presents a flexible framework to develop technology-based solutions to augment learning experiences by coordinating and synchronizing instructional multimedia streams, matching lesson plans to student class experience and to program requirements.

Introduction

There are many different factors that influence whether a student has successfully attained core program knowledge. Though the causes for poor student performance are hard to pinpoint, providing timely, factual information to the stakeholders (students, instructors and program administrators) creates a foundation for more productive learning. A comprehensive assessment strategy facilitating two-way communication between each stakeholder, focused on immediate feedback, needs to be defined and implemented. This strategy should skew student performance above the desired threshold, generating "A Significant Difference" (Russell 1999).

It is the instructor's responsibility to ensure that the course provides the appropriate content for the student, supporting program requirements. Course learning outcomes are accomplished through course delivery and verified through test evaluation. Co-relationships exist between the program-defined content and the lecture-delivered content; and the lecture-delivered content and the student-received content. Unfortunately, a gap between defined, delivered and received content frequently exists.

Educational assessment has multiple, distinct uses in instructional improvement including: school and student accountability for academic achievement, feedback for teachers, data for administrators to allocate resources, and stimulation for students to receive a deeper understanding (Baker 1999). Typically, student performance is evaluated at irregular intervals. Students who were confused during lectures would not find out how far behind they were until it was too late to catch up. Without timely feedback connecting student learning to instructor evaluation, none of the stakeholders have the power to affect change or to correct problems.

A typical classroom experience involves multiple, simultaneous communications or streams of information. These may include verbal and visual presentations, board notes, electronic exercises, overhead presentations, hyper-linked multimedia references, as well as student questions, discussion, and notes. Unfortunately, these different material formats may overwhelm students, in terms of absorption or proper note taking. Student disengagement in the classroom is an issue that may hinder student's learning in an information overload situation. Research focusing on getting more out of the classroom experience shows that user-interaction in selecting data keeps the students interested in material (Hannafin 1996). According to Brien and Eastmond the ideal situation is one where the learner knows the final goal as well as the sub-goals that support the final goal. Therefore, it is important that learning outcomes be explicit and feedback frequent (Brien 1994). These studies indicate that students' needs and viewpoints have to be taken into consideration when course material is given in technology-based classrooms.

Many classrooms at the University of Cincinnati, like other campuses across the nation, are being equipped with the latest e-media technology. As students bring laptops into classrooms, they will have capability not only for note taking, but also for interacting with the instructional system. These machines present an excellent opportunity for enhanced interaction via immediate student feedback and assessment.

Approach

To facilitate a connected learning environment for students, teachers and educational organizations, there is a need for a flexible instructional infrastructure that can: Augment both classroom and post-classroom learning; Provide a channel for student feedback; Connect program requirements, course objectives and student learning explicitly so that effective, adaptive instruction can be realized.

The approach is to electronically record instructional content, synchronized with student feedback and assessment data, providing real-time monitoring. Content will be parsed, grouped into content units (CU), labeled, and indexed. These CU can be connected to lesson plan topics and program requirements, connecting delivered content to defined content and received content. Each stakeholder will be given the opportunity to mark or index into the content. As such, it should become immediately apparent if a requirement is not supported or a topic not received. This will foster two-way communication, facilitate review, and promote incremental, constructive change. The intent is to make connections between stakeholders explicit, immediate and effective.

A new framework, CaSA (Classroom and Student Achievement assessment), designed to develop new systems and instructional software is proposed. CaSA is a flexible framework to augment classroom experience by coordinating and synchronizing instructional streams, matching class plans to student class experience, and presenting instruction in a variety of media forms to promote self-directed learning. As such, it will provide a foundation to facilitate timely feedback and collect assessment data.

CaSA will synchronize information streams, providing context and valuable insight during assessment, instructor feedback, and student review. The strategy will take four forms: student topic marking, periodic electronic concept questions both during and after class sessions, real-time feedback monitoring, and instructional stream review and evaluation. By providing tools that assist students in retrieving, evaluating, comprehending and memorizing information while performing learning tasks the system will provide clear benefits (Aroyo, et al., 2001).

Conclusion

E-classrooms, and CaSA, provide a unique opportunity to augment current classroom experience, aligning the expectations of students, instructors and institutions. Given a system where both instructional and presentational aspects of a lecture can be evaluated promptly, instructors, students and program administrators can react quickly when there is a gap between program requirements, course objectives and learning outcomes, between the intent of one stakeholder and the understanding of another. As such, more effective communication can occur. Information can be gathered to measure student, faculty and organizational achievement and to assist in improvement. An e-classroom framework will improve instructor effectiveness with prompt and iterative feedback, giving them information and guidance regarding the kinds of educational materials and practices that most effectively enhance student achievement. It will increase student engagement, providing an environment that produces demonstrable gain in student achievement. Creation and implementation of projects such as this will demonstrate the usefulness of technology in education, especially in higher education where significant technological resources are already invested. Using technology to open clearly defined communication from students, instructors, and program administrators will close the gap from defined, delivered and received content and make "A Significant Difference".

References

Aroyo, Lora; Darina Dicheva and Ivan Velev (2001) *A Concept-based Approach to Support Learning in a Web-based Course Environment* Artificial Intelligence in Education, **68**, IOS Press, pp. 1-13.

Baker, E. L.; Mayer, R. E. (1999) *Computer-based assessment of problem solving*, Computers in Human Behavior, **15**, pp. 269-282.

Brien, Robert and Nick Eastmond (1994) Cognitive Science and Instruction, Educational Technology Publications, pp. 18-33.

Hannafin, R. and Sullivan, H., (1996) *Learner Control in Full and Lean CAI Programs*, Educational Technology Research and Development, **43**, No. 1, pp.19-30.

Russell, T. L. (compiled by), (1999) The no significant difference phenomenon as reported in 355 research reports, summaries and papers: A comparative research annotated bibliography on technology for distance education. North Carolina State University: Office of Instructional Telecommunications.

Online Professional Development for Teachers: Findings from a Formative and Collaborative Inquiry

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Abstract: This presentation will describe and report the findings from two offerings of a new online course on "engaged learning with technology" delivered to K12 inservice teachers. The course emerged as a university-business partnership activity. An overview of the partnership, the framework for course content and design, and research results will be presented. Recommendations for best practices for assisting inservice teachers in developing and implementing technology -rich and engaging learning activities will be offered.

Background

School reformers hold that teaching and learning in schools needs to be reconceptualized from a new paradigm incorporating meaningful and challenging content, higher order thinking, and project-centered, collaborative activities. Technology may be a means for arriving at such a vision (Means, Olson, & Singh, 1995). As a result government, local school boards, and administrators infuse more technology into our schools. By now it is finally being recognized that technology is not a "silver bullet" and that it can create challenges for teachers expected to use it in their classrooms (Ertmer & Hruskocy, 1999; Means, Olson, & Singh, 1995). Schools will need a "next generation" professional development system that uses the technology to cost effectively engage teachers in ongoing, everyday professional development tightly linked to student learning (NCREL, 2001).

Partnership models have evolved and been recommended as one method of approaching solutions to school innovation, technology integration, and teacher training (Osguthorpe, Harris, Harris, and Black, 1995). In 1998, a "Partnership for Technology Integration" was formed between the College of Education (COE) at Northern Illinois University and the Dukane Corporation. The mission of the partnership was "To act as agents of change toward the adoption and educated use of integrated instructional technologies in K12 settings and higher education". One of the principle activities charted to carry out this mission was to develop an online course to assist inservice teachers in developing engaging and technology enhanced lessons. The research described here focused on the lessons learned during the development and first two offerings of "Engaging with Technology (EWT): An Online Course."

The Course

The goal of EWT is to help teachers develop effective technology-supported instructional activities that promote engaged and worthwhile learning as well as enhance student achievement. "Engaged learning" is the concept based on the North Central Regional Education Lab's (1998) promotion for "Learning with Technology." Using the NCREL materials as a starting point, online activities were designed to include individual, small and large group–based instructional strategies. These strategies included Student HomePages, Private Discussion Areas for Peer Feedback, WebQuests, Synchronous Role Play and

Discussion Activities, Streaming Video and Print Case Studies, Existing Web-based Tutorials, and Threaded Discussion Brainstorming and Debriefing Activities.

Methodology

The nature of this inquiry was collaborative and formative. Data sources included Engaged Learning Plans, online discussion (synchronous and asynchronous) transcripts, participant autobiographies, interviews, field notes, researcher debriefings. Each of these was examined using both interpretational and reflective analysis.

Research questions that guided the study included: 1) How do the instructional and communication strategies employed in the online course and course tools assist learners in developing engaged learning lessons integrating technology? 2) How do participants react to learning to integrate technology through a technology-driven course? and 3) What tools and techniques help promote participant interaction?

Findings Highlights

Self-report on pre-survey data for all participants indicated that students beginning the course ranged in their experience with technology skills from novice to expert, but all had access to and had used email and word-processing before enrolling the course. The majority of the students also described themselves as having some knowledge of engaged leaning and technology integration, however only one had used a systematic framework for planning such lessons. Some had tried various technologies in lessons. Results on the post-survey showed an increase in familiarity and interest in the systematic planning of engaged learning lessons that integrate technology. Students also reported a wider range of technologies that they were familiar with and comfortable considering for future lessons. The Internet was cited most often as the technology most useful for their lesson planning.

A review and report from the course facilitators on the lesson plans indicated that teachers developed effective lesson plans incorporating engaged learning strategies and technology. Interviews with the students supported consistently a high level of satisfaction with the course, with integration, and with learning to use technologies.

Facilitator and design team reflections from debriefing transcripts and journal entries yielded the following reflections and recommendations:

- Participants need regular and repeated feedback in asynchronous discussions.
- Synchronous discussions have better participation and depth when guided by questions and when participation is limited to small groups.
- Assessment is more time intensive and more essential in the online environment.
- Instructors comfortable with face-to-face instruction have to learn and employ many "personal" techniques to gain the same or similar relationships with students (own web page with personal comments and picture, chat type communication with individuals and small groups).
- Regular communication between the design team and facilitators was necessary even when content was clear and understood.

References

Ertmer, P. A. and Hruskocy, C. (1999). Impacts of a university-elementary school partnership designed to support technology integration. Educational Technology Research & Development, 47 (1), 81-96.

Means, B., Olson, K., and Singh, R. (1995). Beyond the classroom: Restructuring schools with technology. In C. Cunnigham (Ed.), Perspectives: Instructional technology for teachers (pp. 87-91). Boulder, CO: Coursewise Publishing.

North Central Regional Education Laboratory. (1998). Learning with technology: Facilitator's guide. Oak Brook, IL: NCREL.

North Central Regional Education Laboratory. (2001). EnGAUGE: Underlying principles. Available online at: http://www.ncrel.org/enguage. Downloaded March 15, 2001.

Applying qualitative research in e-learning. Discussion and findings from three case studies. Investigating the quality of e-learning towards a knowledge management oriented metadata schema.

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Abstract: The case of learning in digital economy 's era is a fascinating phenomenon. The complexity of learning integrated with the diversification of new technologies set a dynamic landscape where the performance seems to be the overall objective of combined efforts. Our approach tries to investigate the phenomenon from a "myopic" point of view. The starting point of our research effort is the acceptance for the existence of a direct relation that brings together learning, new technologies, pedagogy and knowledge management. In this paper we present the initial findings from the application of qualitative research methodology. More specifically we discuss three case studies (multiple case strategy) concerning elearning systems implementations and we discuss the way that knowledge management theory can support in practical ways the performance of e-learning systems.

Introduction

A common practice in academic institutions or business units is the employment of new learning technologies in order to support the human resources management. In most of cases the adoption of several Learning Management Systems, provides a context for exploitation but unfortunately the achieved learning performance is rather inadequate (Lytras and Pouloudi 2001a). Several conflicting opinions about the convergence of knowledge management and e-learning realized a dialectic context of reasoning and justification. The fact that knowledge management concentrates on knowledge processes and knowledge artifacts (Mentzas *et al.* 2001) promoted the initial step in our approach. If in an e-learning environment we can justify several knowledge processes that construct a kind of knowledge artifact that is finally diffused to learners then the information technology can analyze the technical standards and the required applications for the support of our conceptualization.

Research Methodology

In the general literature of research methodologies in information systems, (Orlikowski and Baroudi 1991), we can found many approaches which in general can be placed among the qualitative or in the quantitative research methodology. More over the analysis of our research problem and the justification of our research methodology can be supported by the concepts, which Klein & Myers (Klein and Myers 1999) proposed. The hermeneutic cycle and its basic emphasis on the complementarities of a phenomenon and its component promote the basic idea that a phenomenon such as e-learning has to be analyzed through the qualitative research methodology. The case studies in our research are:

- The Global E-management Master e-learning system and especially the development of the T1 course entitled E-technology, which was delivered to the student of the GEM consortium,
- The XEXO project (Educational space without limits), which objective was to establish an e-learning system and to deliver a master degree course to the students of three universities in Greece
- The Teleducation Center of Athens University of Economics and Business that utilizes the WebCT platform

in order to provide learning content to students.

Conclusions

The limited space of the article, does not allow to present the findings in detail even though that we believe that qualitative research reveals many hidden aspects of the phenomenon of elearning which no quantitative research can do. Figure 1 summarizes the e-learning content development life cycles.

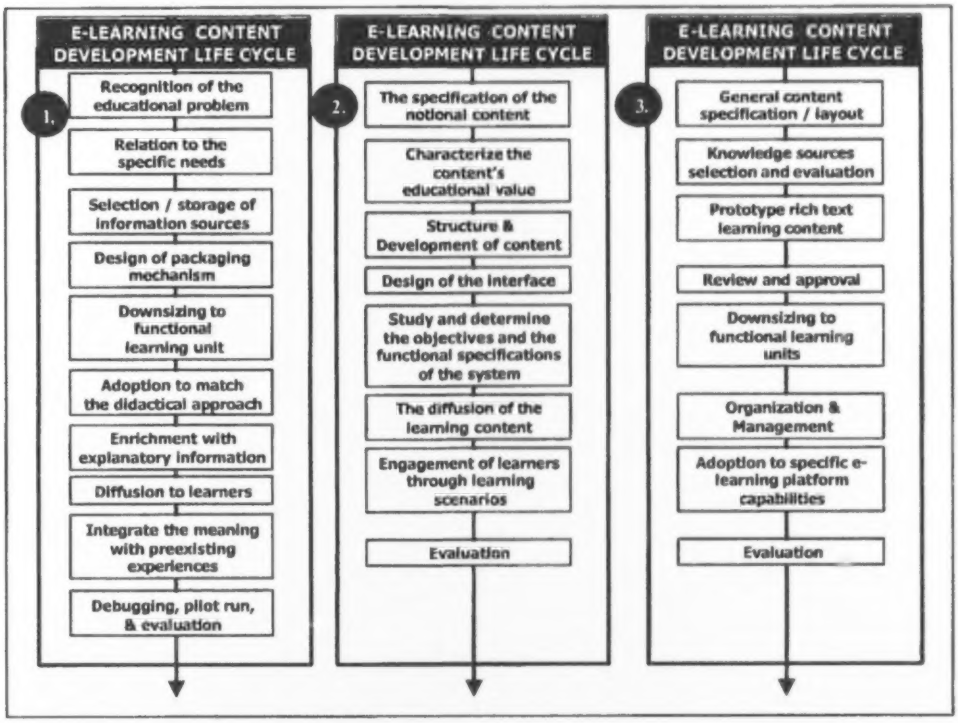
E-LEARNING CONTENT DEVELOPMENT LIFE CYCLE
1.
Recognition of the educational problem
Relation to the specific needs
Selection / storage of information sources
Design of packaging mechanism
Downsizing to functional learning unit
Adoption to match the didactical approach
Enrichment with explanatory information
Diffusion to learners
Integrate the meaning with preexisting experiences
Debugging, pilot run, & evaluation
E-LEARNING CONTENT DEVELOPMENT LIFE CYCLE
2.
The specification of the notional content
Characterize the content's educational value
Structure & Development of content
Design of the interface
Study and determine the objectives and the functional specifications of the system
The diffusion of the learning content
Engagement of learners through learning scenarios
Evaluation
E-LEARNING CONTENT DEVELOPMENT LIFE CYCLE
3.
General content specification / layout
Knowledge sources selection and evaluation
Prototype rich text learning content
Review and approval
Downsizing to functional learning units
Organization & Management
Adoption to specific e-learning platform capabilities
Evaluation

Figure 1. The knowledge management perspective in 3 cases

Key themes	Theoretical findings	Empirical results	Conclusions
E-LEARNING CONTENT DEVELOPMENT AS A CONSTRUCTIVE KNOWLEDGE MANAGEMENT PROCESS	(Mentzas *et al.* 2001) , (Lytras *et al.* 2002b), claim that knowledge processes are a value carriers. This theoretical abstraction utilized the propositions of other researchers , (Nissen *et al.* 2000) who provided several life cycle descriptive models for KM	All 3 cases provided information that justifies e-learning as a KM process. Specific phases usually informal provide a context for the diffusion of learning content to users. Several problems unfortunately and limited management mechanisms decrease the performance	The conclusion is that the knowledge process concerning e-learning realization range to a wide spectrum that incorporates two general pillars: General knowledge management processes and process for the adoption of knowledge to learning objects.
LEARNING OBJECT AS A KNOWLEDGE ARTIFACT	(Mentzas *et al.* 2001) claimed that knowledge artifact is a way for realizing the knowledge management. Several researchers e.g.	In all cases it was recognized that learning content was not knowledge in its true sense since there was an absence	The development of learning content requires the attachment of metadata in order to become a qualitative transformation of

	(Nonaka and Takeuchi 1995), where a questioning concerning what is knowledge is provided. The justification of learning object as a knowledge artifact drive an excessive analysis	of metadata or semantics that would enrich the semantic density of learning material. But it was also stated that codification and diffusion is of critical importance for the learning objects.	information to knowledge. This requires excess effort from educators. The overview of several metadata schemas (LOM, GEM, Ariadne, IEEE LOM, IMS, DC) seem to bee inadequate to support the learning dimension of e-learning
METADATA JUSTIFICATION AND E-LEARNING PEDAGOGY SUPPORT	Shuell (1992) & Bloom and Krathwohl (1984) provide a context for providing different learning value. Learning processes or learning objectives are the value drivers.	Unfortunately the learning performance of three cases was based on static learning scenarios. It was evident that this dimension of e-learning implementations was too weak and needed support.	The detailed analysis of learning processes can cause a significant contribution specifying metadata elements for specific learning processes.

Table 1. Comparing the Theoretical and Empirical Evidence

References

Klein, H. K. and M. D. Myers (1999). "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems." MIS Quarterly **Vol. 23**(1): pp. 67-94.

Lytras, M. D. and A. Pouloudi (2001a). E-learning: Just a Waste of Time. In Strong, D., Straub, D. & DeGross, J.I. (Eds) Proceedings of the Seventh Americas Conference on Information Systems (AMCIS), Boston, Massachusetts, pp. 216-222.

Lytras, M. D., N. Pouloudi and G. Doukidis (2002b). "A framework for technology convergence in learning and working." Educational Technology and Society, Journal of International Forum of Educational Technology & Society and IEEE Learning Technology Task Force, (accepted for publication in the special issue of April 2002).

Mentzas, G., D. Apostolou, R. Young and A. Abecker (2001). "Knowledge networking: a holistic solution for leveraging corporate knowledge." Journal of Knowledge Management **Vol. 5**(1): pp. 94-107.

Nissen, M., M. Kamel and K. Sengupta (2000). "Integrated Analysis and Design of Knowledge Systems and Processes." in: Information Resources Management Journal **Vol. 13**(No. 1 (Jan-Mar)): p. 24-43.

Nonaka, I. and H. Takeuchi (1995). The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, New York: Oxford University Press.

Orlikowski, W. J. and J. J. Baroudi (1991). "Studying Information Technology in Organization: Research Approaches and Assumptions." Information Systems Research **Vol . 2**(2): pp. 143-67.

Semantics for E-learning:
An advanced Knowledge Management oriented metadata schema for learning purposes

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Abstract: In recent years many researchers try to investigate the direct or indirect impact of knowledge management approaches to the achievement of strategic corporate objectives. Several approaches have been promoted, with main emphasis to be paid at the justification of knowledge exploitation processes. Our research effort is concentrated on the demand for high quality interchangeable knowledge objects capable to support dynamic learning initiatives. The general metadata models (Dublin Core, IMS, LOM, SCORM) for knowledge objects enrichment are been reviewed and a well justified critique is provided in order to claim the importance for the justification of an "interchangeable knowledge objects standard" for learning purposes. The overall objective is the justification of a dynamic learning environment capable of supporting the value diffusion.

Introduction

The development of dynamic learning environments requires a systematic justification of methods and processes that vary learning (unique value proposition) for every learner. This challenging situation sets a context that promotes the research in reusability of knowledge resources. A realization of reusability can be based on semantics that enrich general knowledge resources (e.g. an article, a journal paper, a PowerPoint presentation, e.t.c.). The ultimate objective is to expand the customization capabilities of learning environments and knowledge management seem to be a well justified mean for the achievement of such a goal (Lytras and Pouloudi 2001c), (Lytras *et al.* 2002a), (Lytras *et al.* 2002b). Our research intents to justify a metadata schema that supports a dynamic e-learning environment. The current situation on metadata is described by a narrow vision on learning.

A synopsis of conceptual abstractions

The organization of knowledge in distinct objects, small structural components, is the basis of reuse. In the case of customized learning the same learning content can be used in many ways due to its integration with other knowledge objects. Our approach is based on two clear assumptions that initiate the whole research: **A learning object** is a synthesis of knowledge and metadata that expand further the learning effect of knowledge. From this perspective an e-learning environment has to utilize a learning objects base. A critical question is which metadata can we use in order to increase the learning effectiveness. **A learning process** is an abstraction of a logical sequence of learning activities or tasks. The conceptualization of learning processes determines an interface in which the components of a learning object can be realized. This layout is a value container, which is utilized by the embodiment of learning object. The critical question is which learning processes can we use? And is there any hierarchy of learning processes that determine different value layers?

The underlying issue behind the packaging of knowledge is the reveal of a key idea that will support the accomplishment of a metadata scheme. Our proposition that has been developed after many implementations of e-learning projects in our research unit, ELTRUN. (www.eltrun.aueb.gr) is that the convergence of knowledge management and e-learning is realized through an integrated life cycle model (Lytras *et al.* 2002a). Each step in this model represents a value adding process. Each step sets a context for questioning about the required metadata that have to be attached to a generic knowledge source in order to formulate learning object. The key proposition in our approach is that a number of metadata can supports each step in the whole model and also the learning processes as learning objects containers. For the specification of the elements of this metadata schema a review of well-known metadata schema has been undertaken.

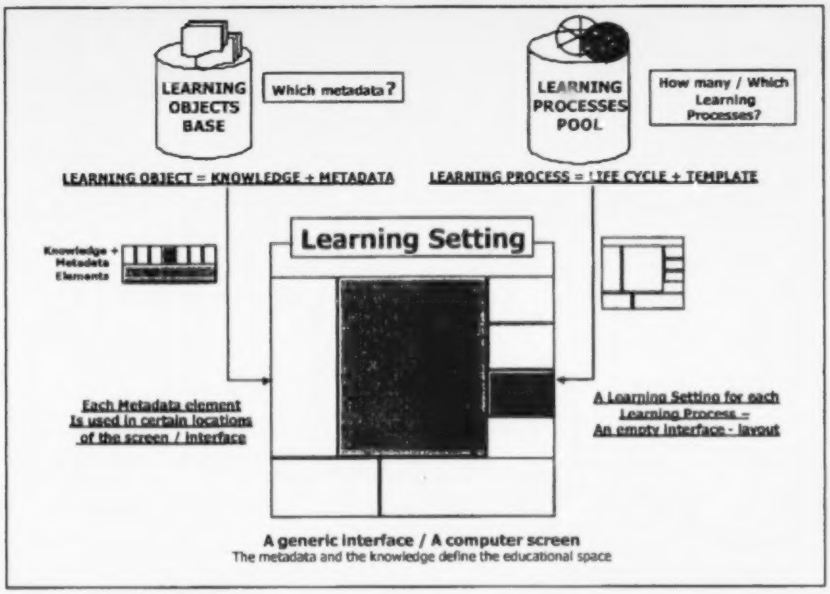
LEARNING OBJECTS BASE
Which metadata?
LEARNING PROCESSES POOL
How many / Which Learning Processes?
LEARNING OBJECT = KNOWLEDGE + METADATA
LEARNING PROCESS = LIFE CYCLE + TEMPLATE
Learning Setting
Knowledge + Metadata Elements
Each Metadata element Is used in certain locations of the screen / interface
A Learning Setting for each Learning Process = An empty interface - layout
A generic interface / A computer screen
The metadata and the knowledge define the educational space

Figure 1: The basic conceptual abstraction

Multidimensional Dynamic Learning Proposed Metadata Schema

Metadata are data about data. In the context of learning, metadata are data about learning objects. This definition provides the major characteristic of metadata: They are descriptive indexing labels. Unfortunately for the case of learning this is not enough. The indexing of learning object it seems to be a management facility with limited impact on the realization of engagement of learners. A lot of approaches concerning metadata have been proposed for general or learning purposes. Some of the most well known organizations that work in metadata specifications are the Aviation Industry Computer-Based-Training Committee (AICC), the IEEE Learning Technology Standards Committee, the ARIADNE, the Educause Instructional Management Systems (IMS) Project, the W3C, and the ADL. The critical review of several metadata schemas including IEEE Learning Objects Metadata, IMS, Dublin Core, SCORM, GEM realizes a gap in learning. This gap in the propositions of the famous metadata schemas sets a context for significant contribution.

Conclusions

The overall approach described in the limited space of this paper provides a context for exploitation focusing on learning. The incremental refinement of conceptualization drives to a set of metadata that can assist the transformation of knowledge resources to reusable learning objects. This step-by-step justification finally drives an extensive XML specification of the metadata schema. The selection of learning processes as the carrier of value expands the dynamic nature of an e-learning system. The whole approach seems to integrate the two well-defined and distinct approaches to knowledge management, the knowledge artifact and the knowledge activities approaches. Future research is concentrated on the analysis and the development of a dynamic e-learning environment based on the key ideas of Knowledge Interchange Concept. For this scope an IST proposal is going to be prepare. We welcome any collaboration that will support the refinement of this proposal.

References

Lytras, M. D. and N. Pouloudi (2001c). "Expanding e-learning effectiveness. The shift from content orientation to knowledge management utilization", Word Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA 2001), June 25-30, 2001, Tampere, Finland (CD Proceedings).

Lytras, M. D., N. Pouloudi and G. Doukidis (2002b). "A framework for technology convergence in learning and working." Educational Technology and Society, Journal of International Forum of Educational

Technology & Society and IEEE Learning Technology Task Force, (accepted for publication in the special issue of April 2002).

Lytras, M. D., N. Pouloudi and A. Poulymenakou (2002a). "Knowledge Management Convergence: Expanding Learning Frontiers." Journal of Knowledge Management, **Vol. 6**(1): pp: 40-51.

Relate / Value	Language, Subject, Quality, Main Concept
Acquire	Purpose, Title, Description, Creator, Publisher, Contributor, Identifier, Authors, and Institution
Organize	Date, Format, Location, Type, Source, Relation, Discipline, Sub discipline, Main concept, Main concept synonyms, other concepts, granularity
Transfer	Cost, Copyright & other restrictions, rights, Document type, Document handle, Document format, File size
Use	Operating system type, OS version, other platform requirements, Installation remarks, Access rights, restrictions, Usage remarks

Table 1: Metadata for General Knowledge Management

Relate	Interactivity Type, Interactivity Level, Intended End user role, Learning context, Typical Age Range, Typical Learning Time, Language, Relation, Coverage, Audience, Grade, Pedagogy, End user type, Didactical context
Adapt	Metadata (author, creation date, last modified date, language, validator, validation date)
Attract	Semantic density, difficulty, Description, Standards, Quality, Duration, Difficulty Level, Interactivity Level
Engage	Essential Resources, Pedagogy, and Pedagogical Duration
Learn	Pedagogy teaching methods, pedagogy. Assessment, semantic density, annotation (annotator, creation date, content)

Table 2: Metadata for Learning Exploitation

Presentation	Summary, Purpose, Essential Resources, Annotation, Topics, and Search Guidance
Analysis	Summary, Purpose, Conceptual Components, Typical Relations, Annotation, Relevant Topics, Search Guidance, Analysis conclusions, Collaboration Details
Synthesis	Summary, Purpose, Relevant Knowledge Objects, Typical Relations, Conceptual Components, Annotation, New Meaning, Draw Relations, Search Guidance, Recommended Conclusions, Conclusions, Collaboration Details, Guidance
Evaluation	Purpose, Relevant Knowledge Objects, Summary, Collaboration Details, Guided Theories, Guidance, Application Session, Simulation Session, Annotation, New Meaning, Conclusions, Recommended Conclusions
Reasoning	Summary, Purpose, Relevant Knowledge Objects, Annotation, New Meaning, Guidance, Conclusions, Recommended Conclusions, Starting Points, Collaboration Details
Explanation	Summary, Purpose, Relevant Knowledge Objects, Topics, Typical Relations, Draw Relations, Annotation, New Meaning, Guidance, Collaboration Details, Recommended Conclusions
Relation	Summary, Purpose, Relevant Knowledge Objects , Main Concepts, Draw Relations, New Meaning, Annotation, Guidance, Typical Relations, Conclusions, Collaboration Details
Problem Solving	Summary, Purpose, Relevant Knowledge Objects, Present Problem, Sub problems, Main Concepts , Collaboration Details, New Meaning, Annotation, Guidance, Conclusions
Collaboration	Summary, Purpose, Recording, Annotation, Findings

Table 3: Metadata for Learning Processes

The Learning Support, Training And Environment For Effective Online Teaching And Learning: Sevenoaks Senior College, Western Australia

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The study examines the support, training and environment likely to make possible effective online teaching and learning. It focuses on an innovative new senior college in Perth, Western Australia that is committed to creating an outcomes-focused curriculum by integrating unique Information and Communication Technology infrastructure into the delivery of educational programs, on-line curricula, and management systems for both teachers and students. Sevenoaks Senior College has provided the means to manage education through an infrastructure that supports a learning community via strategic partnerships and online collaboration. This is an important direction for schools as it addresses the educational needs of students with lifelong learning strategies for future work and university life. The study being carried out over 2001-2003 combines quantitative and qualitative research methods to examine the ways in which ICT is used and the learning environment.

Background/Theoretical Framework

In *Backing Australia's Ability: Innovation Action Plan*, $68.2 million over five years (2001-2006) was committed to the Schools Online Curriculum. The commitment was made on the premise that:

> "*While investment by all schooling systems in equipment and connectivity has paved the way for change, it is the availability of quality online content that will begin to improve learning*"
> *(Learning Federation Schools Online Curriculum Content Initiative, 2001)*

At the local state level, the Western Australian government has invested approximately $100 million on information technology in schools, including approximately $8.3 million to build the Sevenoaks Senior College.

However, increased spending on ICT in schools and educational institutions does not necessarily guarantee improved teaching and learning environments and improved student outcomes (Centre for Research on Information Technology and Organisations, 1999; EdNA, 1999a; White, 1999). Education has a poor history of meeting the challenges of major shifts in Information and Communications Technology (Trinidad, 1998).

Findings To Date – Multi Layered And Multi-Faceted Case Study of Sevenoaks Senior College

The Online Courses

To date, the teachers at Sevenoaks Senior College have developed 90 courses in WebCT; for the first year of operation, this can be considered a significant success for the teachers and support facilities found at Sevenoaks.

Some of the courses developed online at Sevenoaks Senior College include an English unit dealing with TV drama, a Digital Media unit based on an anti-smoking campaign, a Physics Nuclear Technology unit and a Political and Legal Studies; all used a constructivist framework. Discussions with teachers indicate that time constraints, the need to recognise workloads and set limits within a given time frame is critical.

The Teachers

Interviews have reflected a positive attitude to the vision of Sevenoaks Senior College. However, one of the biggest hurdles that the teachers have experienced is getting students to use their time wisely and effectively. "I found that some students did all the reading that was required but had to be pushed to produce anything substantial, and that the computer nerds talked the language but tended not to do much else" [IDT1:2001]. Observations and interviews with teachers and students indicated that the supportive learning environment created by the teachers was vital to the success of the unit (Aldridge et al, 2002).

A key factor in the development of online learning at Sevenoaks has been the integral role of the Teacher Librarian. The Teacher Librarian has become responsible for facilitating staff development by acting as a staff trainer, a mentor and an initiator in the development/creation of modules of online curriculum

The Students

According to students studying at Sevenoaks whom were interviewed, computers are used mainly for researching information on the Internet, typing up assignments and accessing course information from the WebCT platform during class time (Trinidad, Macnish, Aldridge, Fraser & Wood, 2001). These results reflect previous research, which has reported that Australian school students spend more time using word-processing software than any other software, and that they use the Internet primarily for email, research and entertainment (EdNA, 1999a; White, 1999).

A significant feature of the Nuclear Physics course was the opportunity available to students to engage in discussion, debate and present and argue about ideas. One student interviewed commented: "I liked the online course because sometimes you can learn more from other students." Some students indicated their displeasure at the amount of time that was required to research and look for information. On the other hand, one student commented on the advantage of the unit in terms of inquiry rather than being given information by the teacher: "I usually find that, when you actually find out something on your own, you learn more from it" (ID98:2001).

All of the students whom were interviewed held very positive attitudes towards the use of ICT in the classroom. Student comments on the benefits of online learning included: "You know exactly what to do and there are no excuses for not doing assignments" (IDS12:2001) and "[We are able to] look up more information, which is better than books and gives a wider range to look at" (IDS2:2001).

Discussion and Conclusion

As Sevenoaks Senior College moves into its second year, it is timely to consider ways in which teachers can be helped to use the ICT environment in more innovative ways in their classroom and to move towards a higher level of course development. There is a need for appropriate professional development to move towards developing/adapting courses with innovative models; achieving quality measures and standards; and planning the integration of ICT into classes.

In summary, the learning environment at Sevenoaks is one where teachers and students feel supported. It is an environment that enables students to assume more responsibility for their individual learning and where teachers are provided with the means to manage the transition from a traditional classroom to one that effectively integrates ICT in teaching and learning for the benefit of the student.

References

Aldridge, J. M., Fraser, B.J., Murray, K., Combs, B., Proctor D. & Knapton, P. (2002). Learning Environment, Teaching Strategies and the Implementation of A Grade 11 Online Nuclear Physics Program. Paper presented at the *National Association for Research in Science Teaching*, March 2002, New Orleans

Centre for Research on Information Technology and Organisations. (1999). *Teaching, learning and computers: Findings.* [On line] Available http://www.crito.uci.edu/tlc/html/findings.html

EdNA. (1999a). Non-*usage: July 1999.* education.au limited ACN 058 020 876. [Online] Available at http://www.edna.edu.au/publications/online_ed99/report.html

Erickson, F. (1998). Qualitative research methods for science education. In B. J. Fraser & K. G. Tobin (Eds.), *The international handbook of science education* (pp. 1155-1173). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Learning Federation Schools Online Curriculum Content Initiative Pamphlet (2001). http://online.curriculum.edu.au/socci/content/pdf/learningfederation.pdf

Trinidad, S. (1998). National overview: Table of state education department technology initiatives. *Australian Educational Computing, 13* (2), 4-5.

Trinidad, S., Macnish, J., Aldridge, J., Fraser, B., & Wood, D. (2001). Integrating ICT into the learning environment at Sevenoaks Senior College: How teachers and students use educational technology in teaching and learning. Paper presented at *Australian Association for Research in Education AARE2001 Conference*, December 2nd5th, Fremantle: University of Notre Dame.

White, G. (1999). *Online education report. Education.au Ltd.* [On-line] Available http://www.edna.edu.au/edna/publish/system/edures/edreport.html

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Informatics and Media Education -
Designing a Curriculum for Media Education in Teacher Training with Regard to Basic Areas of Informatics

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Abstract: The Didactics of Informatics research group at the University of Paderborn is involved in efforts to design, implement and evaluate a curriculum for Media education for prospective teachers at the secondary school level. One major issue is the question of whether it is necessary for future teachers to learn the basic concepts of informatics, and if so, which topics within informatics are relevant, and which main objectives should be achieved. After two years of seminars on basic informatics for students of education at the University of Paderborn, it is now possible to submit the preliminary results. The presented paper discusses the rationale behind introducing informatics into media education for teachers, and describes elements of the curriculum, as well as the main teaching objectives for a better understanding of computer-based media.

The Role of Computer-Based Media in School

From the Perspective of the Student

Students today should have many different abilities in using computers and computer-based media. First of all, they must have the ability to use hardware and software (i.e. to turn on a computer, use a word processor, work cooperatively over a network, etc.) Because of the ongoing revolution of products and ideas, training for specific software products will not sufficiently prepare students for future demands. Today's students should be able to analyse and evaluate the social impact of using computer systems and computer-based media (CBM). Therefore, it is not sufficient to teach only the basics of computer operation. Students should learn about concepts of computer-based media, digital coding of data, and computer networks (especially the Internet), as well as the relationship between traditional and computer-based media. They should acquire basic skills and understand the functionality of new media such that they can evaluate its future impact on society. These are the elements of competency in media that should be taught to students.

From the Perspective of the Instructor

Educators have tasks which range from planning and instructing courses to administration of schools or counselling of students, and they can incorporate CBM into these areas. But if students should learn more than simple computer operations, then teachers must as well. They should not only have media competency so that they can work with computers, but also didactical media competency in order to integrate computers into the learning and teaching processes. Finally, teachers need media *educational* competency to teach computer-based media. It is essential that teachers learn to use CBM in different classroom settings (scenarios), in order to enhance the learning process. These scenarios are helpful in designing a curriculum for media education in teacher training (Magenheim & Schubert, 2000).

Organisational Aspects

Administration can also benefit from the use of computer-based media. Although its needs differ from those of the classroom, administration is concerned with the improvement of the school system, and this can be done with CBM. It can be used to create a more customized learning environment, design curricula for media education or create new ways of teaching and learning, make the school more responsive to community needs and vice versa, administrate school equipment and networks, and make the school dynamic and open to change.

The role of computer-based media in school involves learning by the students, instruction by the teachers, and organisation and improvement by the administration. Teachers need not only a specific tool, but knowledge about how it works in order to adapt the tool to their specific needs. This means that the curriculum must be generic, and must include the basics of informatics. If future instructors do not obtain grounding in informatics in their media classes, they will not be able to use the full potential of computer-based media.

To gain an understanding of the possibilities of computer based-media that cover the above perspectives and allow prospective teachers to keep their understanding up to date, a curriculum for media education must supply the learners with a solid foundation. This foundation is built by incorporating the specific qualities of CBM into the curriculum.

One of these qualities is digitalization. CBM uses digitally-represented data, regardless of form (text, video, sound, etc). This quality allows certain features such as transforming, copying, etc. To understand this aspect, one must consider the technical and informatics background of digitalization.

Another important aspect is to understand how the processing of digitally-coded data and its representation is interwoven with the human processing of information in media use. CBM are tools for constructing, transforming, and copying digital data, and simultaneously, they convey information. One must comprehend this duality of CBM in order to fully grasp the effect on our daily lives.

To understand and use CBM effectively, its construction process must be considered; software development is not only a technical process, but must take into account cognitive processes and needs of the users (Magenheim, 2001). This is especially important in an educational context where prospective teachers should learn to apply pedagogical software tools, to evaluate and (hopefully) to improve them in cooperation with software developers.

It is clear that these goals are only reachable by a curriculum that includes basic elements of informatics. These will be discussed later, but first, we consider other elements necessary for the development of a curriculum.

Elements of a Curriculum for Media Education in Teacher Training

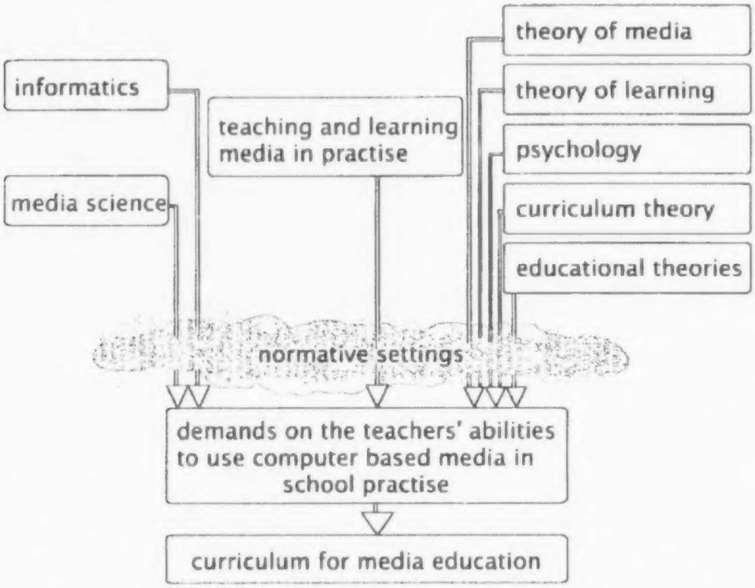
theory of media
informatics
theory of learning
teaching and learning media in practise
psychology
media science
curriculum theory
educational theories
normative settings
demands on the teachers' abilities to use computer based media in school practise
curriculum for media education

Figure 1: Influencing Factors on a Curriculum for Media Education

Many factors influence a curriculum for media education. Arts and sciences (not a topic of this paper) contribute to its concepts, content, and teaching methods. However, these cannot entirely dictate the curriculum, as they are filtered through normative settings (society, educational conventions and politics). They do assist in forming the requirements, which are necessary in the use of computer-based media. From these requirements, tasks and scenarios can be generated and worked into the construction of the curriculum. Specific contents can be taken from the general curriculum to cover different tasks.

The curriculum for media education in teacher training developed by the research group at the University of Paderborn does not claim to be complete; rather, it is focused on those aspects of a curriculum which require fundamentals of informatics.

Basic Areas of Informatics in Media Education for Teachers

As we have seen, instructors must have different skills and knowledge areas to be successful. There must be a way to distinguish the use of specific software tools from the use of computer-based media. Useful here is Basic Areas of Informatics (BAI), which describes the fundamentals of informatics for general media education (Schulte & Scheel, 2001). BAI serves as a theoretical foundation for forming basic skills and knowledge. BAI was developed in the context of didactics of informatics to specify the role of informatics in secondary education for a general media education. Thus, didactical concepts, common media education concepts, and corresponding work in informatics were analyzed, with a resulting abstract consisting of four tasks for building the informatical foundations of a general media education. These areas are:

1. Concepts of formalism and problem solving strategies in informatics

In informatics, modelling languages and tools are developed for the representation of information. We call them representation techniques. Modelling tools such as UML are usable outside of the software development process. The aim here is to supply students with the background knowledge necessary to competently use these tools. On the one hand, students should be able to express representations of things

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(structures and processes in different subject areas) formally with the aid of representation techniques. On the other hand, they should learn skills for using software products (i.e. word processors, spreadsheets) to represent things. The aim is not to teach a specific user interface, but rather to teach understanding for the typical media functions of these computer-based tools – for example, the proper use of style sheets. These functions are 1) to represent things, 2) to (re)arrange representations, 3) to save representations in data files, and 4) to provide others with information about these products (see Hubwieser, 1997). This Area does not cover questions concerning the content or aesthetics of representations.

2. Technical basics

This Area describes the technical and informatics skills necessary for using computer-based media. It covers skills such as choosing the appropriate data format and software-tool, building suitable directory trees to manage data, and querying databases and search engines. Students should gain an overview of the technical infrastructure in which they use computer-based media: For instance, the global networks, protocols and software tools that build the World Wide Web.

3. Semiotics

In computer-based media, symbols have a dual purpose: They form programs to control machines, but they also serve as media in a broader sense; for example, source code for a program is executed by a machine but understood by a human. The learning goal of this Area is to reflect on these specific semiotic implications of computer-based media. The user communicates with other users, but interacts with the machine (human-computer interaction). There lies an area between which is a combination between human-computer interaction and communication between humans. This can be seen in automated email systems, in which a message is generated by computer as a result of statistical information, but it is possible for a human to add a personal note (i.e. a user might receive a note thanking him or her for contributions) (Maurer,1999).

Students should also be able to understand the possibilities and the role of technology in automated and partially-automated communication processes. Therefore they should learn to differentiate between the ways in which humans and computers process data. Media functions can be addressed to further this understanding.

4. Social impacts of computer-based media

The goal here is to become aware that software-tools and description techniques – in short, the technical infrastructure – a) is purposely created to meet specific aims, b) is changeable, and c) embodies implicit values and regulates individual behaviour (Lessig, 1999).

It is important here to contextualise the current computer, software, or internet generation within its development history. In many cases, the functionality of a current version is only clear with knowledge of its evolution.

All in all, the BAI describes essential basic skills for prospective teachers, but does not cover an important aspect which was previously mentioned: The specific function of computer-based media in school and typical scenarios of its use in teaching and learning.

Scaffolding a curriculum of basic informatics within media education

The professional future of an educator is determined by activities within the scope of the classroom, administration, or other didactic area, as well as communications with students, parents, and community administrators. These are termed *action scenarios.* Often, it is useful or even necessary to integrate computer-based media into teachers' professional lives.

These situations can be incorporated into seminars for future teachers, on the topic of media education and fundamentals of informatics. First, we analyse professional scenarios of teachers and identify typical situations of computer-based media use. Then, we cover the fundamentals of informatics which teachers should know, in order to foster:

- a fundamental understanding of CBM
- elementary skills in handling a sample of computer-based software tools
- an effective use of computer-based media in school-related action scenarios
- the ability to organise learning and teaching processes with CBM in different subjects
- the ability to organise media education in the classroom, with CBM itself an educational topic

Finally we must structure these situations based on fundamentals of informatics with regard to the tasks previously described. This will generate a generic curriculum enabling us to create a selection of contents and objectives for university courses on the BAI of CBM. The table below describes how to assign each action scenario to a Basic Area of Informatics, as well as describing outlines for problem-centred seminars. The contents listed in the table below should not all be covered in a single seminar, but represent possible options describing how to teach the basics of informatics in a problem-centred seminar. In some cases, it will be possible to re-assign contents to different Areas. For example, xml is assigned to Area 1 (as a formalism) but can also demonstrate how documents are divided into content, structure, and layout, thereby allowing specific semiotic functions and automated processing (see Area 3).

Nevertheless, the curriculum will be helpful in organising student seminars. These seminars should focus on practical problems and issues regarding the use of CBM in teachers' professional lives. University seminars and related materials with the topic of BAI should be organised around a certain action scenario. The project should contain an assignment to produce specific computer-based media to be used later in a real pedagogic action scenario. While finding solutions for this relatively complex problem, students shall not only learn about different functions of CBM and how to use them in a pedagogic context but also gain a fundamental understanding of basic areas of informatics. The university seminars should not be organised simply as lectures, but should offer students different action scenarios in which they can exercise the use of CBM and develop media products of their own as a contribution to the complex problem-solving process. The concept also includes aspects of constructivist learning, because students should have access to a hypertext learning environment, with relevant materials such as supplement texts, pictures, animations, videos, interactive forms and so on. By navigating this web-based learning environment, they will be able to organise learning processes of their own and gain the knowledge they need to solve the problem presented in a seminar.

This will give them the ability to use their newly acquired knowledge and skills on CBM in a variety of similar scenarios. At minimum, after attending another one or two such courses, they will finally have the media competency described in the objectives above, and be able to independently manage complex assignments using Information and Communication Technologies (ICT).

References

Hubwieser, P. & Broy, M. (1997). Ein neuer Ansatz für den Informatikunterricht am Gymnasium. *Log In - Informatische Bildung und Computer in der Schule*, 3/4 (17), 42-47.

Lessig, L. (1999). *Code and other laws of cyberspace*. NY: Basic Books.

Magenheim, J. & Schubert, S. (2000). Evaluation of Teacher Education in Informatics. In Benzie, D., & Passey, D. (Eds.) *Proceedings of Conference on Educational Uses of Information and Communication Technologies, 16th World Computer Congress 2000*. China Beijing, 181-184.

Magenheim, J. (2001). Deconstruction of Socio-technical Information Systems with Virtual Exploration Environments as a Method of Teaching Informatics. *Proceedings of ED-MEDIA 2001*. Finland Tampere. 1199-1204.

Maurer, H.(1999). WWW needs more interaction. In Beiersdörfer, Engels, Schäfer (Ed.), *Informatik 99*. Berlin: Springer, 4 -10.

Schulte, C (2001). Changing Code – Notes on the Interdependency between Informatics and Society. Networking the Learner WCCE 2001. *7th IFIP World Conference on Computers in Education*. Copenhagen.

Schulte, C. & Scheel, O. (2001). Aufgabenbereiche der Medienbildung im Informatikunterricht. In Keil-Slawik, R., Magenheim, J. (Ed.), *Informatikunterricht und Medienbildung. INFOS 2001. 9. GI-Fachtagung Informatik und Schule*. Bonn: Köllen Druck+Verlag GmbH, 157-171.

Combination of Scenario Types and Basic Areas	Scenario Type A: using CBM in classroom practise	Scenario Type B: producing CBM	Scenario Type C: using CBM in organisational context
Specific Example of Scenario Type	Co-operative networking project	Building an interactive website	Administration of a school library
Basic Areas of Informatics	Optional content	Optional content	Optional content
Area 1: Concepts of formalism and problem solving strategies in informatics	• Structuring knowledge with mind mapping software, • Structuring co-operation with project planning software • Formal description of scheduling processes • Divide and conquer method • Knowledge in distributed systems	• Elements of documents (layout, structure, content) • Structure of documents • Document type definition • Document description language (HTML) • Basics of Metadata, aspects of XML • Hypertext, knowledge management and organisation of working processes	• Modelling techniques as UML, CRC Graphical representation of information • Object diagrams, storyboards • Entity relationship diagrams • Interaction diagrams • Concepts of knowledge management
Area 2: Technical basics of CBM	• Communication protocols (OSI, TCP/IP) • DNS and internet addresses • Network structure and technical components of networks • Virus, worm, logic bomb, denial of service attack • Firewalls and security • Digital coding of data • Transformation of information into data	• Internet services; searching engines • Client server concept • Data encryption • Parameter concept • Interactive elements of a window • Concept of event-driven programming • Basics of an object oriented programming language (applets; script language)	• Basic aspects of software development process • Basic algorithms (e.g. sorting algorithms) • Basic data structures • Database development software
Area 3: Semiotic function of CBM	• Knowledge and skills concerning basic functions of cognitive tools (text processing, spread sheets, database presentation, graphical design software) • Basic concepts of CSCW, CSCL • Computer as an external storage and mind tool • Media functions of information systems	• Layout concepts (style sheets, master slides) • Basic concepts of screen design • Concept of visual communication • Perception of semiotic types (text, diagrams, pictures, icons, animated graphics, videos)	• Development of graphical user interfaces for the database • Human-computer interaction • Models of human communication vs. models of technical data exchange
Area 4: Social impacts of CBM	• Impact of ICT on workflow and learning processes • Changes in roles, personal relationships, communication styles between people involved in CSCW • Concept of socio-technical information systems	• Web presentation of institutions and merchandising effects • Web performance and influence on public opinion • Economic and social impact of e-learning and e-commerce	• Security of data • Protection of personal data of customers • Software techniques of data protection • Legal aspects of data processing in school • Structure of a knowledge- or information-based society • Software development and interest groups

Table 1: Combination of Scenario Types and Basic Areas

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Enhancing Scientific Practice and Education Through Collaborative Digital Libraries

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Abstract: The need for accurate and current scientific information in the fast paced Internet-aware world has prompted the scientific community to develop tools that reduce the scientist's time and effort to make digital information available to all interested parties. The availability of such tools has made the Internet a vast digital repository of information. But the ad hoc nature in which information is gathered and organized on the web, makes access to such information a time consuming and sometimes frustrating affair. Digital library systems have the potential for solving problems in maintaining high quality scientific content delivered via the web by providing tools for scientists to collect, verify, organize, manage, and update their collections. This paper describes an environment that reduces the effort and time required by scientists to share their data with other collaborators in an automated and asynchronous manner, thereby allowing them to focus mostly on their own scientific practice. The data is maintained as a collaborative collection in a digital library that can also be used as an educational resource.

1. Introduction

Digital library systems have the potential for solving problems in maintaining high quality scientific content delivered via the web by providing tools for scientists to collect, verify, organize, manage, and update their collections. The ability of the Internet to bring geographically distant scientists and researchers together as a community provides the opportunity to build collaborative digital libraries that can provide a larger quantity and higher quality of data. The notions of ownership and attribution of intellectual and scientific property must be retained and the contributors must control sharing of their data.

This paper describes an environment that reduces the effort and time required by scientists to share their data with other collaborators in an automated and asynchronous manner, thereby allowing them to focus mostly on their own scientific practice. The data is maintained as a collaborative collection in a digital library that can also be used as an educational resource [1]. The collection can be continually updated by the contributors and used or reused to build course content via tools provided by the digital library [2].

2. Research Context

2.1 Digital Flora of Texas

The Digital Flora of Texas (DFT) [3] project was established as an open, web-based digital resource. Participants currently include scientists from 43 contributing herbaria as well as many researchers at public and private organizations [4]. Each participating herbarium (or collection) has its own curator or group of curators who verify and validate the data they contribute. The DFT project has a wide array of web tools, collections and prototype systems that can be used for research or education. The DFT contains information visualization tools for displaying statistical and distributional maps of taxa of the flora of Texas. In addition, upload and data conversion tools provide an automated way for researchers to easily build collections and share them with the scientific community. The DFT collections are accessible through the web, making it easier for researchers, scientists, instructors and students to access accurate and up to date information. Instructors can use the collections to construct web-based content for their courses. These educational and scientific resources can be used and reused in many different contexts [5,6,7].

2.2 Collections

DFT collections are built either by a group of collaborating researchers or by individual researchers. In either case, the collections are publicly available and all scientists/researchers can participate in verifying and validating the result. Researchers, who are geographically distributed, collaborate using the various tools provided by the DFT project to build and maintain the following collections:

- The Herbarium Specimen Browser is the Internet's only multi-herbarium specimen data portal. It offers unique filtering, mapping and listing displays for a growing mass (more than 240,000 currently) of specimens taken from the participating Texas herbaria [8].
- The Image Gallery provides access to 8000 images of plants representing families found in Texas [9].
- The Contributor collection contains contact information for all contributors who generate digital content for this community-based collaborative digital library [10,11].

The following collections are a result of individual research:

- The Bibliography (Wilson) provides over 3000 bibliographic references for the Texas Flora [12].
- The Checklist of the Vascular Plants of Texas (Hatch, et al) refers to 180 families, ~1300 genera, and ~5000 species [13].
- The Centex Flora (Reed) is a manual of the dicot flora of Brazos and surrounding counties that provides keys and descriptions for 104 families, 489 genera and 1104 species [14,15].
- The Texas Grasses (Hatch and Dawson) has keys, descriptions and images for 142 genera and ~550 species in the grass family [16].

3. Design of a Collaborative Digital Library

3.1 Model of Collaboration/Interaction with System Components

In the design of a scientific collaborative digital library, it is of utmost importance for the contributor to maintain ownership of his/her scientific and intellectual property. The notion of ownership and control is maintained in the DFT because the contributors decide when to share their data and what part of their data to share. Automation is used only under control of the contributor and is a two step process: 1) uploading data to share and 2) incorporating data into the public collection. The sharing occurs at different times and from different geographic locations.

3.2 Rationale for Choice of Tools

The DFT is using the previously defined Flora of Texas Consortium (FTC) data model [17] as the common data format for its collections. eXtensible Markup Language (XML) [18] is ideal for the FTC data model since it renders a strong sense of structure to data and can be validated and maintained with little or no programming. A wide variety of Application Programming Interfaces (APIs) are also available that can convert a wide range of data formats to XML.

Greenstone is an open source digital library system that automatically provides multiple, user-defined browsing and searching indexes on the collections it maintains. It provides plugins for converting many standard format files (e.g. Word, PDF) to XML and allows rebuilding of collections while they are in use (no down time). It also provides a standard, yet customizable user interface and compresses its documents, thereby saving space and, more importantly, mitigating the effect of long XML tags.

3.3 System Architecture

Contributors can upload their data and build or rebuild a collection in the DFT at any time. The contributors may use any program they wish to maintain their personal collections (e.g. Word, Excel, Access, Filemaker Pro). When they are ready to upload their data, they dump it in a flat ASCII file (an operation that is standard with all data management tools). The upload system converts the data into XML and validates it against the FTC data model. Errors, if any, are reported to the contributors. Records without errors are uploaded and are ready to be added to the collection. The uploaded data is not shared with the other collaborators until the contributor explicitly builds or rebuilds a collection of this validated data, making it available for public use. Other collaborators as well as non-specialists with an interest in the domain can access the collection using the common web-based user interface provided by Greenstone or by customizing their own user interface. This process relieves the scientists of the tasks of converting data into various acceptable formats enabling them to channel more time and effort toward practicing their science (Figure 1).

The Herbarium Specimen Browser, Image Gallery and Contributor collections mentioned in section 2 are collections that are built and maintained by geographically distributed contributors and follow the same methodology as described above. To upload his/her data, the contributor uses the web-based upload system [19] to specify the number and order of fields, field separators and field enclosures. Figures 2 and 3 show the upload form and an example search results page for the Image Gallery collection.

4. Lessons Learned

4.1 Scientific Practice

"The products of Systematic Botany, previously generated locally as static, hardcopy documents, can now be presented as collaborative enterprises from distributed centers as high-content, dynamic data resources that are constantly updated and refined." [1] The system architecture of the DFT enhances the sharing and browsing aspects of collaboration by providing a web-based input system that converts the uploaded data to standard XML format. This data is then added to the shared collection under control of the contributor. Thus, scientists can follow this process without disrupting their normal working style. This automated process shortens the time to share scientific information and the notion of ownership of intellectual and scientific property is maintained, as the scientists control their own collections and share whenever they are ready. The upload system also filters the data and performs various error checks (e.g. typographical error checks) in order to verify the data. Scientists appreciate the fact that their data is verified by the input system and by the information visualization tools (e.g. the mapping system) provided to browse through the digital library.

4.2 Education

We have observed that collaborators use and reuse either their own information content or that of the other collaborators in the digital library to build new course structures and educational packages. Tools provided with the digital library expedite the process of reuse and construction of new packages. Students are also presented with a larger and more diverse collection and are not restricted by the limitations of a localized collection. In most cases, we observed that collaborators found it useful to have cross collection querying/browsing, wherein the results of a search on one collection are used to search an entirely different collection. This exploratory learning methodology helps students find information they are looking for while following trails that interest them the most. Greenstone supports this cross collection querying/browsing model, enabling the user to seamlessly move from one collection to another.

4.3 Digital Libraries

The immediate benefit of having a collaborative digital library is the continuous updating and refinement of the information content and accuracy of information provided by the collaborative interactions of the scientists. Since it is fairly easy to maintain and browse the digital library, we find more and more collections being built using the system we have described. For example, the Image Gallery collection was developed because the scientists involved find the model of collaboration easy to use. Collections do indeed have their own unique identities and are a scientifically valid resource, but they also tend to become integrated in the notion of a digital library that allows cross collection querying/browsing.

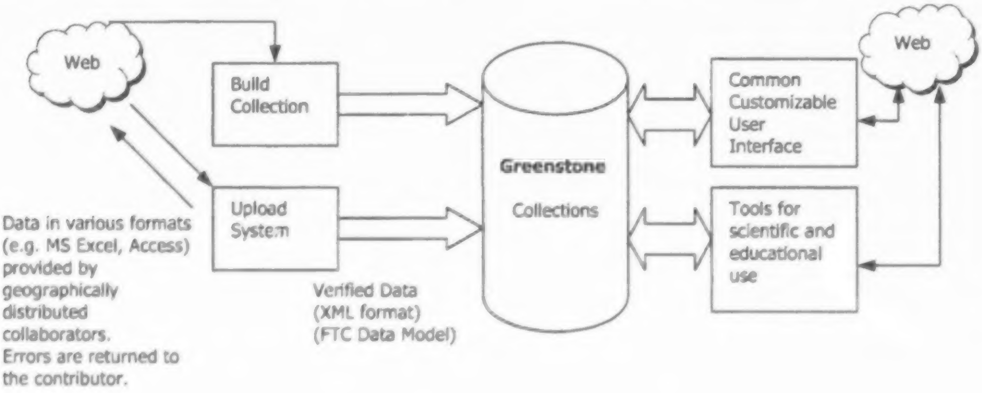
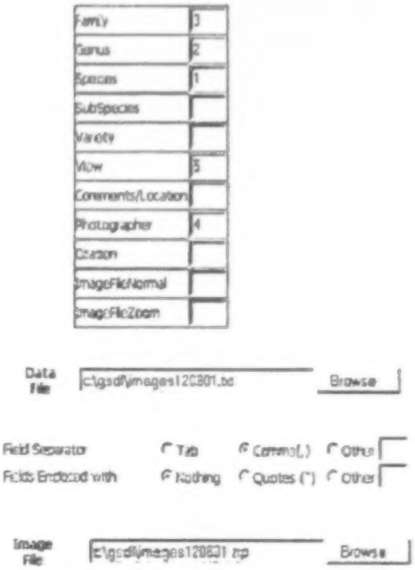

Web
Build Collection
Upload System
Data in various formats (e.g. MS Excel, Access) provided by geographically distributed collaborators. Errors are returned to the contributor.
Verified Data (XML format) (FTC Data Model)
Greenstone
Collections
Common Customizable User Interface
Tools for scientific and educational use
Web

Figure 1. Architecture for DFT Collaborative Digital Library Collections.



Family	3
Genus	2
Species	1
SubSpecies	
Variety	
View	5
Comments/Location	
Photographer	4
Citation	
ImageFileNormal	
ImageFileZoom	

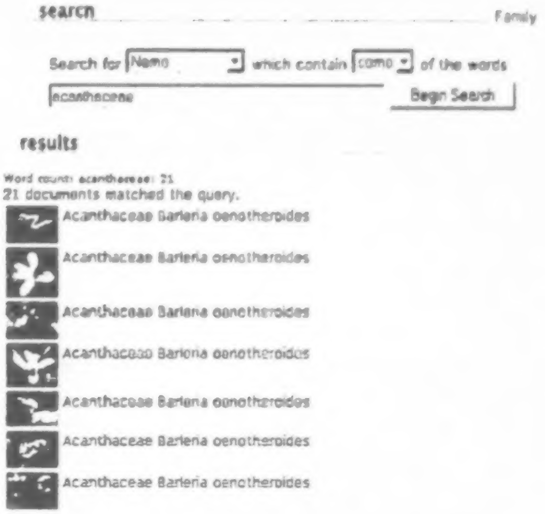
Data File: c:\gsdl\images120301.txt

Field Separator ○ Tab ● Comma(,) ○ Other ☐
Fields Enclosed with ● Nothing ○ Quotes (") ○ Other ☐

Image File: c:\gsdl\images120301.zip

Browse
Browse

Figure 2. Example upload form for the Image Gallery Collection.



search
Family

Search for Name which contain some of the words

acanthaceae

Begin Search
results

Word count: acanthaceae: 21
21 documents matched the query.
Acanthaceae Barleria oenotheroides
Acanthaceae Barleria oenotheroides
Acanthaceae Barleria oenotheroides
Acanthaceae Barleria oenotheroides
Acanthaceae Barleria oenotheroides
Acanthaceae Barleria oenotheroides
Acanthaceae Barleria oenotheroides

Figure 3. Example search results page for the Image Gallery Collection.

5. Future Work

Currently, the system does not have collaborative tools to support a peer review process by a group of curators [20]. With this set of tools, any person with botanical interests and a computer connected to the Internet could contribute to the digital library. The curators would be responsible for accepting or rejecting contributions and for maintaining high quality content. Considering the ease of creating and maintaining collections, we would like to put more content in the digital library in the form of a monthly journal, a collection of thesis and dissertations, and a collection of videos of lectures and field trips; thus adding various media formats to the digital collection and enhancing the value of the collections. Currently, collaborating scientists and university students are the main beneficiaries of the DFT. It would also be interesting to see how well the system scales to the needs of primary and secondary students.

References

[1] Hugh D. Wilson (2001). *Informatics: new media and paths of data flow.* Taxon 50: 381-387.

[2] Dipto Chakravarty, Jon Mason, Kevin Riley (2001). *IMS Digital Repositories White Paper* Revision: 22 August 2001

[3] http://www.texasflora.org/

[4] http://www.texasflora.org/dft_tx_herbs1.htm

[5] http://www.csdl.tamu.edu/FLORA/301Manhart/index.htm

[6] http://www.csdl.tamu.edu/FLORA/Wilson/481/s99/semhome99.htm

[7] http://www.csdl.tamu.edu/FLORA/fsb/fsbhome1.htm

[8] http://www.csdl.tamu.edu/FLORA/tracy2/main1.html

[9] http://www.csdl.tamu.edu/FLORA/ftc/dft/library.htm

[10] http://botany.cs.tamu.edu/contributor/

[11] http://botany.cs.tamu.edu/gsdl/cgi-bin/library?site=localhost&a=p&p=about&c=contributor&ct=0

[12] http://www.csdl.tamu.edu/FLORA/ftc/dft/bibbase.htm

[13] http://www.csdl.tamu.edu/FLORA/taes/tracy/home2.html

[14] http://www.csdl.tamu.edu/FLORA/centexflora/testing/demo1.html

[15] http://botany.cs.tamu.edu/gsdl/cgi-bin/library?site=localhost&a=p&p=about&c=centexflora&ct=0

[16] http://www.csdl.tamu.edu/FLORA/taes/tracy/610/index.html

[17] http://www.csdl.tamu.edu/FLORA/ftc/ftcffld4.htm

[18] http://www.w3.org/XML/

[19] http://botany.cs.tamu.edu/dfot

[20] Goh, D., and Leggett, J.J. (2000). *Patron augmented digital libraries.* In *Proceedings of the Digital Libraries '00 Conference*, San Antonio, TX, pp. 153-163, June 2-7, 2000.

[21] http://www.csdl.tamu.edu/FLORA/tamuherb.htm

[22] Erich R. Schneider, John J. Leggett, Richard K. Furuta, Hugh D. Wilson, Stephan L. Hatch (1997). *WWW tools for accessing botanical collections.* In *Proceedings of WebNet 97*, November 1-5, 1997, Toronto, Ontario. (Winner: Best Student Paper Award.)

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Learning Centres Give Possibilities to Everybody

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Abstract: Chydenius Institute (Research and Training Centre of Jyväskylä University) implements the Finnish Virtual University. In Kaustinen and Kokkola regions, which are rural areas, is created a network of learning centres in municipalities. In this way every citizen has the possibility to develop him/herself occupationally or because of interest. The learning centres have computers with ATM -network and videoconferencing facilities. Every citizen is able to come to study in web-courses, to surf in internet or to take part in conversations in newsgroups or posting lists. There are organized open lessons in real-time via two-way videoconferencing where people can follow experts in different areas of life. Speeches of Studia Generalia offer interesting themes and discussions of current topics. In this way people have the possibility to study and distance makes no difference: we are all equal.

Chydenius Institute is a Network University for adults. It's located in Kokkola, in the western coast of Finland. Administrative it's an autonomous Research and Training Centre of Jyväskylä University. Functionally Chydenius Institute belongs also to the University of Oulu because of the agreement of cooperation. Under discussion is the agreement with the University of Vaasa.

FINLAND
BY
VIRTUAL FINLAND
Oulu
KOKKOLA
Vaasa
Jyväskylä
ALAND ISLANDS
GULF OF FINLAND

Practically Chydenius Institute cooperates with universities in these areas:

- University of Jyväskylä: e.g. educational and social sciences, information technology
- University of Oulu: e.g. medicine, electronic engineering
- University of Vaasa: economics

In addition to this, Chydenius Institute implements the Finnish Virtual University. This consortium of all the universities in Finland has a purpose to develop web-based learning and implement the strategy of the National Information Society announced by the Ministry of Education.

Finland is one of the largest countries in Europe. There are plenty of rural areas and long distances. That's why it has been natural to develop distance learning methods. Videoconferencing has become very common way of delivering teaching in educational institutes and schools, but also companies are used to have it as a communication tool between them.

Chydenius Institute, an Adult Network University, offers most of the lessons for Master of Electronic Engineering via videoconferencing, using IP- and ISDN-based technology. The students are working daytime and participate in lessons during evenings and weekends. Videoconferencing makes possible for them to work and stay with their families without travelling to the University of Oulu (at 250 km from Kokkola). The same model is implemented with the Master studies of Information Technology organized by University of Jyväskylä. Because the Ostrobothnia region has an ATM-network, there has been delivered earlier mentioned lessons also for homes of some students.

During the academic year 2001-2002 the Open University of Oulu University has offered 15 credits of Educational Technology. This training has delivered for Chydenius Institute in Kokkola and Kaustinen using ISDN-bridge. There has been given lectures also from other universities using videoconferencing.

In Kaustinen and Kokkola regions, which are rural areas in Central Ostrobothnia, has been created a network of learning centres in municipalities. In this way every citizen has the possibility to develop him/herself occupationally or because of interest. The learning centres have computers with ATM-network and videoconferencing facilities. Every citizen is able to come to study in web-courses, to surf in internet or to take part in conversations in newsgroups or posting lists. There are organized open lessons via two-way videoconferencing where people can follow experts in different areas of life. Speeches of Studia Generalia offer interesting thems and discussions of latest happenings. In this way people have the possibility to be aware of recent research and information.

Central Ostrobothnia

There has been offered training for enterprizes and companies in Kokkola and Kaustinen region using this learning centre network that Chydenius Institute has organised. Municipality of Lestijärvi has own IP and ISDN bridge/gateway, which has been utilised in this training. Also associations and communities use the network of learning centres.

Learning centres are located in municipalities depending on their own possibilities. They might be in school, library, folk institute or municipal office. Every municipality has invested for the infrastructure: in a learning centre there should be a number of computers with ATM-network and videoconferencing facilities. These learning centres are open either office-hours or in the evenings. Every municipality decides according to the needs and practicalness.

Citizens who don't have computers at home or they don't have low modems are very welcome to use the facilities of the learning centre. In this way everybody has the possibility to study interesting subjects in open universities, in web-courses and also in learning environments that the Finnish Virtual University offers. People are able to develop their knowledge of ICT and utilize the use of ICT. University studies and networks come close to everybody and distance makes no difference: We are all equal!

References: www.chydenius.fi

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Dynamic Educational e-Content Selection Using Multiple Criteria in Web-based Personalized Learning Environments

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Abstract: In this paper we present the way a multi-criteria decision making methodology is applied in the case of agent-based selection of offered learning objects. The problem of selection is modeled as a decision making one, with the decision variables being the learner model and the learning objects' educational description. In this way, selection of educational content is based on dynamic data input collected at the time of the decision. This methodology is studied in the context of an agent-based e-market for educational content brokering, and is engaged by the broker agents recommending learning objects to learners, according to their cognitive style.

Introduction

In agent-mediated educational content brokering, artificial agents are responsible of locating offered learning objects, negotiating with the content providers on the terms of the service provision, and for presenting the learner with those offers that best match his/her needs and preferences. Successful completion of this task is based on two parameters: the capability of the mediating agent to understand and model the user needs, and its capability to evaluate all available learning objects and recommend the most suitable. The most common ways to introduce intelligent brokering for educational content are based on techniques from Artificial Intelligence (AI): knowledge representation, reasoning, and expert systems, often offer tools and techniques in the developers of such systems since they allow the agent to behave intelligently in two ways; first, with the ability to store the knowledge of the experts (for example using a knowledge base); second, using the previous knowledge to infer rational decisions.

In the last years though, most agent-based e-commerce systems engage methodologies and tools which originally come from sciences other than AI; these include methods and techniques from Game Theory, Optimization and Decision Making (Guttman et al, 1998). In this paper, we are going to approach the problem of content selection (know as the recommendation problem in e-commerce systems) from a decision-making point of view. We are going to introduce how a multi-criteria decision making (MCDM) methodology is applied in the case of agent-based educational content brokering, and we are going to discuss the benefits and drawbacks of this approach.

There is an interesting feature in this approach: it replaces searching knowledge inside a knowledge base, using constraints posed by logical expressions and logic rules, with an evaluation of knowledge using mathematical formulations. It can therefore provide measures of "how much better one decision is compared to another", even if both decisions are rational and solve the constraints problem. This usually sounds rather awkward though – how can we represent the expert knowledge in terms of mathematical expressions? Logic variables (CategoryOfUser='This') and logic rules (IF CategoryOfUser='This' THEN TypeOfContent='That') are simple, and easily comprehended; how is the learner going to be modeled using mathematical variables, and how is the expert going to express the experience in a mathematical form?

We will try to give answers to these questions by introducing the example of modeling the learners with the classic Honey and Mumford cognitive styles model (1992). We will introduce the basic principles of a multi-criteria decision making methodology, and study which parameters of the Honey & Mumford model serve as criteria for the selection of the available content (learning objects); we will also study a method that can be used to carry out this selection. Finally, we will present how this decision-making procedure is incorporated into an agent-based system, and how the broker agents operate it.

The Honey & Mumford Model

Tennant (1988) defined cognitive style as "an individuals characteristic and consistent approach to organizing and processing information". There are several learning and cognitive styles theories and models, which categorize learners in terms of instructional preferences, information processing and personality styles, and are usually employed for the realization of individualized instruction (for a survey, see Sampson et al, 2002). In order to demonstrate how a cognitive style model can be used in order to create the multi-criteria selection model, we will engage the classic Honey and Mumford model. The Honey and Mumford model (1992) is a cognitive style model, developed for use in commerce, management and training situations. It categorizes learners according to the following dimensions of a person's learning style: Theorist, Activist, Reflector and Pragmatist. In order to rate learners on each one of the categories, the model uses the answers in a specially designed Learning Styles Questionnaire (LSQ) of 80 questions, with binary answers of "Correct" and "False", and after an internal processing of the results, it provides a percentage weight for each category. Therefore, the learner's style is defined depending on the weight at each learning style category.

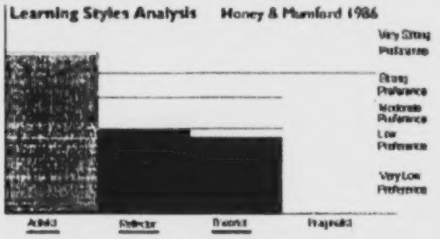

Figure 1: An example learner's model after a LSQ is processed. It provides a measure of how the learner 'scored' in every category (source: PSI-Press, http://www.psi-press.co.uk/)

From a practical point of view, it is important that a learner's model describes not only how learners are categorised, but also how the instruction method should be adapted for each learner category (Spector, 2001). The real complexity for the designers of e-learning systems arises when they try to match subject matter with learner characteristics and appropriate instructional methods. Such a process includes both learner modeling (using the Honey & Mumford model results – see Figure 1) and description of the educational properties of the learning content (that is e.g. a description of how suitable a course is for the learners having a specific cognitive style). The matching procedure involves all these parameters as input – and still a proper matching mechanism has to be found. We address this problem as a decision making one.

Multi-Criteria Decision Making Methodology

According to Roy (1996) the general methodology of decision making problems includes four steps: (i) defining the object of the decision, that is the set of potential actions, and the problematic of the decision; (ii) studying the parameters influencing decision and defining so a set of criteria; (iii) choosing an appropriate multi-criteria aggregation method; (iv) proceeding at the activity of decision aid.

Step One: The Object of Decision

The first step includes definition of the decision variables in a form of a consideration set *A*. In the case of educational content brokering, this set includes all the available learning objects, which will be evaluated by the decision maker (in our case, the brokering agent). What is called 'the problematic of the decision' is the definition of what kind of evaluation or choice does the decision maker want to make upon the different objects available in set *A*;

in the case of broker agents recommending a learning object, the decision problematic is "selection of one". That is the selection of one action from the consideration set of the form $? = [a_1, a_2, \ldots, a_n]$.

Step Two: The Criteria

The next step is deciding what will be the criteria upon which the learning object will be evaluated. This means defining a consistent family of criteria, assuming that these criteria are non-decreasing value functions, exhaustive and non-redundant. Each criterion is defined on A as it follows: $g_i : A \rightarrow [g_{i*}, g_i^*] \subset \Re / a \rightarrow g(a) \in \Re$, where $[g_{i*}, g_i^*]$ is the criterion evaluation scale, with g_{i*} the worst level of the ith criterion, g_i^* the best level of the ith criterion, $g_i(a)$ the evaluation or performance of action a on the ith criterion and $\underline{g}(a)$ the vector of performances of action a on the n criteria (Jacquet-Lagreze & Siskos, 2001).

In the case of educational content brokering, there are two ways to deal with the selection of the criteria. Recommendation is usually based on criteria as price, time of delivery, form of delivery, etc. – a common practice in e-commerce systems. We would like to introduce another aspect of recommendation in agent-based learning environments: based on the pedagogical profile of the learner. That is using the categories of the learner model as criteria; each learning object will be evaluated on how suitable it is for each category of learners. This is exactly the same as making an expression as " TypeOfContent='That' ". To be more specific, in a similar case an expert system would need a definition as: `TypeOfContent="SuitableForActivists"`. In the case multiple criteria are used for the description of the content, this definition is transformed (remaining fully equivalent) to something similar to this:

- `SuitabilityOfContentForTheorists= "NotSuitableAtAll";`
- `SuitabilityOfContentForActivists= "Perfectly suitable";`
- `SuitabilityOfContentForReflectors= "NotSuitableAtAll";`
- `SuitabilityOfContentForPragmatists= "NotSuitableAtAll";`

Therefore, as criteria we will use the four categories of the Honey & Mumford, which can take their values from a 5-scaled climax of qualitative descriptions ["Not suitable at all", "Not very suitable", "Moderately suitable", "Very suitable", "Perfectly suitable"] showing the evaluation of each learning object upon each categories. It is obvious that a learning object (e.g. an on-line course) is never "Perfectly Suitable" for a learner category and "Not Suitable At All" for the rest -it rather addresses some of the needs of other categories of learners too. Therefore, such an evaluation provides the expert with a way to precisely describe the pedagogical 'profile' of a learning object. This meta-data description is a criteria definition that fully complies with the definition of the criteria according to Roy (1996).

Step Three: The Utility Model

First of all, we have to define the preference model that will be used from the broker agent to make the decision; as we have already stated, in our case we are using the Honey & Mumford learner model as a preference model. The expression of the model is then $p_i=[p_1, p_2, p_3, p_4]$, where p_1, p_2, p_3, and p_4 are the weights inferred after the learner has completed the Honey & Mumford LSQ and the results have been processed.

This is the point where the analyst has to define which evaluation method will be used; that is, which multi-criteria decision making method will be engaged in order for the decision to be best modeled and simulated. In this paper we will use one of the most traditional approaches, that leads to a functional representation g that can be formed directly from the criteria $g_1, \ldots, g_4$ that constitute A. The goal of using this approach is to present how the methodology works – depending on the application, other more complex methods can be used. Thus, the comprehensive preference model is characterized by a unique synthesizing criterion g: $g(a)=V[g_1(a), \ldots, g_n(a)]$, where V is an aggregation function. The function will be in the form:

$$V(a) = \sum p_i g_i(a)$$

where $g_i(a)$ are the evaluations of each learning object a regarding the suitability for each category of learners. The weights p_i consist the preference model, which are the parameters calculated by the Honey and Mumford LSQ. The final value of V is the total utility of each learning object for the learner under study.

Step Four: The Activity of Decision Aid

Let us now introduce the way the activity of decision making will be carried out, in the context of an agent-based system We define a generic architecture, with agents capable of handling and communicating descriptions of learning objects, as defined in the previous paragraph. The three basic roles are:

The Assistant. The assistant agents are responsible for user needs and requirements elicitation, and formulation of requests into messages understandable by the broker repository system. The LAssistant is the agent that interacts with the user and can identify the request for a learning object. The CPAssistant is the agent that gets the learning object descriptions from the Content Providers, and publishes them as offers in the e-market. The TAssistant serves as the pedagogical counselor of the learner: it creates the learner model of the user and provides this model to the LBroker. The TAssistant can also be the expert that describes a learning object using the cognitive styles; this is a task that can be directly carried out by the Content Author too, so we will not focus more on this point.

The Broker. The broker agents represent each human user in the e-market and facilitate educational content seeking or advertising. The Broker agents interact among each other in the Brokerage Pool and either advertise published learning objects, or make requests when looking for them. The LBroker evaluates the available offers from the CPBrokers in the way described in the previous paragraphs. The LBroker then recommends the content selection to the LAssistant. The Brokers are also responsible for negotiation among the participating parties upon the terms of the service provisioning (beyond the scope of this paper).

The Matchmaker. This facilitator agent provides mediating services, by informing agents about other agents of the broker repository and their availability. The Matchmaker provides all necessary administrative support information to the human administrator of the agent pool.

We can see that the Broker agent engaging the multi-criteria methodology previously described is the LBroker. In order to pedagogically evaluate the available learning objects and recommend one to the learner, the LBroker needs the learner model (provided by the user) and the meta-description of the available learning objects (provided by the CPBroker or the Tutor). Other kinds of evaluation of the offers (e.g. based on the price, time, and other terms of delivery) are beyond the scope of this paper.

Usage Scenario

Let us demonstrate how the recommendation procedure works in this agent-based system. A content author creates different e-learning courses concerning the same subject. The author wishes those courses to address different learner needs, depending on the cognitive style of the learner. When a learning object (course) is created, the content author also provides an evaluation of its suitability for each different category of the Honey & Mumford model. The author creates thus five different learning objects, with different pedagogical descriptions (as depicted in Table 1).

	LO1	LO2	LO3	LO4	LO5
Activist	3	2	5	3	5
Reflector	1	3	1	2	2
Theorist	4	5	2	1	1
Pragmatist	3	2	1	5	2

Table 1: The content author provides an description of each learning object (LO) on a scale from '1- Not Suitable At All' to '5-Perfectly Suitable', regarding each one of the cognitive categories.

	Activist	Reflector	Theorist	Pragmatist
LSQ values	90%	55%	25%	85%
Normalized	0,35	0,22	0,10	0,33

Table 2: The cognitive styles preference model, as derived from the Honey and Mumford Learning Styles Questionnaire (values are properly normalized in order to provide a sum of 1).

	LO1	LO2	LO3	LO4	LO5
Utility	2,67	2,51	2,51	3,25	2,96

Table 3: The total utilities of the available learning objects (a score upon the '1-Not Suitable At All' to '5- Perfectly Suitable' climax).

Introducing the multi-criteria methodology presented in the previous section the Broker will select a learning object according to these steps:

1. The Tutor provides a multi-attribute cognitive model of the user, according to the results of the Honey and Mumford model (Table 2).
2. When the Learner's Broker receives the five offers for learning objects, it calculates the total utility (that is suitability) of each one, using the methodology described in the previous section.
3. The Learner's Broker selects the most appropriate learning object to be presented to the user (Table 3).

It is interesting to note in this example the difference between the application of a simple rule-based selection of the learning object (in this case the agent would classify the learner as 'Activist' and would propose the learning object LO3) and the proposed methodology. Using the multi-attribute cognitive model and the multi-criteria evaluation model, we observe that the most appropriate learning object seems to be LO4, being the only one suitable for the combination of categories that characterize the specific learner's cognitive style.

Conclusions and Future Work

In this paper we presented an agent-based recommendation system for educational content brokering that implements a multi-criteria decision making methodology. Due to the differences of learners' cognitive models, recommendation can be either carried out by classifying learners into broader categories that then are directly linked to learning objects (e.g. with rules like IF 'thistypeoflearner' THEN 'thistypeofmaterial') or by enhancing the mediating agent with the appropriate intelligence to propose the most suitable learning object available at the market. By engaging a multi-attribute utility (MAUT) model, the brokering agents do not need to posses intelligence in the form of a knowledge base or hard-coded rules but only to include the multi-attribute evaluation logic in their decision making module. In this way learners are modeled in a multi-attribute way, instead of being simply classified into a general learning category, learning objects are described according to their educational scopes, brokering agents dynamically evaluate all available proposals of content, and select the learning objects most suitable for the specific learner's profile, and finally the knowledge the broker agents have to contain in permanent storage is minimized since only the MAUT evaluation formula is needed; all other input is provided at run-time.

In this paper, the decision problem was modeled using the Honey and Mumford LSQ parameters as the preference model, but we believe that the proposed methodology can be similarly applied in the case of other cognitive style models too. Future research will be focused on applying of several other LS models, either separately or combined. An issue to be also studied is the application of more complex multi-criteria decision making methodologies for modeling the user preferences; such methodologies provide easier and more realistic means of expressing preferences, but require more complicated MCDM methods to conclude to the best proposal for each learner, as one of the famous family of the ELECTRE methods (Roy, 1996).

Current international standardization efforts regarding syntax and semantics of a learner model that characterize a learner and his or her knowledge/abilities; i.e. IMS LIP (IMS, 2001), IEEE LTSC PAPI (IEEE, 2000) do not explicitly define information about the cognitive style of the learner. However, both the IMS LIP and IEEE PAPI Learner preference/performance data types provide data elements that allow cognitive style related information to be stored in an appropriate form. These data types could be used in order to represent a multi-attribute representation of the cognitive style model of the learner, by an appropriate extension of the corresponding XML schema.

The IST Project KOD "Knowledge-On-Demand" (KOD, 2001) engages a multi-agent brokering system for selection of learning objects and dynamic synthesis of on-line courses. In the case of KOD, intelligence is included into the learning objects in the form of rules that express the suitability of the object for each type of learners, so that courses can be constructed based on how the learning objects are characterized. This is a case very close to the problem we introduced, and we are currently studying ways to introduce the multi-criteria descriptions in the learning objects of KOD, in order for the KOD agents to be able to dynamically assess and synthesize courses based on the introduced decision making methodology and not on prescribed rules.

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References

FIPA - Foundation for Intelligent Physical Agents. (2002). http://www.fipa.org

GEM – Gateway to Educational Material. (2002). http://www.geminfo.org/

Guttman R., Moukas A., Maes P. (1998). Agent-mediated Electronic Commerce: A Survey. *Knowledge Engineering Review*. (Vol. 13:3).

Honey P., Mumford A. (1992) *The Manual of Learning Styles*. 3rd Ed., Maidenhead, Peter Honey.

IEEE Learning Technology Standards Committee. (2000). *Draft Standard for Learning Technology – Public and Private Information for Learners (PAPI Learner)*. IEEE P1484.2/D7. http://www.ltsc.org/wg2

IMS Global Learning Consortium Inc. (2001). *Learning Information Package (LIP) Best Practice & Implementation Guide*. IMS LIP Final Specification V. 1.0. http://www.imsproject.org/profiles

Jacquet-Lagreze E., Siskos Y. (2001). Preference disaggregation: 20 years of MCDA experience. *European Journal of Operational Research*. (130, pp. 233-245).

JADE – Java Agent DEvelopment Framework. (2002). http://sharon.cselt.it/projects/jade/

KOD - Knowledge on Demand. (2001). IST Project No 12503 KOD. http://www.kodweb.org

Roy B. (1996) *Multicriteria Methodology for Decision Aiding*. Kluwer Academic Publishers.

Sampson D. and Karagiannidis C. (2002). Accommodating Learning Styles in Adaptation Logics for Personalised Learning Systems. *Proc. ED-MEDIA 2002*. Denver, Colorado, USA.

Spector J.M. (2001). An Overview of Progress and Problems in Educational Technology. *Interactive Educational Multimedia*. (3, pp 27-37).

Tennant N. (1988). Theories, Concepts and Rationality in an Evolutionary Account of Science. *Biology and Philosophy*. (3, pp. 224-231).

“Supporting Interns’ Work in Inclusive Classrooms”

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Abstract: The University of Idaho has been redesigning its teacher preparation program for four years. The redesign has included the development of a set of core courses that are required for all teacher certifications. These four courses include a “strand” of content about students with disabilities and methods for working with them in inclusive settings. The special education content in the final course is focused on mediating the interns’ experiences in their yearlong internship placements, which are all over the state. We are currently developing an online support structure for the students to complete the special education component of the final core course. This paper describes that online structure that also includes a method for collecting data about the interns’ use of the system and the content they submit.

Introduction

Research on models of training teacher candidates for their work in inclusive environments has shown that special education content integrated into existing coursework with an accompanying field experience is more effective than other models studied. Further, recent research has shown that the integration of online delivery modes with traditional instructional practice is effective. Therefore, the integrated model we are implementing to provide continued support during the internship holds a great deal of promise for helping our teacher candidates to become effective inclusive educators.

Issues in the Preparation of Inclusive Educators

Teacher candidates enter their programs with clusters of beliefs based on their experiences as students, values, and other background determinants. These determinants influence how they approach their programs and their developing perceptions of what it means to be a teacher (Richardson 1996).

Teacher candidates’ entering beliefs about students and learning will be challenged when they encounter student with disabilities in the general education classroom. The belief that teaching is a matter of telling or showing and learning is committing information to memory will come into question since many students with disabilities have difficulties with this kind of teaching practice (McDiarmid 1989).

These beliefs about teaching and learning make it difficult for teacher educators to help teacher candidates understand instruction about accommodating students with disabilities. Anderson and Bird (1995) point out that, based on their lack of exposure to inclusive practices, teacher candidates may have difficulties assimilating instruction about accommodating students with disabilities into their current understandings of teaching and learning. Mediating these beliefs is especially critical for facilitating the progress of inclusive efforts in schools.

Teacher educators have attempted numerous designs to train general education teacher candidates specifically for effective inclusive practices. These designs have ranged from one-time training events, to separate courses, to the infusion of special education content into the general education curriculum (Bradley, King-Sears, & Tessier-Switlick 1997).

Rademacher, Wilhelm, Hildreth, Bridges, and Cowart (1998) studied changes in the attitudes of general education teacher candidates toward students with disabilities who participated in one of three possible course configurations. The researchers concluded that the teacher candidates who had direct contact over time with students with disabilities in regular and special education placements, along with reflective discussions and assignments, appeared to have a significant, positive impact on their attitudes toward students with special needs, inclusion, collaborative teaching, and their self confidence.

Description of Online Support Structure

The online support structure will offer resources to help the teacher candidates as they make the transition from student to intern and work within the inclusive environments found in today's schools. First and foremost, an online support system will provide a synchronistic communication system to allow for immediate discussion of issues and concerns with field placement personnel. As has been demonstrated, (Seabrooks, Kenney, & LaMontagne 2000) interns benefit from online mentoring. The interns will benefit from online conversations among themselves. They will learn from each others' experiences and gain information about various inclusive settings. The web site will provide the interns with links to information that will help them to problem solve and make instructional decisions. The interns will also use the site to post completed assignments for the special education portion of the final core course.

All of the online data will be archived for purposes of qualitative and quantitative research analysis. By examining the frequency of use, nature of the discussions, and coursework, these data will provide a continuation of the data collection that started in earlier core courses around inclusive attitudes and practices. We will be contributing to the present research about how teacher candidates learn from their programs and utilize that information in field experiences. We will also be able to learn more about the challenges currently faced by teachers practicing in inclusive environments through the content of the discussions. All of the data will help the teacher preparation faculty at the University of Idaho to improve the content and structure of the core courses.

Future Directions

Along with continuing to improve the online support structure based on the data collected, we plan to expand the content to serve a broader audience, i.e., the supervising teachers. We would like to offer an option of the final core course that would invite the participation of supervising teachers. They could take "Inclusive Strategies" for one credit and complete projects with their interns based on models of action research. This practice would help the supervising teacher to improve the work being done in the classroom and provide the intern with a model of data collection and analysis that could be utilized in the future.

References

Anderson, L. & Bird, T. (1995). How three prospective teachers construed three cases of teaching. Teaching & Teacher Education, 11 (5), 479-499.

Bradley, D. F., King-Sears, M. E., & Tessier-Switlick, D. M. (1997). Teaching students in inclusive settings: From theory to practice. Needham Heights: Allyn & Bacon.

McDiarmid, G. W. (1989). Tilting at webs of belief: Field experiences as a means of breaking with experience (Research Report 89-8). East Lansing: Michigan State University, National Center for Research on Teacher Learning.

Rademacher, J.A., Wilhelm, R.W., Hildreth, B.L., Bridges, D.L., & Cowart, M.F. (1998). A study of preservice teachers' attitudes toward inclusion. The Educational Forum, 62 (2), 154-163.

Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula (Ed.), Handbook of research on teacher education (2nd Edition, pp. 102-119). New York: Macmillan.

Seabrooks, J. J., Kenney, S., & LaMontagne, M. (2000). Collaboration and virtual mentoring: Building relationships between pre-service and in-service special education teachers. Journal of Information Technology for Teacher Education, 9 (2), 19-36.

Mind the Gap: An Overview of Perceptual Barriers to K-12 Information Literacy

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Abstract: Because the explosion of electronic and print information requires that productive citizens be able to locate, evaluate, synthesize, and communicate ever-increasing amounts of text, hypertext, visual stimuli, and data, the need for information literacy among students is paramount. However, perceptual barriers to implementation by both teachers and librarians keep information literacy a much talked about, much written about, yet infrequently attained goal in K-12 education. This paper discusses obstacles to K-12 information literacy and presents possible solutions.

Introduction

Despite the attention given to the topic of information literacy, it has yet to be realized among K-12 students in a widespread manner. So, what is in the gap between the definition information literacy and the realization of information literacy? Although students are the ultimate beneficiaries of information skills, gap analysis indicates that teachers and librarians in the settings of classroom and libraries are key factors in the transfer of information literacy skills. An examination of the literature about teacher Internet use, perceived barriers to implementation, and potential vehicles for transformation identifies some ways that teachers and librarians can diagnose the distance from information literacy and begin to close the gap.

How Do Teachers Feel Well-Prepared To Use Computers And The Internet In Teaching?

A recent survey conducted by the National Center for Education Statistics (NCES) found that 99 percent of full-time regular public school teachers reported they had access to computers or the Internet somewhere in their schools. Sixty-six percent of public school teachers reported using computers or the Internet for instruction during class time; thirty percent reported assigning research using the Internet to a moderate or large extent. The ways teachers direct students to use computers or the Internet varied by instructional level, school poverty level, and hours of professional development. Elementary school teachers are more much likely than secondary school teachers to assign students practice drills using computers and to have their students use computers or the Internet to solve problems. Secondary school teachers, however, are more likely to assign research using the Internet (NCES, 2000).

This sense of technology confidence affects the ways teachers control knowledge in the classroom. Because information literacy is an outcome that is linked to technology related skills, it requires a shift to self-directed and recursive instruction. Teaching strategies, therefore, need to be revamped. This need for alteration in teacher practice can cause mental and practical confusion and discomfort (Farmer, 1992). Most often, this discomfort manifests in perceptions about information literacy skills including insufficient class time, teacher fear of failure, and perception that information literacy skills are the role of another class.

Librarians: Untapped Colleagues and Collaborators

Librarians recognize the critical importance of their participation in curriculum development; however, their actual involvement in collaboration with classroom teachers does not match the theoretical role and the role they were trained to perform (O'Sullivan, 2000). Collaborative planning requires a knowledgeable and flexible librarian, with good interpersonal skills and a commitment to integrated information literacy instruction, and the active support of the principal

Because students are familiar with computers, assumptions are made about their knowledge of information sources. Researchers have demonstrated that students teach themselves to search for information by looking on the Web for entertainment related information (Dresang, 1999). Certainly, this information is not closely scrutinized for quality and veracity. Rarely do students need to synthesize information about entertainment related issues and communicate in a sensible and holistic way

Coordinating information gathering activities with a librarian can often a crucial step in the lesson's success. Librarians know whether print or electronic resources would be appropriate for the lesson as well as if the lesson can even be completed with the school's resources. By bringing the librarian and other colleagues into the planning process, teachers can help the information skills be distributed across classes as well as relevant to material being taught in all classes.

For information literacy, the library is a crucial venue and the librarian is a crucial agent of change (Kulthau, 1990). Information literacy is essentially about getting a sense for the range of resources available and how to organize the information these resources provide. Librarians are able to work with teachers and students to obtain knowledge, share knowledge, and keep track of knowledge systematically.

Collaborative Action Research Can "Fix It In The Mix"

Action research can help teachers and media specialists/librarians understand important variables related to student Internet use, how students perceive it as a source of learning, and the challenges educators face in effectively introducing the Internet into the school curriculum. Action research linked directly to the learning needs of students and validated through empirical research has the potential to be the foundation for introducing information literacy on a school-wide basis (Bruce & Easley, 2000).

. The immensity and complexity of information literacy forces teachers into collaborative mode. No one teacher or librarian knows how to locate, evaluate, synthesize, and communicate text, hypertext, visual stimuli, and data. The integration of research and teaching methods must be a shared endeavor aimed at helping students learn. (Kiernan & Shaw-Reeves, 2001). The empirical findings of action research can act as a measure of how far students are from being information literate. The final component of collaborative action research is to present the methods and findings of the research to the larger educational community (O'Sullivan, 2000).

By recognizing the power of individuals, collaborative planning, using the library as a setting, and applying action research to test results, perceptual barriers to adopting information literacy activities such as lack of readiness, insufficient time, and improper context can be rethought. When educators begin to acknowledge and address these barriers, students will benefit. Information literacy will provide students with the critical-thinking skills they need to transform information into the valuable knowledge required to make informed decisions in the 21st century.

References

Bruce, B. C., & Easley, J. A. (2000). Emerging communities of practice: Collaboration and communication in action research. *Educational Action Research, 8*(2), 243-259.

Dresang, E. T. (1999). More research needed: Informal information-seeking behavior of youth on the Internet. *Journal of the American Society for Information Science, 50*(12), 1123-1124.

Farmer, D. W. (1992). Information literacy: Overcoming barriers to implementation. *New Directions for Higher Education*(78), 103-112.

Kiernan, J., & Shaw-Reeves, R. (2001). *Incorporating action research into the classroom* (conference presentation). Ypsilanti: Eastern Michigan University.

Kulthau, C. C. (1990). *Information literacy: Learning how to learn.* Paper presented at the Symposium of the Graduate Alumni and Faculty of the Rutgers School of Communication, Information, and Library Studies, Newark, NJ.

NCES. (2000). *Teacher use of computers and the Internet in public schools*: National Center for Education Statistics.

O'Sullivan, M. (2000, May/June). Teaching Internet information literacy: A collaborative approach (Part II). *Multimedia Schools, 7*, 34-37.

Educational Digital Libraries: Building Community, Building Libraries

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This panel will present various perspectives on designing and implementing community-based educational digital libraries. The educational, social, and technical challenges of digital library development will be explored, in addition to the promises that digital libraries and other types of distributed learning environments hold for improving accessibility, developing community, and advancing the educational reform agenda of particular disciplines. An emerging digital library program, the Digital Library for Earth System Education (www.dlese.org) will serve as an instance of digital library development issues for the panel discussion. The presentation will also include a demonstration of this library effort to date.

Position Statement

Community libraries are evolving with the information age. The past decade has witnessed the increasing ubiquity of the World Wide Web in homes and schools, the emergence of new kinds of "electronic communities," and the widespread creation and distribution of digital educational materials. Digital libraries are becoming a means for disciplinary communities to share, organize, and assess their intellectual holdings. To date, there are many digital library efforts underway aimed at improving K-12 and undergraduate science education.

Over the past three years, The Digital Library for Earth System Education (DLESE) has emerged to support the specific educational needs of the geoscience community within this larger national library network. In the tradition of community libraries, DLESE can fundamentally change the way students learn, instructors teach, and researchers interact, by providing new ways of sharing information, tools, and services. As such, DLESE provides unprecedented opportunities for scientific learning and discovery, for increased access to and diversity within the Geosciences, and for revolutionizing teaching and learning about the Earth.

The value of DLESE lies in its potential to scale success on a national level. At the technical level, we are building on the ubiquity of Internet and web technologies, and the maturation of digital library technologies. At the educational level, DLESE scales successful innovations by providing a venue and a forum for creators of educational resources to share, on a national scale, both their educational products and their creativity and expertise. At the social level, DLESE provides a community platform for social creativity and the creation of intellectual capital.

What is DLESE?

DLESE is conceived as a community-based resource that will serve the unique needs of Earth system educators and learners at all academic levels, in both formal and informal settings, by providing:

Interfaces and tools to allow student exploration of geospatial materials and Earth datasets. Though a wealth of Earth data exists on the Web; much of it is difficult for educators to use. DLESE will provide student-friendly access to a wide variety of archived and real-time datasets.

Rapid, sophisticated access to collections of peer-reviewed teaching and learning resources. Earth science educators have been frustrated in attempts to find high quality teaching resources appropriate for their teaching style and educational level on the Web in a timely manner. This resource discovery challenge is being met with the creation of metadata schemas, controlled vocabularies, and cataloging *best practice* recommendations, all informed by community participation.

Services to help users effectively create and use materials. A full array of digital and human-mediated services for both users and contributors to the library is critical to the vision of DLESE as an active organization that both builds and serves its community.

A community center to facilitate sharing and collaboration. DLESE will serve as an intellectual commons for the global Earth system community by being the primary contact for educators, learners, and citizens who seek reliable information about the Earth.

A federated collection of holdings. DLESE is being designed from the beginning to support resource discovery across a diverse, federated network of holdings and collections (e.g. NASA, Alexandria Digital Library). These distributed resources will be complemented by a small, centrally managed core collection.

The DLESE Community Framework

DLESE is a significant undertaking, and our library building effort is as much a social experiment as it is a technical challenge. DLESE's community participation framework and participatory design process emphasize inclusiveness and promote a process of cultural change, and is essentially the intersection of three primary functions: policy, operations, and community.

Policy. Critical to the construction and management of DLESE is a governance structure that supports wide involvement in policy decisions. Library policy is set by the DLESE Steering Committee, broadly representative of Earth science education in K-16 and informal education, informed by Standing Committees (Collections, Technology, Users, and Services) reflecting the diverse needs of the community DLESE seeks to serve.

Operations. The DLESE Program Center (DPC) performs key operational functions for the library, and is headquartered at the University Corporation for Atmospheric Research (UCAR) in Boulder, CO. Critical activities underway include the development of the DLESE system architecture, user interface, and standards and protocols for metadata and interoperability.

Community. A third, and crucial, leg of the DLESE framework is an informed and engaged community. By shaping the conditions of library use, community members are subsequently better positioned to influence policy decisions. Community members have contributed user scenarios, resources, developed review criteria, reviewed metadata standards, and articulated policies for academic recognition and intellectual property.

Accomplishments over the past year include: developing and evaluating a library testbed, significantly engaging the community in the process; establishing a community-led governance mechanism; initiating collections development activities; and designing and developing a metadata schema and cataloging tools.

Conclusion

A distinguishing mark of DLESE is its grass-roots foundation and its emphasis on participatory design. As the library grows and matures, DLESE will face the special demands of scalability and sustainability that accompany such ambitious efforts. Although there are aspects of our experience that are unique to the discipline of Earth system education, we believe that most of the challenges that we have encountered are applicable to the development of distributed learning environments across a wide variety of disciples.

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Panelists:
Mary Marlino (University Corporation for Atmospheric Research) is the Principal Investigator for the NSF sponsored Digital Library for Earth System Education (DLESE). For the past three years, she has been the Director of the DLESE Program Center, and is responsible for the overall direction for the library-building effort. Marlino has extensive experience in large project management, and the design and evaluation of instructional technology. Prior to coming to UCAR, she was Director of Educational Technology at the US Air Force Academy for nine years.

Tamara Sumner (The University of Colorado) is an Associate Professor of Computer Science at the University of Colorado, and is a Co-PI on the DLESE project. Her areas of expertise include both computer and cognitive sciences, with emphases on user-centered design methodology, usability evaluation, distance education, and system design to support electronic publishing in scholarly communities. Prior to joining the University of Colorado, she led numerous software development projects at both The Open University and at Hewlett Packard.

David Fulker (University Corporation for Atmospheric Research) has 15 years of experience in leading community-based technology programs, including the Unidata Program Center and the newly established National Science, Technology, Engineering, and Mathematics Digital Library Program Center. In this capacity he is responsible for overall management and technical direction of this emerging national effort.

Infrastructures for Web Based Support of Campus Learning: Applicability in Engineering Colleges

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Abstract: The purpose of this paper is to present an ongoing research project that evaluates and identifies the requirements and needs for Web Based Support to learning environments in an on-campus context. These environments supplement, with different methodologies, the traditional teaching and learning in engineering institutions of higher education. A set of undergraduate and postgraduate courses of the Porto Polytechnic School of Engineering (ISEP) and the Faculty of Engineering of Porto University (FEUP) will be used as test beds.

Introduction and motivation

Academic institutions and companies operating in the education "market" are increasingly exploring the use of Information and Communication Technologies (ICT) to develop teaching and learning environments accessible through a Web interface (Flanagan, 2000, Collis, 1998). Diverse models and patterns for these environments have been developed and implemented in undergraduate and postgraduate courses (Nachmias, 2000, Seufert, 2000, Cardoso, 2001).

like most higher education institutions, ISEP and FEUP have launched a few elearning initiatives on an experimental basis, whose results are being evaluated. However these initiatives have not been conducted in a systematic way and have not been integrated with the information systems of the institutions, taking profit of the management and communication facilities offered by them. This is a serious limitation, as "Information systems also constitute an important tool to support the evolution of the pedagogical process and it is expected to contribute to the continuous education effort" (David, 2000).

Project Development

The project is being conducted during the present academic year, with a special focus on the Computer Science Departments of both Institutions.

The **first phase** goal was to identify the requirements for a Web Based Environment, which advantageously complements the traditional learning process. For this purpose, a set of tools was designed to provide this information, taking in account the nature of the stakeholders (higher education institutions, teachers and managers). The first tool was a questionnaire created to study the perception of the teaching staff in relation to the introduction of elearning in each institution and to identify possible areas where e-learning can be used. The questionnaire also allows determining the statistical, technological and e-learning profile of the teaching staff and the institutional profile of each institution. The questionnaire was initially delivered to a dozen teachers to assess its reliability (internal consistency and stability). For the pilot test; using Cronbach's Alpha formula; reliability for the total of the items was + .80. There is general agreement that + .75 or above indicates appropriate instrument internal consistency (Woodward, 1983).

Later, the questionnaire was delivered in paper to each teacher of the two academic institutions. We have gotten above of 100 responses in each institution, which represents about 21% of the total target

Based on the questionnaire results a directed interview was conducted to a small numbers of teaching staff and managers in crucial leading roles (department directors, scientific and pedagogic council, etc.).

Simultaneously, an analysis was made on existing Web Based Environments. We synthesized existing studies on these tools as well as case studies in other academic institutions.

The triangulation of the results from the previous tools, allowed to organize the requirements, in a preliminary way, in terms of features concerning trainer's support (authoring facilities and course management), learner's support (learning; collaborative and interaction facilities) and technical administrators support

The **second phase** of the project (currently ongoing) will look into the adequacy and advantages of integrating Web Based Learning Environments with the information system of the two academics institution. The evaluation will be based on the requirements and in terms of its value of use and analysis of cost/benefit.

The first step was to select, acquire and install a Web Based Learning Environment (WBLE) for each Institution, based on the respective requirements.

The next step in this phase is to integrate the WBLE with each information system, test and evaluate the final environment. This is currently being done but has proved to be a more difficult process.

We have selected pilot courses (and a corresponding teaching/learning methodology) in each Institution to evaluate the efficiency of the WBLE and its integration with the Information System. Before the courses start, an assessment of student's technological profile was conducted through a questionnaire.

As it is difficult to demonstrate that a change in practice or in knowledge over time can be attributable to a single isolated resource (the WBLE, in our case), the Integrative approach therefore looks at how the resource is used in conjunction with all the other resources that are available to its users. It will focus on users' opinions and level of use of the resource, and on how it is embedded into the course as a whole. Also the opinions of the administrative staff and technician involved in this study will be heard.

Conclusions and Expected Results:

The expected results are twofold: identification of the requirements and evaluation of the effectiveness of an integrated e-learning/information system environment in engineering education.

We expect that the results of this project may be useful for other engineering institutions of higher education that wish to create, manage, access and share Web Based Infrastructures for "campus-learning". We also think that the experience of this work represents an alternative view about the role of learning Web-based environments/systems in educational processes.

References:

Flanagan M., Egert, C. (2000), Courseware quality and the collaborative classroom: implementing IOS courseware to generate seminar-style interactions, IMEj, 2(1).

Collis B. (1998), WWW-Based environment for collaborative group work. Education and Information Technologies, 3, 231-245.

Nachmias, R. et al. (2000), Web-Supported Emergent-Collaboration in Higher Education Courses, Educational Technology & Society 3(3).

Seufert S. (2000), The NetAcademy as a Medium for Learning Communities, Educational Technology & Society 3(3).

Cardoso L, Machado A (2001), A Problemática da Adopção de Ambientes de Ensino Distribuído no Ensino Superior, 2ª Conferência APSI.

David G, Ribeiro L (2000), Impact of the Information System on the Pedagogical Process. FEUP.

Woodward CA, Chambers L. (1983), Guide to Questionnaire Construction and Question Writing. Canadian Public Health Association.

Toolbook Instructor Authoring Software for Interactive Mathematics Courseware

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Abstract: ToolBook Instructor is a comprehensive desktop authoring software [7] designed for use by a broad spectrum of course developers and instructional designers to create standards-based content. The purpose of this paper is to describe the development of an interactive multimedia courseware for college algebra and precalculus. The course work developed using the Toolbook Instructor provides lectures, examples, simulations and exercises on topics usually covered in a precalculus course.

1. Introduction

The multimedia Interactive courseware is in the form an electronic book. The presentation of a topic is done via hypermedia. Text, sound, graphics and animation are used to present a topic. This is followed by examples. The user is then provided with a chance to do interactive exercises. The multimedia authoring software used in writing the precalculus book is Toolbook Instructor II ([7]). Most of the computer algebra used in arriving at the solutions of the mathematics problems in the book is written in the scripting language of the authoring software. Many of the decision in the presentation of the mathematical expressions are dictated by the limitation of the authoring software. The book has been used as tutorials for trigonometry, algebra and precalculus courses. Several chapters were integrated into interactive classroom lectures. However, reliable evaluation of the courseware is still pending. Students have given high marks for the software in the student evaluation of the courseware. The development of the courseware got its start from the Minority Science Improvement Program (MSIP) funded by the U. S. Department of Education in 1994- 96. One of the objectives of the project was to develop interactive multimedia computer assisted instructional (CAI) modules for topics in trigonometry.

3. Courseware Design And Educational Issues

In developing the electronic book the author looked at several design issues that one must consider in developing interactive instructional material. Many of the earlier problems in designing and developing interactive educational software are well stated by Jones, Farquahar and Surrey [4]. The uses of design elements such as pull down menus, multiple windows, navigational buttons, help buttons, and the uses of program metaphors are discussed by Jones [4]. Jones & Okey [5] give helpful suggestion to the designers of interactive software. Burbulas and Callister ([1]) discuss the roll of Hypermedia for the presentation of educational material. Integrated text, sound, graphics and animation in the presentation of information should not only enhance means of providing rapid information but should also motivate and keep the student interested in the material presented (Hooper [2] and Romiszowski [6]).

4. General Technical Issues

Toolbook provides object oriented programming with integrated multimedia tools. Toolbook has its drawbacks, especially, when one is writing a book for doing mathematics. The main drawback has to do with mathematical typography. There is also a serious problem with the fonts substitution in a text field. There also exists the problem of displaying mathematical expressions and formulae on the screen. Mathematical equations and formulae have to be imported as graphics and pasted in the text field. One can cleverly get around this difficulty but it requires great programming effort. Beside the presentation problem, there are obvious problems of creating interactive mathematics tutorials. There is a problem on how to evaluate student's responses to a problem generated by the computer. There may be several correct responses to a question. The program has to parse the student's answer and compare it with the possible correct answers generated by the program. Directing the student to answer a question using a certain pre-arranged format can reduce some of these difficulties. There are some basic requirements that are common to the field of electronic book publishing in the category of educational software Romiszowski ([6]).

Computer Algebra and Computation

After all, the precalculus electronic book teaches mathematics. So, how are the calculations and algebraic manipulations performed? Toolbook provides basic functions that are available in any programming language. All the calculations and operations are programmed using the Toolbook script. For example, the programming for interactive algebra section took about three months. There are programs that factor polynomials of degree six or less. The program can find real and complex zeroes of polynomials of degree six or less. If no rational zero exists, the program attempts to find approximate zero using the standard numerical analysis methods such as Newton Law or the Intermediate Value Theorem. If rational zero exists, it attempts to provide rational zeros and factors. Since, the purpose of the software is to provide instruction only, the software is not a sophisticated computer algebra system like Maple or Mathematica. However, it is able to do the algebra problems that are found in an elementary algebra book. It will do algebra of rational functions. It will solve polynomial equations of degree six or less. It will graph polynomial, rational, trigonometric, logarithmic, and exponential functions. And it will do so interactively. It demands the students to know these functions and challenges them to interactively graph them using various important properties of the functions. The whole theme of the book is about student involvement. It demands understanding of topics discussed. There are no multiple-choice questions. All question require that student perform calculation to arrive at the answers. The book is capable of giving objective type tests and could provide instantaneous results.

Web Connection and External Help

One can provide connection to Web by creating buttons with hyperlinks. In the Precalculus book each chapter contains a button for launching a web page specially designed for the courseware. The page provides links to existing precalculus material on the web. Moreover, the page can be used to provide an instructor means of providing external help through links to other web pages and other material developed by the instructor. The content of the page can be changed to fit each instructor individual needs. This gives a instructor the chance to customize the page as desired. In fact, the purpose of this web page is to provide links to interactive tutorials, homework assignments, and other support material for the course.

References

[1] Burbules, N. C., & Callister, T. A. (1996). Knowledge at the crossroad: Some alternative future of hypertext learning environment. Educational Theory, Vol. 46(1), 23-49.

[2] Hooper, K. (1988). Multimedia in Education, S. Ambron & Hooper (Eds.), Interactive multimedia. Redmond, WA: Microsoft Press.

[5] Jones, M. G., (1989). Human-computer interaction: A design guide. Englewood Cliffs, NJ: Educational Technology Publications.

[4] Jones, M. J., Farquhar, J. D., & Surry, D. W., (1995). Using metacognitive theories to design user interface for computer-based learning. Educational Technology, August 1995.

[5] Jones, M. G., & Oke, J. R., (1995) Interface design for computer-based learning environments. Instruction Technology Research. 1995.

[6] Romiszowski, A. J., (1994). Educational systems design implications of electronic publishing. Educational Technology, September 1994

[7] Toolbook II Instructor, http://home.click2learn.com/en/toolbook/.

From Gutenberg's Galaxy to Cyberspace: A New Model for a New Writing Space

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Abstract: This paper synopsizes the central findings of a two-year empirical study into how the new rhetorical situations presented by hypertext affect the writing process and thus impact upon literacy and education. It theorizes a conceptual model based on these findings.

New technologies are transforming literacy in general and writing in particular. Hypertext is perhaps the most radical transformation to date. In hypertext, writers struggle to master a new process that includes electronic links, visual images, sound, animation, and other forms of data within a single digitized writing space. This transformation challenges educators to reframe our roles and points of reference as we increasingly use hypertext in the form of websites to enhance curriculum. Hypertext offers new opportunities for optimizing learning if we use it well. We need new process models to help us rethink our conceptions of writing in order to adapt this new form of writing to best pedagogical practices. This paper presents such a model.

This paper synopsizes the key findings of a completed two-year conceptual and empirical study of the hyperwriting process. My research was guided by the overarching question: *How are writers' perceptions of the new rhetorical situations presented by hypertext affecting their attitudes towards writing and the consequent decisions they make in response to these perceptions?* The study was the basis of my recently completed doctorate. My position within the study was that of an "indwelling researcher" who inhabits the world s/he is studying. That is, my dissertation was composed and submitted as a hypertextual website. It was the first dissertation of its kind at my university—both content and form—and one of the first in the world. It challenged academic norms in both content and form and successfully redefined academic notions of literacy to some degree.

The findings of this study are contextualized within a significant body of pre-hypertextual writing theory and a small but growing body of hypertext theory. Unlike writing theory, hypertext theory consists principally of speculative theorizing. Little attention has been paid to the particulars of the writing or reading processes, and empirical studies are virtually non-existent. This study begins to address that imbalance.

The design of my study is based on phenomenological concepts and methods common to qualitative research using an emergent, field-based, ethnographic approach. This framework is well-adapted to the complex nature of the writing process—a process that is rooted in individual human cognition contextualized within a social experience. Because our "social universe" is constructed, it does not exhibit the same kind of cause and effect consistency as the physical universe. A qualitative methodology allows for the unpredictability and variability inherent in this socio-cognitive process (Denzin, Donmoyer, North, Villanueva). The emergent interdisciplinary paradigm of the ethnographic approach (Clifford and Marcus, Geertz) further supports the goal of discovery and deeper understanding, important in a discipline such as hypertext theory that is itself interdisciplinary and emergent. Purposive sampling allows for a range of experience with maximum variation, and data collection in natural settings respects the importance of context in an intrinsically social activity. Inductive analysis helps to ensure that what is seen as important is determined not only by the researcher, but by the informants and the data they generate (Eisner, Glesne and Peshkin, Maykut and Morehouse, Strauss and Corbin). Data collection methods include interviews, observations, correspondence, journals, and artifacts. A significant amount of data was collected over the Internet using asynchronous and synchronous communication (Markham, Mason, "Ethnography in Cyberspace").

The informants in this study include writers whose orientations range from academic, to business, to creative. At the time of data collection, they all composed regularly in a hypertextual writing space and published on the World Wide Web. Although it is possible to compose in hypertext that is not destined for the Web—thus integrating only internal hyperlinks—I did not encounter writers who used hypertext this way. To my informants, hypertext and the

Web were virtually synonymous. I collected data from seven "major" writers who used hyperwriting in their professions, and approximately ninety "minor" writers in the group setting of three classroom-based writing courses. Further, having authored extensively in hypertext myself—and having assumed the posture of the "indwelling inquirer"—I also drew on my own experiences. In my dissertation, I reported my complete findings in the manner of an "emic" or "thick" description extended to include interpretations, speculations, and pedagogical applications (Mason, *From Gutenberg's Galaxy*). In theorizing a conceptual model based on my findings, I believe I have achieved the ultimate goal of qualitative research to develop "the highest level of interpretation and abstraction from the data in order to arrive at the organizing concepts and tenets of a [grounded] theory to explain the phenomenon of interest" (Maykut and Morehouse 122).

As stated above, the principal conceptual framework for my interpretations is a significant body of pre-hypertextual writing theory, and a small but growing body of hypertext theory. I will elaborate on this framework by giving a brief overview of writing and hypertext theories as follows:

The 1960's witnessed a major shift away from a behaviorist understanding that viewed writing principally in terms of models and rules derived from finished texts. This shift is embodied in what we now call writing theory or composition theory. Writing theory is grounded in a philosophy of rhetoric that rejects a traditional product-oriented understanding of writing in favor of a process-oriented approach. Early writing theory draws heavily on the philosophies of Kenneth Burke who regards language first and foremost as symbolic action and only second as representation. The work of Richard Rorty, Thomas Kuhn, and Clifford Geertz further shaped writing theorists' growing understanding of the role of social and cultural contexts in the writing process. Moreover, the influences of Michael Polanyi, John Dewey, Suzanne Langer, Lev Vygotsky and Jerome Bruner inspired the notion of writing as both a tacit and a transactional process with both cognitive and social implications. Early explorations of the writing process focused on an individual writer's cognitive process. Tensions soon broke out between theorists who focused on individual cognition and those who viewed writing as a socially contextualized process. Bizzell and Faigley synopsize this complicated intellectual exchange in theoretical models that help us to understand the evolution of writing theory. Exchanges among process theorists set in place a framework for "reinventing" the rhetorical tradition (Freedman and Pringle) in such a way as to emphasize ultimately both the cognitive and social dimensions of writing in order to reveal the full complexity of writing as "a manifestation of complex and interpenetrating cognitive, social, and cultural processes" (Kennedy 243). It is upon this dynamic that the sub-division of writing theory known as genre theory is built. Genre theory is the most fully elaborated theory of writing to date because it joins the micro level of writing to the macro level of discourse, unites process with product, and connects the individual (cognitivist) and the social (constructivist) approaches. It is the link between writing theory and hypertext theory.

Genre theory bridges the theoretical gap between traditional writing and hypertext because, like the broader conceptual framework of discourse theory, genre theory recognizes writing as a form of social practice. Genre is understood differently than in its more traditional literary sense of textual features (Freedman and Medway). Genre here includes the interests, goals, and shared assumptions implicit in different discourse communities. Genre theorists explore the ways in which these factors function as heuristics of process that culminate in textual practices and features (Berkenkotter and Huckin). Noted discourse theorist Norman Fairclough details the ways in which discourse is social practice. In his 1995 study, *Critical Discourse Analysis: The Critical Study of Language*, Fairclough defines discourse not only as language in sociocultural practice; he further observes that "texts in contemporary society are increasingly multi-semiotic. . . .not only because they incorporate photographs and diagrams, but also because the graphic design of the page is becoming an ever more salient factor" (4). Writing in 1995, Fairclough's definition of discourse anticipates the impact of hypertext on text. Genre theory provides a much-needed link to discourse theory and, by extension, to hypertext theory since writing theory, with few exceptions, (Hawisher and Selfe, Selfe and Hilligoss) treats hypertext as a displacement of print-based literacy (Johnson-Eilola). Like Lemke, I find it more logical to view hypertext in the larger ecosocial context of a communication continuum that begins with grunts and cave drawings.

Hypertext theory is an interdisciplinary framework that that draws on postmodern theory in general, and literary, communication, and social theories in particular. Best known among hypertext theorists are George Landow, Jay David Bolter, Paul Gilster, Richard Lanham, Michael Joyce, Paul Levinson, Steven Johnson, Janet Murray, Stuart Moulthrop, James O'Donnell and Sherry Turkle. What all these theorists share in common is a view of hypertext as a paradigm shift, and as a physical embodiment of the ideal text envisioned by the postmodern theorists such as Foucault, Barthes, Derrida, and Bakhtin; that is, text whose structure consists of multi-sequential nodes, links, and networks, whose content can include the aural and the pictorial, and whose interactive nature re-negotiates the relationship between reader and writer. Hypertext is thus understood by hypertext theorists as a phenomenon that reconfigures the writing space and the thinking processes behind it. As Gilster observes, "hypertext is a mental process as well as a digital tool" (138).

It is within the theoretical framework described above that I interpret my data. In the original full length study (Mason, *From Gutenberg's Galaxy*) I identified, reported, and interpreted a number of immediate contextual concerns. These included the Internet as a public writing space, multimedia, collaboration, and "techno-angst." I further extended my interpretations to suggest pedagogical implications. Finally, I used my interpretations as a scaffold upon which to build my own theoretical speculations about the impact of hypertext on ways of thinking and knowing. In the limited space of this paper, I offer a much-reduced synopsis of the central focus of my research: the particulars of the hyperwriting process. From my interpretation of these particulars I theorize a new process model. While avoiding the positivist pitfall common to generalization, I do believe it is both the prerogative and responsibility of the qualitative interpreter to identify commonalities as a basis for theoretical speculation. It is these common practices among my informants that I will now describe.

The Importance of the Visual

The need to visualize both the "look" on the screen and/or the overall design of their "docuverse" was uppermost in the minds of most informants when they faced a new hyperwriting task. ("Docuverse" is a term coined by Theodor Nelson to describe a hypertextual document.) Different informants had different ways of addressing this challenge, but each relied on some form of visual schematization. Terms such as story-boarding, mind-mapping, sketching, and drawing were commonly used by the writers under study to describe their process. The words of my informant, Mac, best represent this experience. Mac said, "Well, I think the first thing—and everything plays off this—is that you start essentially with a storyboard, much more the way you would approach putting together a cartoon or a movie than a simple piece of writing." Concern over how to visualize their writing space ranged from envisioning the macro level of the site as a whole—colors, shapes, and structural relationships—to envisioning the micro level of individual page layouts. Further, the potential to include images—both still and animated—seemed to invite writers to imagine the pictorial as an intrinsic part of whatever text they were composing. The need to visualize occurred early in most writers' processes and persisted throughout.

Considerations of Structure

According to hypertext theorist Jay David Bolter, "In this shifting electronic space, writers will need a new concept of structure. In place of a closed and unitary structure, they must learn to conceive of their text as a structure of possible structures" (144). A concern with structure in terms of navigational paths was common to all my major informants. They acknowledged this to be a new writing concern. My informant Jay put it this way: "I had to determine how people might look through the material and what people looking through the material might be searching for, and what kinds of questions they might have, to first and foremost anticipate the kinds of twists and turns that my readership might take. I had to go there before they did. This is different, this trying to anticipate the thought processes of other people." I believe Jay identifies a fundamental difference between printed text and hypertext. Writing in hypertext forces a higher degree of audience anticipation on the part of the writer. It is easier to predict reading patterns in print; options are fewer and more obvious. How to divide text, what to include in menus, and where to place hyperlinks in order to build trails and "leave breadcrumbs" thus become crucial decisions in hypertextual structuration. In building these trails, however, writers must envision the stability of their text much the way Schryer describes genre in the context of social practice as "stabilized-for-now" (Freedman and Medway 105-124). Janet Murray comments on this complex socio-cognitive process in *Hamlet on the Holodeck* when she observes, "authorship in electronic media is procedural. Procedural authorship means writing the rules by which the texts appear as well as writing the texts themselves" (152). It is questionable, however, to what extent those writer-based rules will be followed. Readers in hypertext are free to follow whatever paths they choose and create their own structures. Hypertext theorists comment widely on the role of the reader in creating coherence. It may well be that, as Myka Vielstimmig suggests, when it comes to hypertext "the coherence is performative" (31). Nonetheless, writers appear to be challenged to envision a range of paths in order to create a navigable structure. Furthermore, the writer's acute awareness of the reader's role in negotiating meaning emphasizes the redefinition of the constructivist transaction between writer and reader that is emerging in this medium (Bolter, Landow, Johnson-Eilola, Sosnoski). Fairclough's definition of discourse as "language seen as a form of social practice" is clearly evident (6).

Content and the Place of Words

Composing in a multi-medial "writing" space, my informants began to question the role of words. The majority tried to eliminate words when possible, sensing that in this medium, "a picture is worth a thousand words." Among my informants, Mary, an English teacher, noted that when she hyper-writes words are the last element she considers whereas in traditional text they are the first. Mary also observed her tendency as a hyper-writer to avoid complex sentences in favor of subject-verb-object, and—much to her amazement—a sudden acceptance of incomplete sentences. Informant Don described how he went to extraordinary lengths to minimize words. He even claimed his primary concern was "how the page looks rather than the content it contains." To get the "look" he wanted, Don admitted he'd do anything to "make the words fit into a specific size cell in the table." Rose, a writer of hypertext fiction, still valued words but said that in hypertext, "I think I tend to be shorter—both my stories and the sentences and words in them." Several informants remarked that the ability to hyperlink to external resources often eliminated the need to "write" text at all in some circumstances. In sum, my data suggests that hyperwriting requires more than word-based language skills, and that content is defined as more than words. Writing in this medium thus appears to draw on more than "linguistic intelligence" (Gardner), and re-configures the role of words within the semiotic configuration of the writing space. This multi-medial reconfiguration of the writing space may be welcome news to intelligences and learning styles that have been previously undervalued in the traditional curriculum.

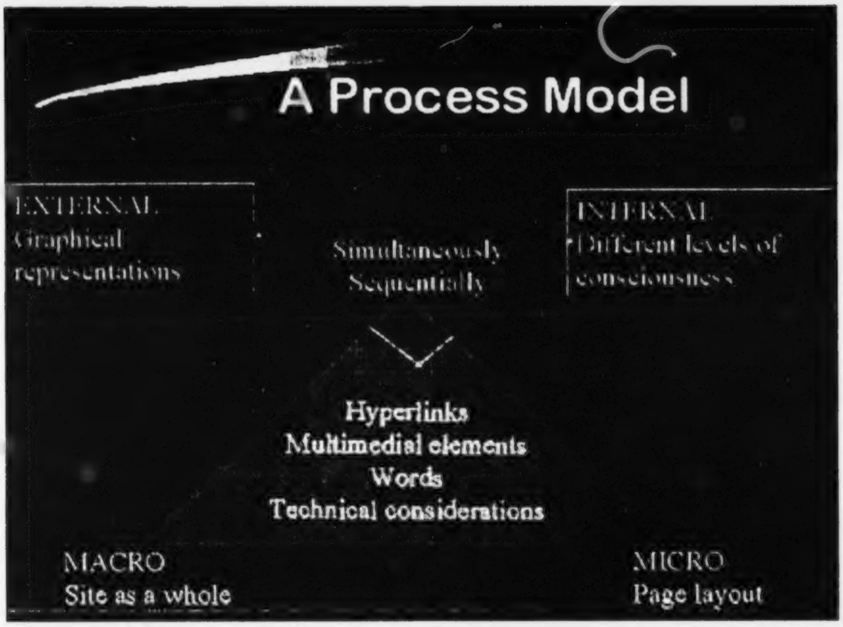
Conventions

As with any new medium, conventions develop. In printing, for example, we take for granted pagination, margins, standardized spelling, indexes, and so forth. Hypertext in the form of a website is no exception. My informants concerned themselves with the increasingly expected conventions of this medium. They knew, for example, that readers would expect a navigation bar on each page, and they deliberated about where to place it. Informants concerned themselves with page titles, menus, banners, headers, footers, back-to-top icons, home icons, authorial information, and dates. They also pondered what to do about conventions connected to the "Gutenbergian artifact" (Negroponte) of copyright. They worried about if and how sources for material they included in their websites should be cited, and whether and how to copyright their own original material. Informants also had to unlearn and relearn common habits based on print-based conventions. Underlining, for example, creates confusion if used to highlight text since hyperlinks themselves are underlined. Finally, within a medium as new as Web-based hypertext, conventions metamorphose continually as technology creates new options. Thus, my informants were confronted with the stress of a medium whose points of reference were constantly shifting.

The particularities of the hyperwriting process that I have highlighted above constitute a brief overview of the key findings in my study. A more extended analysis, and a range of less commonly cited habits are detailed in the full study (Mason, *From Gutenberg's Galaxy*).

A Conceptual Model for the Hyperwriting Process

Perhaps it was working in such a visual medium that prompted me increasingly to visualize the substance of my interpretations as a concept map. "A Process Model" (Fig. 1) represents the interpretations of my empirically grounded theory in a single conceptual image. This model is not meant to be definitive or prescriptive in any way. Writing is a highly individual yet complex activity that cannot be reduced to a single model. Furthermore, as research evolves new ways of understanding the hyperwriting process will emerge. The value of any model, however, is that it allows researchers a concrete point of reference from which to question and conceptualize further. As a result of my findings, I have also come to believe that graphic representations engage a part of the brain that words do not and thus, when combined with words, can transform scholarly theorizing into a more whole brain activity.



A Process Model

EXTERNAL
Graphical
representations

Simultaneously
Sequentially

INTERNAL
Different levels of
consciousness

Hyperlinks
Multimedial elements
Words
Technical considerations

MACRO
Site as a whole

MICRO
Page layout

Fig. 1: A New Process Model for Hyperwriting

Here is how I would verbally describe the hyperwriting process as it is represented in the "new model" presented (Fig. 1). The "typical" hyper-writer appears to hold in mind and make key decisions about many elements of a given writing task at the same time. Some of these elements are common to a Gutenbergian writing space and are a given in any writing medium (e.g., audience, purpose, words); however, many elements are new rhetorical considerations (e.g., multi-media, hyperlinks, technical functions). It is these new elements that this model embodies.Because of the number of diverse elements the hyper-writer appears to consider both simultaneously and sequentially, it seems logical that different levels of consciousness may be involved. Moreover, the hyper-writer must consider both the macro-level (e.g., navigational system, style templates) and the micro-level (e.g., page layouts, content) simultaneously as they impact on each other in an electronic environment that is always in a kind of inter-dependent controlled motion rather than frozen on a printed page. To accomplish this multi-faceted procedure, the hyper-writer likely processes these elements internally at different levels of consciousness both simultaneously and sequentially, while at the same time representing these elements and their evolution externally on either paper or—more likely—by using web authoring software or even hard-coding in HTML. These external representations appear to be highly graphical in nature as compared to the traditional writing process that is constituted largely by words. Holistically, this model represents what may be the most crucial distinction between traditional writing and hyperwriting, between Gutenberg's Galaxy and Cyberspace—as most of my informants noted in various ways—*there is just so much more to deal with all at the same time*!

References

Bakhtin, M.M. *The Bakhtin Reader: Selected Writings of Bakhtin, Medvedev, and Voloshinov.* New York: E. Arnold, 1994.

Barthes, Roland. *A Barthes Reader.* Ed. Susan Sontag. New York: Hill and Wang, 1982.

Berkenkotter, Carol and Thomas N. Huckin. *Genre Knowledge in Disciplinary Communication.* Hillsdale, NJ: Erlbaum, 1995.

Bizzell, Patricia. "Cognition, Convention, and Certainty: What We Need to Know about Writing." *PRe/Text: The First Decade,* ed. Victor J. Vitanza. Pittsburgh: U Pittsburgh P, 1993. 65-92.

BEST COPY AVAILABLE

Bolter, Jay David. *Writing Space: The Computer, Hypertext, and the History of Writing.* Hillsdale, NJ: Erlbaum, 1991.

Bruner, Jerome. *Acts of Meaning.* Cambridge: Harvard UP, 1990.

Burke, Kenneth. *The Philosophy of Literary Form: Studies in Symbolic Action.* Berkeley: U of California P, 1973.

Clifford, James and George E. Marcus, eds. *Writing Culture: The Poetics and Politics of Ethnography.* Berkeley: U California P, 1986.

Denzin, Norman K. and Lincoln, Yvonna S. *Handbook of Qualitative Research.* Sage, 1994.

Derrida, Jacques. *A Derrida Reader: Between the Lines.* Ed. Peggy Kamuf. New York: Columbia UP, 1991.

Dewey, John. *The Philosophy of John Dewey.* Ed. John J. McDermott. Chicago : U of Chicago P, 1981.

Donmoyer, Robert. "Generalizability and the Single Case Study." *Qualitative Inquiry in Education: The Continuing Debate.* Eds. E.W. Eisner and A. Peshkin. New York: Teachers College P, 1990. 175-200.

Eisner, Elliot. *The Enlightened Eye: Qualitative Inquiry and the Enhancement of Educational Practice.* NY: Macmillan, 1991.

Faigley, Lester. "Competing Theories of Process: A Critique and a Proposal." *College English* 48 (1986): 527-42.

Fairclough, Norman. *Critical Discourse Analysis: The Critical Study of Language.* NY: Longman, 1995

Foucault, Michel. *The Foucault Reader.* New York: Pantheon, 1984.

Freedman, Aviva and Peter Medway, eds. Genre and the New Rhetoric. Bristol, PA: Taylor and Francis, 1994.

Freedman, Aviva and Ian Pringle, eds. *Reinventing the Rhetorical Tradition.* Ottawa: Canadian Council of Teachers of English, 1980.

Gardner Howard. *Frames of Mind: The Theory of Multiple Intelligences.* New York: Basic, 1983.

Geertz, Clifford. *The Interpretation of Cultures.* New York: Basic, 1973.

Gilster, Paul. *Digital Literacy.* New York: John Wiley, 1997.

Glesne, Corrine and Alan Peshkin. *Becoming Qualitative Researchers: An Introduction.* New York: Longman, 1992.

Hawisher, Gail E. and Cynthia L. Selfe, eds. *Evolving Perspectives on Computers and Composition Studies: Questions for the 1990s.* Urbana, ILL: NCTE P, 1991.

_________. *Passions Pedagogies and 21st Century Technologies.* Logan, UT: Utah State UP, 1999.

Johnson, Steven. *Interface Culture: How New Technology Transforms the Way We Create and Communicate.* San Francisco: Harper, 1997.

Johnson-Eilola, Johndan. *Nostalgic Angels: Rearticulating Hypertext Writing.* Norwood, NJ: Ablex P, 1997.

Joyce, Michael. *Of Two Minds: Hypertext, Pedagogy, and Poetics.* Ann Arbor, MI: U of Michigan P, 1995.

Kennedy, Mary Lynch. *Theorizing Composition: A Critical Sourcebook of Theory and Scholarship in Contemporary Composition Studies.* Westport, CT: Greenwood Press, 1998.

Kuhn, Thomas S. *The Structure of Scientific Revolutions.* Chicago: Chicago UP, 1962.

Landow, George P. *Hypertext 2.0: The Convergence of Contemporary Critical Theory and Technology.* Baltimore: Johns Hopkins UP, 1997.

Langer, Susanne K. *Feeling and Form: A Theory of Art.* New York: Scribner's, 1953.

Lanham, Richard. *The Electronic Word: Democracy, Technology, and the Arts.* Chicago: U of Chicago P, 1993.

Lemke, Jay. *Textual Politics: Discourse and Social Dynamics*. London: Taylor and Francis, 1995.

Levinson, Paul. *The Soft Edge: A Natural History and Future of the Information Revolution*. New York: Routledge, 1997.

Markham, Annette. *Life Online*. Walnut Creek, CA: Altamira P, 1998.

Mason, Jean S. "Ethnography in Cyberspace: Data Collection Via Email and Instant Messaging." *Inkshed* 18, 1, Spring 2000.

__________. *From Gutenberg's Galaxy to Cyberspace: The Transforming Power of Electronic Hypertext*. Doctoral dissertation. Montreal, Canada: McGill University, 2000.

Maykut, Pamela and Richard Morehouse. *Beginning Qualitative Research, A Philosophic and Practical Guide*. Washington, DC: Falmer P, 1994.

Moulthrop, Stuart. "Electronic Fictions and 'The Lost Game of Self' " *New York Review of Science Fiction* Feb. 1994 8-14.

__________. "Response: Everybody's Elegies." *Passions, Pedagogies, and 21st Century Technologies*. Eds. Gail E. Hawisher and Cynthia L. Selfe. Logan, UT. Utah State UP, 1999. 418-24.

__________. "Rhizome and Resistance; Hypertext and the Dreams of a New Culture." *Hyper / Text / Theory*. Ed. George P. Landow. Baltimore: Johns Hopkins UP, 1994. 299-322.

__________. "Travelling in the Breakdown Lane: A Principle of Resistance for Hypertext." *Mosaic* 28 Dec. 1995, 55-77.

Murray, Janet. *Hamlet on the Holodeck: The Future of Narrative in Cyberspace*. New York: Free Press, 1997.

Negroponte, Nicholas. *Being Digital*. New York: Knopf, 1995.

North, Stephen M. *The Making of Knowledge in Composition: Portrait of an Emerging Field*. Upper Montclair, NJ: Boynton/Cook, 1987.

O'Donnell, James J. *Avatars of the Word: From Papyrus to Cyberspace*. Cambridge, MA: Harvard UP, 1998.

Polanyi, Michael. *The Tacit Dimension*. London: Routledge, 1967.

Rorty, Richard. *Contingency, Irony and Solidarity*. New York: Cambridge UP, 1989.

__________. *Truth, Politics and "Post-Modernism"* Assen: Van Gorcum, 1997.

Schryer, Catherine F. "The Lab vs. The Clinic: Sites of Competing Genres." *Genre and the New Rhetoric*. Eds. Aviva Freedman and Peter Medway. Bristol, PA: Taylor and Francis, 1994. 105-24.

Selfe, Cynthia and Susan Hilligoss, eds. *Literacy and Computers: The Complications of Teaching and Learning with Technology*. NY: MLA, 1994.

Sosnoski, James. "Hyper-readers and their Reading Engines." *Passions, Pedagogies, and 21st Century Technologies*. Eds. Gail E. Hawisher and Cynthia L. Selfe. Logan, UT: Utah State UP, 1999. 161-77.

Strauss, Anselm and Juliet Corbin. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, CA. Sage, 1990.

Turkle, Sherry. *Life on the Screen: Identity in the Age of the Internet*. New York: Simon and Schuster, 1995.

Vielstimmig, Myka. "Petals on a Wet, Black Bough: Textuality, Collaboration, and the New Essay." *Passions, Pedagogies, and 21st Century Technologies*. Eds. Gail E. Hawisher and Cynthia L. Selfe. Logan, UT: Utah State UP, 1999. 89-114.

Villanueva, Victor Jr., ed. *Cross Talk in Comp Theory*. Urbana, ILL: NCTE, 1997.

Vygotsky, Lev. *Thought and Language*. Revised and edited: Alex Kozulin. Cambridge, MA: MIT P, (1962) 1986.

Desktop Streaming^{TM}

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April 30, 2002

1 Abstract

In the Information Age, Help Desks play an increasingly important and highly visible role in providing effective customer service and satisfaction. Effective communication is a key component in delivering customer satisfaction. Therefore, we at the ISS Help Desk, at The George Washington University, purchased Desktop Streaming^{TM} - software that allows remote screen sharing, without client side installation, over a standard internet connection.

2 Introduction to Environment and Users

Any large organization, like The George Washington University (GW), has an eclectic mix of computer users and an equally varying computer skill set.

And it is when computers do not function properly, that clients call the Help Desk.

3 What Does the Help Desk Do?

Ideally,

- Resolve the issue over the phone

- If issue cannot be resolved, assign the call to another division

Computer problems are not easy to describe and sometimes, neither are their solutions. Verbally instructing clients, particularly novices, on the steps to troubleshoot computer issues can be time consuming and frustrating to clients and IT Support Staff.

In a small organization, it is feasible to walk over to the cubicle down the hall to solve the problem in person, but that is not always possible with large and/or off campus/site users because

- of distance[1]
- of time to get to off-site locations[2]
- it reduces Help Desk coverage.
- you always forget something at your desk

and you almost wish you could see the user's computer from your desk.

4 Enter Desktop Streaming^{TM} (DTS)

DTS is a great tool for remote screen sharing. HelpAlert^{TM} - "call" routing software - is about 2 MB is size and works on any Windows based machine[3]. The client visits a web site using a Java enabled browser over a standard internet connection, and you can see the client's screen within a minute.

No Client Side Install The was very important to us. It was not is to install/push software on the client machines (10,000+ computers). All the client needs is an internet connection and a Java enabled browser. Both IE and Netscape worked great, but we've heard of (not experienced so far) issues with Netscape.

Screen Sharing This is neat part about DTS. You can share the client's keyboard and mouse, but the client has ultimate control over their computer. We try to emphasize this before we access the client's screen. The screen sharing session starts in draw mode, and the Help Desk Analyst has to manually switch over to share the client's keyboard and mouse[4].

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[1] Distance Learning students as far as California, Remote Campuses, Faculty at Conferences

[2] A 4 hour flight to California

[3] You can screen share with any Windows and Solaris based machine

[4] This prevents computer accidents

Web Push Type in a URL and click Push, and the web page loads on the client's screen. Great tool for getting to sites quickly.

File Transfer Exchange files using regular FTP - you don't have to forget CDs/floppies at your desk.

ChatLink^{TM} Allows the Help Desk Analyst to instant message with client if need be. We hardly use this as we usually have clients on the phone when we are screen sharing.

Whiteboard You can draw on the client's machine. Lets say the client cannot find something on the computer, you can circle it. The software always starts out in whiteboard mode, which is very useful.

Management Console Gives access to logs for screen sharing, and chat sessions. Handy for metrics, if you are into that kinda stuff.

5 Conclusion

DTS offers several features that make technical support efficient and reliable.

Hypermedia Educational Technology And Teaching Strategies

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Abstract: This paper presents the basic knowledge about the influence of hypermedia educational technology on the selection and design of the teaching process for new generations of adolescent and adult students. The global teaching model which is predominant in the present-day school could be called "the class-subject-lesson system". This didactic system cannot meet the needs and expectations of young people and adults at the start of this millennium.

Introduction

In the mid 17th century J. A. Komensky (1592-1670) established the teaching model which is termed "the class-subject-lesson model". This model, according to which a group of students meets every day in a school building for common teaching activities, is still predominant today in most schools around the world. This group of students is taught by one teacher in one classroom. Activities alternate every 45 minutes. Such a teaching model has provided cheap education for a large number of students in compulsory education. It is regarded that mass education of young people was made possible by the most revolutionary invention of that time, i.e. the book.

Although the model established by Komensky has been criticised during the last three and a half centuries, it still represents the basis of the teaching process even today. This system received a most severe blow at the beginning of the 20th century from the well-known movement of reformist pedagogy (J. Dewey, M. Montessori, R. Steiner, C. Freinet, P. Petersen, etc.).

Today, young people and adults live in an essentially different media environment compared to the one J. A. Komensky did. How would Komensky have designed the teaching process in school if he had been surrounded by the present-day communication media?

Some empirical results

In Croatia, children spend at school about a thousand teaching periods a year (one teaching period lasts 45 minutes). One year has 8760 hours, which means that the students spend at school about one ninth of the total time of one year. Moreover, the teaching activities for students are organized during180 days within a year. This means that students do not attend school more than half of the year.

On a sample of primary school students attending lower grades of primary school (N=3245) it has been tested how many students have a personal computer at home and how many of them have had the chance to use the Internet. The sample comprised children from 6 to 10 years of age. The results showed that 31% of the students have a PC at home and 25% have experienced the benefits of the Internet. More than 50% of the teachers teaching these students are computer literate and use a PC in their everyday work.

A sample of grammar school students (N=308) showed that 61% of them have a PC at home and 70% have had a chance to use the Internet. The sample comprised students between 15 and 19 years of age.

In Croatian schools teacher-oriented teaching is still predominant. Students are dissatisfied with such situations and react by not attending classes and by passively boycotting their teachers' occasional appeals to become involved in the common activities. A number of secondary school students decide to withdraw from full-time education and enrol in some kind of distance education. These forms of education ensure a more flexible planning of their school- and free time (Matijevic, 1996).

Teaching aims and strategies

Nineteenth-century school is considered by experts to have been intellectualistic. This means that teaching activities were mainly oriented towards cognitive development. The educational ideal was to learn

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as many new facts as possible. The emotional and psychomotor development was in a position of secondary importance. In the school of the 20th century some things changed.

Apart from the teaching and learning of facts the school is required to take into consideration the emotional and psychomotor development of students. However, this is more of a declaratively stated wish than the real state of affairs in schools. Because of an essentially different media environment and the revolution in technology and information science which has been going on in the last 20 years of the 20th century, some new aims of teaching and learning have been gaining ground. Experts have observed the existence of much better media for storing and processing information than students' heads. Instead of learning facts the students should learn how to learn independently and how to find and use information. Besides, school has started to prepare young people for changes which will become part of their lives. The educational value of learning social and communication skills has also been observed. These aims could not be realized by means of traditional didactic solutions based on teacher-oriented teaching, where, generally, the role of the teacher was to speak and show, and that of the students to sit, listen and watch.

The students, who live in a new learning environment and media environment could not be satisfied with a passive role in the teaching process. There are many things going on after the time spent at school, which are much more interesting than the contents explained and shown by the teachers. School faces many changes. Komensky, in his time, had only the book at his disposal as a teaching medium and the voice of the teacher. If he were alive today he would probably offer a more diverse didactic repertoire for school activities than the class-subject-lesson system.

The class, as a relatively constant group in terms of experience and previous knowledge on similar topics, does not exist any more. There are noticeable differences among individuals of the same age. These differences are determined by greater mobility (travelling) and by the rich media environment. The differences in the interests and in the mental condition are evident. It is very difficult to organize a teaching activity aimed at cognitive learning, which can, at the same time, satisfy the needs and expectations of a group of students.

This media environment essentially determines the new roles of the teacher. Traditionally, teachers were trained to implement a certain curriculum with groups of students. Today the school needs teachers who can help with and successfully solve the educational problems of individual students. *The school needs teachers-mentors and not teachers-lecturers.*

Hypermedia educational technology surpasses the didactic framework of the class-subject-lesson system. Experts in European schools frequently make the mistake of trying to find ways of using the advantages of the Internet and multimedia exclusively within the class-subject-lesson system. In this way, the possibilities of hypermedia are substantially reduced.

Conclusions

Hypermedia educational technology not only provides opportunity for the solution of many problems of traditional teaching but it also raises numerous new questions. Some of the most important ones are the following: To what extent and how to use this technology to accomplish the aims of education in modern school? Which teaching aims should be ceded to this technology and to what extent, and what should be left for direct human communication between students and teacher? What kind of relationship should exist between learning by means of hypermedia educational technology and learning in authentic reality? Which teaching aim cannot be achieved through the use of hypermedia? What are the new roles of the teacher with regard to hypermedia educational technology? The question posed by J. Kemp (1973) acquires a new meaning in relation to hypermedia educational technology. Experts for teaching and learning issues must search for answers to the above-mentioned questions. A lot of multimedia software exists on the market which cannot be accepted as satisfactory by educational experts and which is harmful for the development of young people in the same way as the worst solutions in traditional teaching are. One must not lose one's way in technology, or, in other words, technology must not be more important than man.

References

Kemp, J. (1973). Which Medium?, In: *Individualized Instruction – programs and materials*. Educational Technology Publications, Englewood Clifs, New Jersey, 203-212.

Matijevic, M. (1996), Adolescents in correspondence education. In: *Lifelong learning - Open learning - Distance learning: 1996 EDEN Conference*, Futurscope, Poitieres, France, 182-185.

Fostering Inquiry-Based Learning Online: A Case Study

Inquiry Online: The Challenge

Using examples from TERC/Lesley University Master's in Science Education online courses, this presentation will explore strategies for fostering inquiry within a distance learning environment. The topic will be investigated from two perspectives: that of a course developer and that of a program participant.

This presentation is a case study in two respects: a case study of the online program and a case study of a program participant's response to the experience. Each course component discussed will be paired with an example of that participant's work.

To place our program within the larger context of online learning, we will address a range of questions relevant to the development and implementation of online environments:

- What online course features support or detract from a learner's inquiry experience? What assumptions about inquiry are encoded into an online course's structure and presentation?
- Are some aspects of the online environment actually more conducive to inquiry than face-to-face classrooms? How can educators take best advantage of the Internet-mediated learning context?
- How can online course developers tell if the understanding goals are achieved? How does one assess the extent to which learners genuinely become engaged in inquiry?

We have grappled extensively with these questions in the process of developing and implementing our own courses. This presentation is an opportunity to share what we have learned, grounding our theories and insights about online learning with actual examples from our program.

About the Program

The Science in Education Master's program is a two-year program for K-8 teachers who are currently teaching in classroom settings. The program, a partnership between TERC and Lesley University whose development is funded by NSF and FIPSE, launched its first course in the summer of 2000. The first cohort of degree recipients will graduate in the winter of 2003.

Course Implementation: Our program is delivered entirely online using a combination of Blackboard online courseware and a multimedia-rich web site interface. All of our courses are team taught by a scientist and a science educator.

In each course, program participants: 1) engage in sustained science investigation; 2) learn strategies for supporting inquiry in the classroom; and 3) put new pedagogical ideas into practice in their own classrooms. They further their understanding of science content by carrying out a series of investigations at home, then go online for in-depth discussions to share results, look for patterns in their findings, and generate explanations based on evidence.

Their coursework carries over to the classroom where they try out ideas for supporting learning through inquiry and for assessing inquiry-based experiences.

Course Development: A development team that includes a scientist, educator, and instructional designer/multimedia specialist produces each course. In the formative phase of course development, the team works with an advisory group of teachers. The course is then piloted twice, with weekly formative assessment informing course revisions.

Our multi-year project also includes an extensive research study of our model for online learning. Wynne Harlen's Model of Inquiry, used as a key organizer in our online Master's program, has informed the development of instruments to evaluate the impact of the program on participant understanding. Indicators of inquiry learning are obtained from the following sources:

- data collected via weekly online formative evaluation questionnaires;
- participants' comments to colleagues and faculty in course discussion forums and in email correspondence with faculty;
- videotaped interviews with program participants;
- observation of teachers working with students in their classrooms; and
- comparison of pre- and post- course thought experiments performed by participants.

This extensive research, coupled with our thoughtful development model, has given us valuable time for group dialogue about the nature of inquiry and the unique characteristics of online learning.

Implications for Others

The ultimate goal of this project is has been to rethink what teaching and learning can look like in the best of all worlds, then translate their new vision into high-quality online courses for teachers.

Preliminary research results indicate that our model for online learning is successful. Our finding indicate that program participants:

- devote more time to their coursework online than when the same course is taught face-to-face;
- demonstrate a greater increase in science content knowledge than their face-to-face counterparts;
- develop a deep sense of responsibility and community with their fellow learners;
- develop the perspective of scientists – behaving more like graduate level science majors;
- become deeply invested in the program (our 96% retention is unusual for distance learning); and
- change how they teach as a result of their online learning experiences.

Our work should be of interest to anyone contemplating teaching online, but it also has larger implications for furthering our understanding about teaching and learning in general.

Collaborative learning in an online masters program

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Abstract

The Master of Agribusiness program developed by The University of Melbourne is offered to off-campus students using an online mode of study. The approach to study is based on collaborative learning, to develop graduate skills in communication, negotiation and teamwork in addition to the program's focus on Agribusiness. This study outlines the theoretical basis and the development of the program and online learning materials. Evaluation data from post-course questionnaires and a focus group highlight the features and difficulties of the program from the student perspective.

Introduction

A major concern for teachers using online delivery is how to ensure that their students attain a high level of understanding and ability from the course. Performance outcomes need to meet the expectations of the professional area in which the students will work. The development of a Master of Agribusiness program at The University of Melbourne's Institute of Land and Food Resources was based on two key considerations: it needed to reach a geographically widespread rurally-based target group of students nationally and internationally; and it needed to use the methods of teaching and learning that had been found to be most effective in learning business management skills. To achieve these aims the course was modeled on a similar course offered by the University of Guelph in Canada (Sparling, 1998; McAlpine, 2000). Online delivery is used as the means of reaching the students. Collaborative learning is a fundamental aspect of the approach to teaching and learning. An important reason for this choice is that the collaborative learning approach was developed in business schools as an effective means of developing the communication and teamwork skills that are needed in the business environment, in addition to the course subject matter (Milter & Stinson, 1995a). Online delivery enables this approach to be applied in a distance-learning environment, by providing both the means of access to course materials and the communication channels necessary to implement a collaborative learning approach. This article considers some of the teaching and learning issues relating to the implementation of collaborative learning in an online environment, using the Master of Agribusiness as a case study.

Improved learning using technology

One of the principal reasons for using online technology is to achieve higher quality learning outcomes than are being achieved through current means (Bates, 2000). The use of instructional technology is increasing as an aid to learning by the design and development of courseware to facilitate student-centered outcomes-based learning (Oliver & Omari, 1999). Online delivery has been identified as having the potential to increase access to education, promote improved learning, and to achieve this while containing, rather than increasing, the cost of education (Owston, 1997). The desired outcome of instructional design and courseware development is materials that promote effective learning.

Research on the application of technology in education has focused on how the technology can be used to enable students to learn more effectively. This is not based on a view that the use of technology automatically improves learning outcomes. Rather, the research examines ways that the technology can be applied to provide the resources that facilitate 'learner-centered' activities. These resources may be information sources or tools, such as databases, that promote enquiry and information seeking (Hannafin & Land, 1997). Technological resources such as computer conferencing, databases, spreadsheets, and simulators, may be used as 'cognitive tools' if their purpose is to support thinking and learning processes that will enhance the quality of learning (Jonassen & Reeves, 1996).

The theoretical basis for this research is the cognitive-constructivist view that students learn most effectively by actively creating meaning from their own learning experiences (Jonassen, Mayes, & McAleese, 1993). To ensure that the meaning created is effective learning, the students' learning needs to be centered on activities that develop critical thinking, problem-solving and reasoning skills (Hannafin & Land, 1997). Investigations have found that the most effective learners make learning an active, engaging process that develops a rich pattern of meaningful associations. An important aim for teachers and educational developers is to design learning activities that require learners to engage in the active learning processes that the most effective learners do naturally (Biggs, 1999).

From this theoretical position, technological resources can be developed to enhance and guide the process of student learning. The active process of constructing a meaningful interpretation from complex learning tasks is supported by rapid access to resources and tools, by creating communication channels that enable speedy resolution of problems and the development of new ideas through interaction with teachers, other learners, and experts who may be external to the teaching/learning situation. They enable the learners to work with information and data quickly in order to develop solutions. By being designed and developed to support these activities, technology can enable effective learning outcomes.

Collaborative Learning

Students need to experience the cultural context and the environment in which knowledge will be applied. An important aspect of collaborative learning is that the students can apply their own experience to the learning process, and benefit from the experience of other students. In this way, students can use their own interests and experience as 'springboards' to the achievement of a deeper level of knowledge generation. This has been described as a move from dependence to interdependence, using dialogue as a fundamental mode of enquiry (Palloff & Pratt, 1999). An important aim is to develop critical thinking, reasoning and problem solving skills. Glaser (1990, cited in Jonassen et al., 1993) argues that cognitive development occurs through processing concepts that are originally experienced in social contexts, and that while meaning may be an individual construct, shared understandings result from social negotiations of meaning.

The vital part of using online discussion in any format is to keep the students actively engaged. Palloff and Pratt (1999) suggest a range of activities that foster active engagement, including:

- Posting instructions and learning expectations;
- Forming teams and posting guidelines for their performance;
- Encouraging a search for real life examples;
- Using dialogue as enquiry by encouraging thought provoking expansive questioning;
- Sharing responsibility for facilitation among group members;
- Promoting constructive feedback.

Open-ended questions such as "What do you consider to be the ethics of a computing professional?" (McLoughlin & O'Sullivan, 2000, p. 47) are useful to facilitate dialogue as enquiry. A statement that is designed to promote discussion should be very effective in promoting dialogue (Palloff & Pratt, 1999).

The role of the online tutor is critical to attaining effective learning outcomes. Tutors need to set appropriate activities and provide the right kind of guidance. Feedback from experienced tutors indicates that online tutoring can be more demanding than tutoring in a face-to-face situation. Some students show a high level of appreciation for online conferences, but students are likely to be dissatisfied if there is a lack of participation by others (Mason & Weller, 2000). For online conferencing to be successful, participation needs to be directly assessed or closely associated with assessment tasks.

Building a learning community

One of the important outcomes of collaborative learning online is a sense of community among the learners. In some studies both learners and tutors report the feeling of getting to know their fellow participants even better than they would in face to face tutorials, and how this process enabled students to build confidence and to extend themselves further (Mason & Weller, 2000). Bruffee (1999) argues that the development of a learning community is a critical part of the education process. He sees the role of the teacher as helping students to negotiate their way into membership of communities they aspire to join, that is the practitioners of the knowledge they are learning. Klemm and Snell (1996) propose that students need to adopt roles, and to change roles, to help to build collaborative communities.

Case study of the Masters of Agribusiness

Design

The online study courseware is based on a similar course that is offered by the University of Guelph in Canada (Sparling, 1998). Materials are structured to facilitate collaborative learning. To achieve this, the courseware is organized to provide access to course content materials, study guides for each course, and guidance about study in this mode, contacts for support if this is needed, a means of assignment submission online, access to library materials, and access to a range of online discussions. Several separate discussions are each focused on a specific purpose. In this way, discussion about a specific assignment, information about administrative or technical issues, and specific questions to the course tutor do not all appear together, as this may be confusing for many students and be distracting from the main issues to be addressed. Each course has a homepage that links to the content materials and study guides, to the various online discussions, to information on assessment and assignment submission, and to library resources.

Course content is organized around weekly topics. Each topic has reading material from a text book or other sources. The online content materials provide guidance as to what should be done each week and, sometimes, additional readings if the information in the text book is insufficient. A discussion, called the Online Workshop, is used for ongoing discussions of the weekly topics. Students are required to make a contribution to these discussions. Typically there is one new topic each week. There may however be additional topics also. Students are encouraged to interact with each other in the discussions, rather than making postings that are written as a comprehensive individual presentation. The course tutor's role is to keep the discussion on track, to raise important matters that the students may miss, and to assist the students to develop their ideas.

Students are given individual and collaborative group assignments to submit. Specific online discussions are established for small group collaborative tasks, with access restricted to the students in the group and the course tutor. These enable the students to discuss how they will do the group assignment, to allocate roles, and to send drafts to each other. Students can access library materials online, in the form of access to full text articles from some journals. Assessment for each course is based on individual and group assignments, and on the student's contribution to the online discussion of weekly topics.

Evaluation

Questionnaires

A questionnaire that could be completed online was developed for this evaluation. The questionnaire used a combination of specific statements to which the students were asked to indicate agreement/disagreement on a 5 point Likert scale, and questions that asked for open-ended comment. Statements were arranged in groups addressing the following issues:

- technical issues of access and clarity of use;
- effectiveness of content information, how to learn and assessment;
- computer conferencing and collaboration;
- involvement of the course lecturer and perceived effectiveness of learning.

Each group of statements was followed by an open-ended question. Responses to the statements most relevant to this paper have been reproduced and are discussed below.

SA - strongly agree → SD - strongly disagree

			SA	A	NS	D	SD
1	The way to use the online technologies was made clear to me from the beginning.	C1		1		1	2
		C2		5		1	
		C3	4	2			
2	I experienced difficulties in gaining access to the online course materials.	C1	3	1			
		C2	1	2		2	1
		C3		2		2	2
3	After the initial problems of connection were overcome, access to the online materials and conferences was consistent and effective.	C1	1		1	1	1
		C2		4	1	1	
		C3	2	1	1	1	

C1 - Course 1 → C3 - Course 3

Table 1 Responses to questions on technical issues and clarity of use for three courses.

Data from the questionnaires for the first three courses offered online have been included in this study. One course is notable as it provided the students with more online content, and had more input from the lecturer into the online workshop discussions than the other courses. This course was rated more positively by the students than the others. The positive rating was consistent across nearly all of the questions, indicating the pervasive nature of the perceived benefit from this input.

The responses in Table 1 show a diminishing level of issues and problems relating to the use of the technology. The students had many difficulties with access, as they needed to install software (lotus Notes Client) as well as establish an Internet connection to the server. This caused some delays in fully getting to grips with the first course. One student commented: 'It was extremely difficult to try to come to grip with the course material whilst using the browser and trying to get Notes running. More consideration should be given to supporting student with the set-up. We did feel like guinea pigs'. These initial problems were sorted during the first course, and there were few problems relating to access after that. A student's comment in the second course was: 'Technical problems did improve with time'.

Questions 9 and 10 in Table 2 focused directly on collaborative aspects of the course.
Students were consistently positive in their responses to the question about working closely with others. They were more divided on the issue of learning from each other, with a minority either neutral or in disagreement with this statement. One student commented on the value of other students' responses as follows: 'The answers to the compulsory questions from the other students were very informative and gave me a broader understanding of the course.' Comments in two courses pointed to difficulties with the computer conference medium, which did not allow a free flowing discussion. After the first course, a student's comment was: 'It is almost impossible to "discuss" on this basis and the freedom of expression one has verbally cannot be replicated literally.' Some students felt that meaningful discussion needed to be by phone. This does not appear to have been a problem in the third course. One of the students wrote of this course:

> We are at last getting a real methodology of handling an ideas session online. Each contributing many points for elaboration by others and by ourselves in turn. Then editing and re-editing. A real online brainstorming session!

SA - strongly agree → SD - strongly disagree

			SA	A	NS	D	SD
7	The computer conferences enabled me to exchange information and ideas with the tutor and other students.	C1		3			1
		C2		1	1	3	1
		C3	3	2			
8	The computer conference discussions helped me to learn more about the subject than I would have learned working on my own.	C1		3		1	
		C2			2	3	1
		C3	2	2	1		
9	I worked closely with other students on the group learning tasks.	C1		3	1		
		C2	1	5			
		C3	4	1			
10	I learned a lot from the other students while working on the group learning tasks.	C1		1	2		1
		C2	1	3		2	
		C3	2	1	2		

C1 - Course 1 → C3 - Course 3

Table 2 Responses to questions on computer conferencing and collaboration for three courses.

It is likely that the students were becoming more accustomed to using the medium. More important, however, was the way that the course tutor managed the online discussions. This is elaborated further in the discussion content analysis. The overall success of the course, and importance of guidance for group work is evidenced by the following:

> I really enjoyed the … course. The workload was appropriate and the fact that it was well related to my area of work was very beneficial for me. Although it is up to groups to work out how to work together, suggestions from past experiences could be made. It took us three goes to get a really good group way to approach the assignments. I guess you could say that this is continual improvement as we went. Some suggestions may be useful to others.

Focus group

A focus group discussion was held with the students after the courses included in this evaluation had been completed. Topics included in the discussion included technical issues related to connection with the system and working collaboratively in an online environment. The students expressed a high level of interest in the way that the program was run and how this affected the way that they learned. The discussion focused on the overall program, rather than differences between one course and another.

The students all had vivid memories of the initial phase of the program, in which they had to install the client software and make a connection to the server through an ISP. As this happened during the initial weeks of the first course, students had to deal with installation while to keep up with the course activities. Two student comments illustrate some of this frustration:

> I actually spent several days of actual assignment time in economics trying to get to a computer to run with Lotus notes. It's not as if I am a recent convert to computers – I've been using them for a long time.
>
> It's a huge issue; it affects our ability to study.

The students proposed earlier installation with more support as a solution:

> We need a lot more IT advice on how we are actually going to get connected and make sure that everyone is connected right from the start.

After the connection issues were overcome, the students needed to learn to work with the technology as a learning support tool. One student summed this up by saying:

> I had a few initial teething problems which were really I mean they just came down to IP addresses and that type of thing with Lotus Notes, but on the whole once we got over that initial hurdle everything ran – it just took a week or two to get everything sorted but after that it did work quite well I thought.

Another commented on the use of the discussion groups specifically:

> I think the Lotus Notes worked quite well as a group discussion basis as well, I mean most of the discussion groups we had there were some hiccups at the beginning, but really as a tool to use as a group discussion basis and to get your work done, once all those teething problems were finished I think it's quite a good use of that technology and it went well, I think, for most of us.

Collaborative tasks were the most challenging aspect of the course to the students, as they had issues of negotiation and organization to deal with as well as the information and interpretation associated with the content of the task. As they progressed through several courses they improved their ability to work together. Two comments illustrate this process:

> … when [we] … did our first one we actually divided up the task… and then each one had a task – well that was alright except I think it worked better with actually building it up and moving the assignment around and each person contributing …

Other comments also reflect that the process was difficult at first, but became easier with practice as the students got to know each other and improved their organization. The students generally saw the collaborative tasks as a good way to learn despite the added stress:

> Yes it was good – nothing will ever replace sitting in a room with people and talking to them but to do the group work that way – you certainly got to know the group members much better and you interacted with their thoughts and ideas and that's the way you learned.

Conclusion

In general the students were strongly supportive of the Masters program. They set a high value on the collaborative aspects. They got to know each other well and appreciated working together on learning tasks. Apart from the initial problem of access, the students found that they learned to work with the online technology, and that it was an effective way of facilitating their learning. The course focus is to develop knowledge and skill in the management of Agribusiness. The online technologies enabled those students based in rural areas to participate in the program. Learning to work collaboratively overcame any feelings of isolation the students may have experienced, and led to skill development that built on the knowledge and experience of the students as well as the staff.

References

Bates, A.W. (2000) Managing Technological Change. Strategies for College and University Leaders. California: Jossey-Bass Inc.

Biggs, J. (1999). What the Student Does: teaching for enhanced learning. *Higher Education Research and Development, 18*(1), 57-75.

Bruffee, K. A. (1999) Collaborative Learning: Higher Education, Interdependence, and the Authority of Knowledge, Second Edition, Baltimore: John Hopkins.

Hannafin, M. J., & Land, S. M. (1997). The foundations and assumptions of technology-enhanced student-centred learning environments. *Instructional Science* 25: 167-202.

Jonassen, D., Mayes, T. & McAleese, R. (1993) A Manifesto for a Constructivist Approach to Uses of Technology in Higher Education. In T. M. Duffy, J Lowyck, and D. H. Jonassen (eds) *Designing Environments for Constructive Learning,* Berlin: Springer-Verlag.

Jonassen, D. H., & Reeves, T. C. (1996) Learning *With* Technology: Using Computers as Cognitive Tools. In D. H. Jonassen (ed.) *Handbook of Research on Educational and Communications Technology.* New York: Simon & Schuster Macmillan, 693-719.

Klemm, W. R. & Snell, J. R. (1996) Enriching computer-mediated group learning by coupling constructivism with collaborative learning. *Journal of Instructional Science and Technology,* 1:2, http://www.usq.edu.au/electpub/e-jist/vol1no2/article1.htm [verified April, 1999].

McAlpine, I. (2000). Collaborative Learning Online. *Distance Education, 21*(1), 66-80.

McLoughlin, C., & O'Sullivan, M. (2000) Educating Software Engineers for the 21st Century: Assisting Students to Develop Communication and Team Skills for Success in the IT Profession using the WWW. In *Open Learning 2000: Proceedings of the 4th International Conference on Open Learning*, Brisbane, December 6 – 8, 2000. Brisbane: Learning Network Queensland.

Mason, R. & Weller, M. (2000) Factors affecting students' satisfaction on a web course. *Australian Journal of Educational Technology,* 16:2, 173-200.

Milter, R. G. & Stinson, J. E. (1995a) Educating leaders for the new competitive environment. In W Gijselaers, D. Tempelaar, P. Keizer, J. Blommaert, E. Bernard, & H. Kasper (eds) *Educational Innovation in Economics and Business Administration: The case of Problem-based Learning.* Dordrecht: Kluwer.

Milter, R. G. & Stinson, J. E. (1995b) Using *Lotus Notes* to Facilitate Action Learning, *Paper presented at the Sixth Annual Business/Economics Teaching Conference, Chicago IL November 10, 1995.* http://mbawb.cob.ohiou.edu/paper1.html [verified 19/8/98].

Oliver, R., & Omari, A. (1999) Using online technologies to support problem based learning. *Australian Journal of Educational Technology,* 15:1, 58-79.

Owston, R. D. (1997). The World Wide Web: A Technology to Enhance teaching and Learning? Educational Researcher, 26:2, pp 27-33.

Palloff, R M. & Pratt, K. (1999) *Building Learning Communities in Cyberspace*, San Francisco: Josey Bass.

Sparling, D. (1998). Seminar at the University of Melbourne on the instructional approach using Lotus Notes in a masters program in Agribusiness offered by the University of Guelph, and personal communication.

Turning Points: learning from online discussions in an off-campus course

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Abstract

Developing a course for online study by off-campus students requires a major change of approach to teaching and learning. This study outlines the constructivist theoretical basis and the approach to teaching applied in the development of a humanities course. The study includes analysis of the turning points in the students' learning as identified in asynchronous discussion postings and evaluation feedback from a post-course questionnaire. Analysis of discussions and student feedback are used to demonstrate student learning and attitudes to the new mode of study.

Introduction

Transforming a traditional course to an online offering to off-campus students requires a reconsideration of the approach to learning and teaching. Using online discussions may be a new experience for both teachers and students. Consequently, learning new ways of interacting via an unfamiliar medium may be a major part of doing the course, and the student has a few hurdles to jump over before learning the course topic can begin.

This paper considers theoretical aspects of online learning in relation to the design, development, and implementation of an online course. The project began with a need to offer the course to off-campus students. The course requires the students to analyze art and literature to identify the influences of culture and ideology on perception. An important aspect of the teaching and learning is the development of the student's ability to analyze issues, compare and contrast different art works and art forms, and to synthesize a level of understanding and a new perspective. The major requirement of the course is the development of a specific set of higher-order cognitive abilities. The online courseware and the learning and teaching strategy were developed to support this particular type of student learning.

Online teaching and learning

Research on issues relating to online teaching and learning reveals a number of issues that are critical to the tasks of design, development and teaching of an online course. Major issues that must be critically examined in relation to current research include:

- Using online technologies to enhance student-centered approaches to teaching and learning to ensure high quality learning outcomes;
- The use of online discussion to support teaching and learning;
- Providing effective support mechanisms for off-campus students.

The following sections will examine these issues to identify the key points from current research that are important for online course design.

Online technologies for learning enhancement

In a situation in which a course is offered entirely online the application of the online technologies has two critical roles: to enable an effective teaching and learning approach by supporting and enhancing the essential teaching and learning processes; and to make the course accessible for the off-campus student. From an instructional design perspective it is critical for the design of the course materials to be based on sound educational theory. The constructivist approach to teaching and learning has been developed to empower students to attain higher-order levels of understanding and the ability to work with complex issues (Hannafin & Land, 1997). An online course in which students are engaged in exploring to find new meanings and to engage in knowledge construction can be considered to be a constructivist learning environment (Jonassen, 1999).

To enable the most effective knowledge construction the student must engage in learning activities that foster the desired learning outcomes. Learning activities should be structured to actively engage the learner in higher-order thinking and learning by analyzing topic material, comparing alternative opinions and perspectives, and synthesizing a new level of understanding and awareness. Biggs (1999) describes as 'alignment' a process of: formulating learning outcomes that reflect the appropriate level of knowledge and skill; designing learning tasks that will foster knowledge construction and skill development; and setting assessment tasks that require the student to apply the appropriate level of knowledge and skill. To achieve this, learning tasks and assessment tasks are either the same task, or closely related. Collaborative work with other students and the teacher, possibly in the form of collaborative assessment tasks, should be a part of the learning process as this fosters deeper learning outcomes (Biggs, 1999).

The design of the online learning environment needs to be structured to support the most effective learning activities. In an online course, critical considerations are the way that the course materials support the student to know how to use the courseware, how to find the learning resources, how to access guidance about coming to an understanding of the course topics, and how to use the communication systems. The structures to achieve this can be conceptualized as tools, such as cognitive knowledge construction tools, or communication tools (Jonassen, 1999). Student guidelines can be considered as scaffolding, or supports that can be provided where necessary and removed when the students have attained a level of ability and no longer need them. Important types of scaffolding are:

- Conceptual – guiding the learner in what to consider
- Metacognitive – how to think during learning
- Procedural – how to use the features
- Strategic – how to analyze and approach learning tasks (Hannafin, Land, & Oliver, 1999, p. 131).

In the instructional design process it is important to ensure that these supports are in place and accessible.

Online discussions

A key element in a constructivist approach is active learning through discussion and sharing of ideas. Laurillard (1993) outlines a process of discussion, adaptation, interaction, and reflection that represents an exchange of ideas that is essential before cognitive change can occur. This process has a strong social element, as it is through interaction and sharing that a sense of a learning community is created and a high level of engagement with the learning task occurs. Learning is seen to revolve 'around learners' conversations about what they are learning, not teacher interpretations' (Mills & Cottell, 1998, p. 229). In this context, group activities are considered to develop generic skills that are transferable to other situations, such as communication, negotiation, and interpersonal skills, and to enhance learning leading to deeper learning outcomes (Morris & Hayes, 1997).

In the context of online learning, discussion and interaction occur using online conferencing tools. These tools are considered to be some of the essential 'cognitive tools' provided by a computer-supported learning environment to aid knowledge-building through sharing ideas and collaboratively constructing knowledge (Jonassen, 1999). Online discussions are applied to enable the cognitive processes described above to occur in an online environment. They should not, however, be seen as a direct equivalent of group discussions in a classroom. Asynchronous online conferences are conducted in writing, which changes the nature of the discussion. Comparative research indicates that while online discussions may be less spontaneous than the classroom equivalent, they are more reflective and often demonstrate a higher quality of learning as a result (Newman 1997). Consequently while the use of online conferencing is growing as a method of supporting off-campus students it is also being used in conventional on-campus courses (Romiszowski & Mason, 1996).

As online discussion is new to many teachers it is appropriate for online teachers to consider appropriate methods for facilitating teaching and learning in this way. Studies of courses in which an online discussion is an optional extra without teacher involvement often report some shortcomings in student use of the discussion. To use online discussion as an essential element in the learning process an appropriate level of involvement by the teacher is essential (McAlpine, 2000).

Salmon (2000) presents a five-stage model for the development of student ability to engage with online discussions. She describes the teacher's role in an online discussion as 'e-moderating'. In this role the teacher must ensure that the students move through the stages of:

- Access and motivation
- Online socialization
- Information exchange
- Knowledge construction
- Development.

Salmon recommends that at the early stages of an online discussion the e-moderator needs to provide online activities that will facilitate the student's ability to manipulate the conferencing tools and to develop knowledge by exchanging and expressing ideas through the online discussion process. It is only when the students have reached the fourth and fifth levels of ability that the students are able to engage in the type of knowledge construction through dialogue that is the goal of the learning activity.

Review of theory

The use of online technologies to promote knowledge construction and active learning requires a range of critical supports and guidelines for learners. They need to know how to use the online courseware and where to find the necessary tools and resources. A critical tool is the online discussion. Through this means the learners can be guided in how to share ideas and work with other learners, and how to develop their understanding of the topic. A staged process beginning with simple tasks for online discussion building to more complex ones is helpful to learners as they come to terms with a new mode of study.

The Course

The course on which this study is based was designed as part of a UNSW initiative to encourage online teaching in General Education. General Education is a requirement by UNSW that all students take some courses in disciplines outside their faculty, to broaden their education and introduce them to forms of knowledge and styles of thinking outside their normal study.

The course is called 'Seeing Australia', an examination of the ways in which Australia has been represented through its history in different modes of cultural production. The content addresses various forms of written and visual representation, including fiction, poetry, non-fiction, painting, photography, and prospectively, film and television. The learning outcomes of the course involve high level cognitive and interpretative abilities. At its completion the students should not only be able to identify various ways of representing Australian place and society, and to distinguish between two predominant traditions of 'seeing' Australia, but also be able to recognize that 'seeing' itself is not a simple 'natural' activity, but based upon cultural assumptions and traditions that largely go unnoticed.

The course was run for the first time on a trial basis in the second semester 2001. For this trial a small, totally external, student cohort was selected. Nine students were Singaporean Chinese enrolled in an external Safety Science degree at UNSW, one was an accounting student from rural NSW. None had taken a humanities subject before. These students were relatively familiar with WebCT, but had not previously engaged in external study that used online technologies as the main focus for learning activities.

Course Content versus Learning Outcomes

The course was divided into Six Modules containing topics that approximated a weekly schedule. Once the students (eventually) came online the introductory module, involving their 'seeing' of their own neighbourhood and of Australia worked well. However, it quickly became clear that the students were not able to maintain a weekly schedule of topics as might be demanded in a face to face course. This immediately suggested that the online format provided a ready diagnosis of student progress, otherwise unavailable if they had sat quietly and uncomprehending in an on-campus class.

The most interesting outcome was the discovery that course content could be sacrificed in favor of the learning outcomes. Although the course was not structured according to a progressive format, in which the student could only move ahead once a topic had been mastered, it was clear that there was no point moving forward unless they had fully grasped the conceptual skills involved in a module. By privileging the learning outcomes over content, four topics in a module could be reduced to three, or even two, in practice, although the content was available in the Reader for the better students. This meant that difficult theoretical topics were engaged by students with no background, by ensuring that they could work at the issues through discussion. In the workshops a certain momentum built up so that even slower students became engaged with the more difficult topics by entering into the discussion. Conversely, it was clear that once a new topic began it took some time to build up momentum. In effect, it became *necessary* for the content to be reduced so that the learning outcomes could be achieved by all. One positive corollary of this apparently slow rate of progress was that the online delivery of content, particularly of paintings and images, allowed the students considerable time for study and reflection at their leisure.

In addition to the slower rate of progress, it was clear that some issues of cultural analysis were simply too difficult for students of non-English speaking background with no experience in the Humanities. Nevertheless, by maintaining a clear focus on the learning outcomes, these problems could all be circumvented. Whereas a concentration on the content might have suggested that the course was falling short of its aims, it was clear that not all conceptual issues or forms of content were necessary for the skill-based learning outcomes to be reached.

Diagnosis of Learning

The discussion provided a ready indication of the degree to which students had grasped the conceptual point or the extent to which they needed to be encouraged to progress. The following comment is from a slower student who is entering a discussion about Oliver Sacks' story "The Man Who Thought His Wife was a Hat" which touches on the neurological bases of seeing as an introduction to the ways in which ways of seeing can vary.

> Hi Bill I am a down to earth person and believe in seeing with my own eyes. In my opinion, Dr P can be describe as followed: Like most musician and painter, he is a man with creative mind as shown in his previous painting work and his love on music. Most people see with their eyes, but after reading his story, I found that one can also see with their ear and nose. In the story 'journey to the west', I remember the monk preach his followers to see with their heart. At that time, I thought it was only a story, but now I found that in real life, they are actually people seeing things in another angle. In Dr P case, Music is the whole world to him. His love for music is so great that he can teach music to his student till the last day of his life. That make me wonder how powerful is our mind.

Here we find a student at an interesting juncture between his understanding of himself as 'a down to earth person' and therefore not amenable to exotic ideas about seeing, and his beginning to comprehend the complex cultural bases of vision. Critically, this turning point comes when he incorporates previous knowledge to construct his understanding. At this stage he is not quite aware of the implications of someone 'seeing' with ears and nose, but the phrase 'how powerful is our mind' is a significant entry to the understanding of the cultural bases underlying ways of seeing Australia. This was a beginning that could be built on by the instructor. But it was a beginning constructed by the student's incorporation of previous knowledge.

Turning Points

It became possible to tell when the learning outcomes were being reached by observing the emergence of active learning in the online discussion. This was particularly so when the Singaporean students constructed the requisite knowledge from their own experience. Throughout the discussions constructivist 'turning points' could be distinguished, at which the students reached learning outcomes by actively constructing the learning central to the course.

This learning construction could sometimes occur in a frivolous way, as we see here from a student who proved to be the mentor and driving force of the Singapore students.

> We often go through life "doing", "seeing", "hearing" and "feeling" things out of habits, which we actually don't intend to do or be conscious about! My personal experience it that I have a wife that is so tidy that very often annoys me. Everyday she simply goes about doing her routine out of habit more than necessity. No item is allowed to be misplaced in the house and that include children toys, so you can imagine the amount of shouting going on around the house every day! Well, this is just her way of seeing life! I certainly do not intend to see Australia through her way!

A much more significant example occurred during discussion of what proved to be an difficult, but ultimately extremely productive topic. This topic was based on a complex essay on the Eurocentric bases of the Mercator projection map. While the content proved to be very difficult for this class, other content was sacrificed so that the link between the map and ways of seeing the world could be confirmed. The discussion threads provide a concrete record of the gradual movement from the idea of a map as a simple description of the real world, to the concept of the map as based on the cultural phenomenon of Eurocentrism.

One turning point was significant for the whole class. The following comment is from the student most ready to go beyond the confines of the material. It represents the kind of moment that teachers look for, and which are all too hard to isolate or analyze in oral discussion.

> I am still looking for the Japanese map of the world which put Japan at the centre mentioned in Message:142. However, I managed to view a 12th Century map of the world which is called a "T and O" map. The world it portrays is a circle, divided by a T-shaped cross, the center of which is in Jerusalem. The circle represents perfection; the world as the object of God's affection. The world is divided into three continents, named after the sons of Noah. This map represented the Church's truth. It conveyed everything important to know for those who lived in a world where nature was unfolding according to God's plan.
> I will try to look for the Japanese map as mentioned.

The student has actively constructed knowledge of the cultural bases of maps by means of a cultural comparison that is germane to his own experience but also critical in the progression of the whole class towards the learning outcomes.

It is moments like these that the instructor can justifiably say "Bingo!" Fascinatingly, it wasn't until I was reviewing the postings on the second reading that I realized just how significant the turning point had been. The review of written responses was crucial in both diagnosis and a perception of the gradual achievement of the learning outcomes.

Evaluation

An evaluation questionnaire was completed at the end of the course. Questions relating to content and online discussion are included below.

The online discussion and group learning tasks elicited a strong favorable response (see Table 1). While the content itself was regarded as difficult by this cohort, the online discussion meant that students felt that their learning had been facilitated. Typical responses were:

> I am very satisfied with the online Group Project method of learning. It was something very new to me and my group members. I would not have acquired such a method of learning if not for this online Group Project. Thank you.
>
> I am happy with the group learning tasks. I enjoyed working with the other group members.
>
> Consequently, although content was often regarded as difficult, the response to the content was very positive.

Strongly agree	SA
Agree	A
Not sure/does not apply	NS
Disagree	D
Strongly disagree	SD

Q		SA	A	US	D	SD
9	The online discussions enabled me to exchange information and ideas with the tutor and other students.	5	1			
10	The computer conference discussions helped me learn more about the subject than I would have learned working on my own.	4	1			
11	I worked closely with other students on the group learning tasks.	2	3	1		
12	I learned a lot from other students while working on the group learning tasks	2	3	1`		

Table 1 Student feedback on online collaboration

Although the content was reduced the responses to the questionnaire confirmed the fact that the learning outcomes were met by allowing longer time to discuss difficult concepts (see Table 2).

> When I enrolled for this subject, I thought Seeing Australia was a 'holiday subject' not requiring any effort to learn new concepts. It was in the thick of the subject that I learned that Seeing is not necessarily what I used to think but a whole new concept which I never knew existed.

Q		SA	A	US	D	SD
14	I found the subject matter interesting	4	2			
15	The course helped me understand the concept of 'seeing' in a new way.	6				
16	The course helped me understand a lot more about Australia.	3	3			

Table 2 Student feedback on learning from the course

Conclusion

Courses taught in the Humanities are extremely amenable to the active construction of knowledge because they do not come with ready-made answers. Skills of analysis and discernment are crucial to the nature of the knowledge these courses present. Nevertheless active learning is habitually discouraged by an obsession with content which is usually held to be synonymous with learning. The presentation of courses online enhances the processes of active learning because the need to write postings and the length of time allowed to consider content, increases reflection and engagement, and provides a ready-made diagnostic tool for the instructor's evaluation of the learning process. But the course, 'Seeing Australia,' also demonstrates that high level cognitive skills can be achieved by students of all abilities if content is subordinated to learning outcomes. The written record provides examples of turning points in the students' learning at which major advances were made as they found the skills required by the course by moving outside the content to engage the material in a more culturally familiar context. These turning points no doubt occur in all teaching, but the written record of online discussion provides confirmation that turning points occur when the learning is constructed as authentic for, and by the student.

References

Biggs, J. (1999) What the Student Does: teaching for enhanced learning. *Higher Education Research and Development,* 18:1, 57-75.

Hannafin, M. J., & Land, S. M. (1997) The foundations and assumptions of technology-enhanced student-centred learning environments. *Instructional Science* 25: 167-202.

Hannafin, M., Land, S., & Oliver, K. (1999) Open Learning Environments: Foundations, Methods, and Models. In C. M Reigeluth (ed) *Instructional-Design Theories and Models*, Vol 2, Mahwah, NJ: Lawrence Erlbaum.

Jonassen D. (1999) Designing Constructivist Learning Environments. In C. M Reigeluth (ed) *Instructional-Design Theories and Models*, Vol 2, Mahwah, NJ: Lawrence Erlbaum.

Laurillard, D. (1993) Rethinking University Teaching: A Framework for the Effective Use of Educational Technology. London and New York: Routledge.

McAlpine, I. (2000) Collaborative Learning Online. *Distance Education*, 21:1 66-80.

Millis, B. J. & Cottell, P. G. (1998) *Cooperative Learning for Higher Education Faculty.* Phoenix, Arizona: Oryx Press.

Morris, R. and Hayes, C. (1997) Small Group Work: Are group assignments a legitimate form of assessment? In Pospisil, R. and Willcoxson, L. (Eds), Learning Through Teaching, p229-233. Proceedings of the 6th Annual Teaching Learning Forum, Murdoch University, February 1997. Perth: Murdoch University. http://cleo.murdoch.edu.au/asu/pubs/tlf/tlf97/morr229.html

Newman, D. R., Johnson, C., Webb, B., & Cochrane, C. (1997). Evaluating the Quality of Learning in Computer Supported Co-Operative Learning. *Journal of the American Society for Information Science, 48*(6), 484-495.

Romiszowski, A. J. & Mason, R. (1996) Computer-Mediated Communication. In D. H. Jonassen (ed) *Handbook of Research for Educational Communications and Technology*, New York: Simon & Schuster Macmillan.

Salmon, G. (2000) E-Moderating: The Key to Teaching and Learning Online. London: Kogan Page.

Interactive Web Page Development for Undergraduate Science Courses: A Discussion of Process and Problems

In 2000 and 2001, three institutions of higher education attended workshops at the Marshall Space Flight Center (MSFC) and Johnson Space Center (JSC) to develop interactive web-based inquiry activities for science courses that serve preservice teachers. These web-based lab activities were developed to provide active learning modules that linked course content to research conducted by scientists at the National Aeronautics and Space Administration (NASA) centers. The participating colleges and universities are members of consortium of universities that form the NOVA network. NOVA is a NASA initiative to improve the quality of undergraduate science and mathematics content courses that serve preservice teachers. NOVA was created to develop and disseminate a national framework for enhancing science, mathematics, and technology literacy for preservice teachers in the 21st century.

In order to foster the goal of increasing the use of technology to enhance learning in science and mathematics, NOVA offered a NOVA Phase III grant opportunity to network members. These grants provided funds to develop interactive web-based activities that linked faculty at NOVA institutions with NASA scientists whose research informed concepts in science courses supported by NOVA. Workshops were held at NASA centers. Science faculty spent five days at a NASA center. The morning was spent with scientists whose research related to topics covered in the courses taught by the faculty. Afternoons were devoted to interactive web page development. NOVA provided technology experts to assist faculty with software and technology training. NASA staff provided resources in the form of images, data, and information on the location of web-based resources.

NOVA team leaders were available to provide expertise in instructional design for active learning environments. The NOVA model promotes instructional strategies that are inquiry based and student centered with extensive use of technology to facilitate learning. A learning cycle approach is the approach used by all three institutions in the development of the interactive web sites. A common version of the learning cycle has three phases, engagement, concept and term introduction, and elaboration. Students are introduced to new material by engaging in an activity, investigation or discussion of a question posed to the class. The explanation phase allows the students to verbalize their conceptual understanding. After students have had the opportunity to explain their understandings, the instructor may introduce scientific terms and explanations. Group and whole class discussion during the explanation phase replace the lecture component of the course. Students apply what they have learned during the elaboration phase of the learning cycle.

Two web modules have been completed and are currently being used by the faculty teams at two schools. One team has completed work on a second module which will be available in the spring of 2002 for classroom use. The third university is in the process of completing their interactive web site. Each web-based activity was developed by a team consisting of a science faculty member, a science educator and technical support personnel. NOVA staff were available for technical assistance with the projects. Faculty were given stipends to support the development of the web activities. These web activities are presently used as a web-based component in face-to-face courses.

One of the web modules links students to research on the phenomenon of urban heat islands. Students explore this topic by making observations of thermal images of cities that were gathered by satellites. Web-based resources provide students with information on the concept of heat islands, the causes of heat islands and the means of reducing heat in urban areas. Students collect data on temperature variation in an urban area using graphing calculators with temperature probes and GPS units. Data is recorded, results are analyzed and conclusions are reported on the web site. This web activity was developed at the MSFC and is based on research by Dr. Dale Quattrochi of the Global Hydrology and Climate Center (GHCC).

A second module was developed at the JSC and is based on the work of Dr. David McKay. This module relates to the requirements and characteristics of life, classification of cells by cell infrastructures, and evidence of life in extreme environments. Students engage in the concept by formulating ways to gather evidence of life on Mars. Web based resources provide students with information about life in extreme environments and about research that may indicate the possibility of life on Mars. Students examine and compare size of cells and cells structures from different groups of organisms. Web-based research of new discoveries of nanobacteria and debates among scientists provide additional resources for students to draw their own conclusion about the evidence for life on Mars. Student design an experiment to find microbes in harsh environments in the immediate area. These experiments are performed in the laboratory.

The members of the panel will present the web-based modules and describe the process and problems of interactive web page development. The presentation will include discussion of the problems encountered in finishing the projects after the NOVA Phase III workshops. Technical support issues will be included in the discussion. Implementation of the project in the classroom and student problems with the modules will be discussed. Issues of faculty time and evaluation are important issues in integrating these web modules into the curriculum. Each panel member will have 10 minutes to present the interactive web module.

The presentation of the module development will be followed by a thirty minute discussion that focuses on the problems of development and implementation of interactive web modules for undergraduate science courses. Science is an active process and developing inquiry based web activities is necessary when e-learning is used in science teaching. Development of these sites is time and resource intensive. Participants will be encouraged to share their experiences in using and developing interactive science web sites. The discussion will focus on barriers to web-based instruction in science and how to overcome those barriers.

The panelist are scientists and science educators that are members of the NOVA Network. All are faculty members at colleges and universities and have participated in NOVA workshops at NASA Centers. Each panelist has developed an interactive web page that is used in an undergraduate science course.

Transforming Student Technology Use through Faculty Development Grants

Science classrooms at a small religious, liberal arts university located in an urban area of South Texas have been transformed technology use in the classroom through faculty development programs. Participation in a National Aeronautics and Space Administrations (NASA) program for college faculty, campus faculty development programs and Department of Education Title V (Title V) faculty development funds paved the way for integration of technology into biology classrooms and increased opportunities for students to apply technological tools to solving problems, to understanding fundamental concepts and to research in current issues in biology.

The university enrolls 3,500 undergraduate students. Seventy-one percent of the student population can be designated as minorities with the majority (54%) coming from Hispanic households. Most of the students are first-generation college attendees who use financial aid to pay for their education (77%). The university qualifies as a Hispanic Serving Institution (HSI).

In 1996 two biology faculty members received a grant from Project NOVA. NOVA is a NASA initiative to create a national model for change in the way that introductory science classes for pre-service teachers are taught. NOVA supports college faculty and administrative teams in activities that apply the principles of constructivism and national reform to content courses in mathematics and science. The National Science Foundation (NSF) has called for more opportunities for students to use graphing calculators and computers in the classroom and outside the classroom as a necessary element of reform in science learning (NSF, 1996a). The National Science Education Standards (NRC, 1996) call for making "the available tools, materials, media, and technological resources available to students" (NRC, 1996 p. 43) and for providing a learning environment that engages the student in actively constructing knowledge by engaging in the process of science.

At the time the NOVA funding was granted, the biology faculty members involved in the project did not have the technological skills needed to implement the use of technology in the classroom. This was a university-wide problem that was recognized by the Office of Instructional Technology (OIT, www.uiwtx.edu/~cheryla). In the summer of 1998, OIT obtained university faculty development funds to develop a program to train faculty in use of instructional technology in the classroom. A key element of the training was to introduce faculty to the instructional design process. Although most participants in the workshops had taught for years, many had little formal training in instructional design. The STI is currently funded by a Title V grant for HIS.

One result of the training for the biology faculty members was that they received a supplementary grant from NOVA. This NOVA Phase III grant provided the faculty members with the opportunity to spend a week at the Johnson Space Center (JSC) to develop an interactive web site for their revised course. This faculty development opportunity was a valuable experience and facilitated development of interactive technology materials for student learning.

As a result of attending OTI training workshops and receiving technology fellowships, the biology faculty gained the technological and instructional design skills to develop instructional products to increase student technology use in the classroom. One important use of technology is the ability to link students to real-world problems and to create an interactive environment for students to solve problems (Bransford, et al, 1999). The biology faculty used NOVA funds to develop a course web site with activities linked to NASA research (www.uiwtx.edu/~mccormic/nova). These activities require web-based research, data analysis, and electronic submission of research results.

The course has evolved from a classroom that had almost no technology use to one that is multimedia enriched and requires students and faculty to become proficient in technology use. The success of the inclusion of technology in the NOVA supported course has been extended to other classrooms in the department. As the biology faculty became more proficient in incorporating technology in instructional design they began to incorporate technology use in other courses.

An additional problem for the students at the university was the fact that many students come to us families who statistically had a low use of home access to computers and Internet service. In August of 2000, the U.S. Department of Commerce (2000) reported that only 37% of Hispanic households owned computers and only16.1% of Hispanics accessed the Internet from home. To address this problem the University became the largest IBM ThinkPad University in the South. All full-time students, sophomores through seniors, have laptops with software and wireless cards. The laptop program provided the means to fully integrate technology use in the classroom. Faculty development led to increased demand for student access to technology and contributed to the need to change the method of providing computer access to students.

The National Science Foundation (NSF 1996b), calls for all students to "have access to supportive, excellent undergraduate education in science, mathematics, engineering, and technology, and all students learn these subjects by direct experience with the methods and processes of inquiry." Faculty development programs model requirements for teaching using technology consistent with national reform movements. As students collaborate with faculty to apply technology to solve problems, students and faculty become part of a technologically literate community. Providing laptops and Internet access bridges the digital divide and reduces competition for scarce resources. Everyone has the technological tools available in the classroom.

References:

Bransford, J. D., Brown, A. L., and Cocking, R. R. Eds. 1999. *How people learn.* Washington, D. C.: National Academy Press

National Research Council. 1996. *Science education standards*. Washington, D. C.: National Academy Press

National Science Foundation. 1996a. *The learning curve- what we are discovering about U. S. science and mathematics education.* (NSF 96-53) Arlington, VA: National Science Foundation.

National Science Foundation. 1996b. Shaping the future: new expectations for undergraduate education in science, mathematics, engineering, and technology. (NSF 96-139) Arlington, VA: National Science Foundation.

U. S. Department of Commerce and National Telecommunications and Information Administration. Retrieved October 2001. *Falling through the net: toward digital inclusion.* http://www.ntia.doc.gov/ntiahome/fttn00/contents00.html

Cognitive Tools in Web-based Learning Environments: Implications for Design and Practice

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Abstract

Cognitive tools are well documented in multimedia learning environments but there has been limited transfer to online learning environments, particularly to Web-based Learning Management Systems (LMS). This paper describes specific tools appropriate for LMS and advocates purposeful integration of cognitive tools in support of adaptive learning for diverse populations.

Industry, government, and higher education have been pressed to offer training that meets the needs of the 21st century worker and student offering flexible scheduling and self-paced courses (Woods & Cortada, 2002; Fjortoft, 1995) at reasonable costs (Aldrich, 2001). Some experts believe that conventional education and training are obsolete in view of increasingly sophisticated and readily available learning management systems (LMS) (Delphi Group, 20002. Because the Web-based learner is physically isolated from peers and typically learns autonomously he or she may or may not be prepared to construct effective learning supports. Therefore the integration of tools that support learning are most critical, even more so when the instructor is not present to determine learner's progress or understanding. This paper briefly discusses cognitive supports as they relate to the nature of Web-based Learning Environments (WBLEs).

Conceptualizing Cognitive Tools

Web-based Learning Environments (WBLEs) typically require that the learner work autonomously and independently. Feedback mechanisms are mostly user-generated rather than technology-generated and yet there are many instances in which WBLEs have provided mechanisms that support the learner in a variety of ways: with study strategies (Morgan, Dingsdag, & Saenger, 1998), prior knowledge evaluation (Portier & Wagemans, 1995), resources for information retrieval and problem solving (Oliver, 1999) , tutorials, and advising services (Wright, 1991). These supports are primarily cognitive, supporting the mental functions required of the online learner.

The term cognitive tool has been defined in several ways. Jonassen (1994) states that computers and the software that provides interactivity are cognitive tools that allow the learner to use them "as tools for knowledge construction rather than media of conveyance and knowledge acquisition" (p.2) as learners are actively involved in constructing their own knowledge and learning *with* technology (Jonassen, 1991). Others define cognitive tools by the function served within an electronic learning environment (Lajoie, 1993). This approach is not in conflict with Jonassen's general notion but more specifically identifies cognitive devices which support learning strategies that vary by learning context. Such tools may support cognitive processes, reduce cognitive load of the learner, extend the cognitive capabilities of the learner or allow the learner to test ideas within problem solving contexts (Lajoie, 1993). Katz (1997) suggests that cognitive tools should support processes of learning that are associated with study strategies such as review, rehearsal, attention, practice, and application. Regardless of how cognitive tools is conceptualized, learning at a distance is essentially learner centered and as such requires supports that are responsive to the learner's immediate needs (Thompson, 1998.

Sugrue (2000) identifies four aspects of learning environments that require cognitive strategies that could be supported by tools, only one of which can be reasonably applied to learner-only interaction, Information Organization and Access[1]. Helping the learner navigate and interact with the electronic environment supports Lajoie's (1993) idea that cognitive tools can reduce cognitive load and assist with lower level thinking processes so that the learner may engage in higher order thinking. Many cognitive tools identified and used in interactive multimedia learning environments resemble devices found in print materials that assist in identifying location within

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[1] The other strategies require opportunities to interact with others: Authentic Activities, Collaborative Learning, and Student Modeling.

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a system or finding one's place, such as bookmarks (Katz, 2001). Erickson and Lehrer (2000) suggest that hyperlinks serve as cognitive tools if they are used intentionally and for specific purposes such as for navigation functions, offering elaborative information, or for structural organization. Index or navigational interface windows (Jonassen, 1998) provide the user with information about their location and/or progress, possibly through a program or site map.

Other tools assist the learner in locating information such as find, glossary (Katz, 2001; Sinitsa, Mizoguchi, & Serdjuk, 2001), and help functions which may also provide cues, elaboration or explanations (Katz, 2001). Tags, pop-up graphics, or rollovers may also direct the user to useful or clarifying information. It may be that visual cues such wipes and dissolves direct the user's attention and support the perceived coherency of the material presented (Slatin, 1991). Additionally, explanatory interface windows (Jonassen, 1989) may elucidate, give details, or coach the user. Others have identified cognitive tools that may serve as an organizer of knowledge or illustrate the relationship of parts to the whole illustrating how knowledge is represented in memory (Sugrue, 2000). Concept and knowledge maps can help learners see the big picture of the relationship of concepts within a specific structure more clear (Rewey, Dansereau, Skaggs, Hall, & Pitre, 1989), making connections between prior and future learning. Metaphorical interface windows provide a representation of material designed to link prior knowledge to materials being learned and organization interface windows support the user's process of making sense out of information (Jonassen,1998). Devices that allow the user to record and organize information are also described as cognitive tools. Harper, Hedberg, Coderoy, and Wright (2000) suggest that authoring tools are a means for students to present ideas for examination by others. Not all learners work well with 2-dimensional electronic representations so notepad (Katz, 2001) or downloadable documents may also function as a cognitive tool if they are used to store ideas and thoughts that are referenced in the process of learning.

Implications and Further Studies

It may be that the nature of Learning Management Systems (LMS) is grounded in the notion of knowledge *management* as opposed to knowledge *construction*. Activating the learner's schema is less likely in a prescribed and pre-determined WBLE, however, adaptive cognitive tools may allow the learner to construct understanding by facilitating the learner's organization of information (Woolf, 1992) which can then be substantiated through interaction with other learners and the course instructor (Derry, 1992; Jones, Greer, Mandicah, du Boulay, & Goodyear, 1992). If a learner enters a WBLE and is offered a path that appropriately supports his or her entry level skills, technology or content knowledge, or learning orientation, the cognitive load will be diminished and embedded supports will facilitate understanding and more authentically respond to the unique and individual needs of the learner (Laurillard, 1992). This is the intent of cognitive tools, particularly in systems which presuppose or require the learner to work to some degree without interacting with others.

References

Aldrich, C. (2001). Strategic e-learning: Trends and observations. (In K. Mantyla, and J. Woods (Eds.), *The 2001/2002 ASTD Distance Learning Yearbook*, (pp. 3-29). New York: McGraw Hill.

Delphi Group. (2002). Why conventional training and education are dead. In J. A. Woods and J. W. Cortada (Eds.), *2002 ASTD Training and Performance Yearbook* (pp.3-12). NY: McGraw Hill.

Derry, S. (1992). Metacognitive models of learning and instructional systems design. In M. Jones & P. Winne (Eds.), *Adaptive Learning Environments: Foundations and Frontiers* (pp. 257-286). Berlin: Springer-Verlag.

Erickson, J., & Lehrer, R. (2000). What's in a link? Student conceptions of the rhetoric of association in hypermedia composition. In S. P. Lajoie (Ed.), *Computers as Cognitive Tools: No More Walls* (pp. 197-226). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Fjortoft, N. F. (1995). *Predicting persistence in distance learning programs.* (ERIC Document Reproduction Service No. ED 387 620).

Jonassen, D. H. (1994). Technology as cognitive tools: Learners as designers. IT Forums Paper. Retrieved on June 23, 2001 from http://itech1.coe.uga.edu/itforum/paper1/paper1.html.

Jonassen, D. H. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? *Educational Technology Research and Development, 39* (3), 5-14.

Jonassen, D. H. (1989). Functions, applications, and design guidelines for multiple window environments. *Computers in Human Behavior, 5,* 183-194.

Jones, M., Greer, J., Mandinach, E., du Boulay, B., & Goodyear, P. (1992). Synthesizing instructional and computational science. In M. Jones & P. Winne (Eds.), *Adaptive Learning Environments: Foundations and Frontiers* (pp. 383-401). Berlin: Springer-Verlag.

Katz, H. (2001). *The relationship between learners' goal orientation and their cognitive tool use and achievement in an interactive hypermedia environment.* Unpublished dissertation, The University of Texas at Austin.

Katz, H. (1997). *Interactive hypermedia cognitive tools*. Retrieved on July 6 from http://www.edb.utexas.edu/mmresearch/Students97/Katz/Katz/ihmct.html

Lajoie, S.P. (1993). *Computer Environments as Cognitive Tools for Enhancing Learning*. In S. P. Lajoie & S. Derry (Eds.), *Computers as cognitive tools* (pp. 261-288). Hillsdale, NJ: Lawrence Erlbaum Associates.

Laurillard, D. (1992). Phenomemographic research and the design of diagnostic strategies for adaptive learning tutoring systems. In M. Jones & P. Winne (Eds.), *Adaptive Learning Environments: Foundations and Frontiers* (pp. 233-248). Berlin: Springer-Verlag.

Morgan, C. J., Dingsdag, D., & Saenger, H. (1998). Learning strategies for distance learners: Do they help? *Distance Education, 19* (1), 142-156.

Portier, S. J., & Wagemans, L. J. J. M. (1995). The assessment of prior knowledge profiles: A support for independent learning? *Distance Education, 16* (1), 65-87.

Sinitsa, K., Mizoguchi, R., Serdjuk, M. *An outline of a Glossary as a cognitive tool*. [online]. Retrieved on August 15, 2001 from http://www.ei.sanken.osakau.ac.jp/ieee/CogTool.html

Slatin, J. (1991). Reading hypertext: Order and coherence in a new medium. In P. Delaney & G. P. Landed (Eds.), *Hypermedia and Literary Studies* (pp. 153-169). Cambridge, MA: MIT Press.

Sugrue, B. (2000). Cognitive approaches to Web-based instruction. In S. P. Lajoie (Ed.), *Computers as Cognitive Tools, Volume II: No More Walls* (pp.133-162). Mahwah, NJ: Lawrence Erlbaum Press.

Thompson, M. M. (1998). Distance learners in higher education. In C. Gibson (Ed.), *Distance learners in higher education: Institutional responses for quality outcomes.* (pp. 24-29). Madison, WI: Atwood.

Woolf, B. (1992). Towards a computational model of tutoring. In M. Jones & P. Winne (Eds.), *Adaptive Learning Environments: Foundations and Frontiers* (pp. 209-232). Berlin: Springer-Verlag.

Wright, S. (1991). Critique of recent research on instructional and learner support in distance education with suggestions for needed research. *Second American Symposium on Research in Distance Education.* University Park, PA: Pennsylvania State University.

Cognitive Presence in Online Discussions: A Content Analysis of eCore™ Courses Using a Neural Network

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Abstract: This paper details the work performed toward building a reliable, automatic, content analysis suite of tools that analyzes online educational discussion list messages. This project is nearing completion and is conducted under contract by Georgia Tech's Center for Education Integrating Science, Mathematics, and Computing (CEISMC) with the Institute of Higher Education at the University of Georgia under a service agreement with the University System of Georgia Board of Regents' Advanced Learning Technologies Unit.

Introduction

In the state of Georgia, the number of credit hours offered online jumped from 59,593 in fiscal year 2000 to 94,531 in FY 2001, an increase of 59% (Yahoo!Finance, 12/11/01). Meanwhile, IDC estimates that the e-learning market will grow from $2.2 billion in 2000 to $18.5 billion in 2005 (Moore, 2001). This growth in electronic learning means that the discourse from many of these learning environments is very easily captured providing an opportunity for researchers to study the process of learning in a way that has never before been available. This study outlines the initial phase of the construction and use of an artificial neural network (ANN) to perform a content analysis of a large body of student messages for cognitive presence. This research seeks to answer two questions. First, can neural networks be used to analyze and describe the cognitive landscape of online educational discussions? Second, at this phase, how is cognitive presence revealed in an online course? This work is based upon the cognitive presence element of Garrison, Anderson, and Archer's (2000, 2001) community of inquiry model. Unlike Garrison, Anderson and Archer, this work uses a neural network combined with the General Inquirer (see Danielson & Lasorsa, 1997; http://www.wjh.harvard.edu/~inquirer) to analyze messages. Additionally, this analysis extends the General Inquirer by adding self-defined categories designed to improve the classification into cognitive presence categories. The suite of tools developed for analyzing these courses may ultimately be used to gauge, guide, direct, and manipulate any learning environment employing online discussions.

The Study

To answer the two questions, can neural networks be used to analyze and describe the cognitive landscape of online educational discussions and how is cognitive presence displayed in an online course, a content analysis of six eCore™ freshman and sophomore history and political science courses was performed during phase one of this study. Phase two of the study will include modeling the decision-making process of the content analysis coders using artificial neural network software. Six coders were trained in the use of a rubric based Garrison, Anderson, and Archer's (2000) cognitive presence hierarchy, which consists of: triggering event, exploration, integration, and resolution. After completion of the training, each coder used the rubric to categorize a set of randomly selected 100 reliability messages and another set of 200 randomly selected course messages. Since the coders represent a subset of a larger population of teachers, Shrout and Fleiss' two-way random effects model was used (ICC(2,6) = 0.8231). Barrett (2001) considers an intraclass r statistic above .74 to be excellent. Pairwise, the Cohen's kappa (k) rater reliability scores ranged from .504 to .747 with a mean of .608. This compares well with Garrison, Anderson and Archer's reliability data for two coders, which yielded k =.35, .49 and .74 for three successive trials. Scores below .8 are acceptable for cutting edge research, that which is breaking new ground, a category under which this research clearly fits (Riffe, Lacy, and Fico , 1998).

Conclusion

The study yielded insight into potential improvements for the rubric and coder training. Coders had difficulty in correctly coding *Triggering Events* that were intentionally initiated by the instructor. In some instances, these messages were coded as *Unrelated/Course Management*. This was due to the fact that the Subcategories under *Triggering Event*, *Sense of Puzzlement* and *Recognizes Problem*, were inconsistent with an intentional, instructor initiated *Triggering Event*. Clearly, the instructor was not puzzled, nor was he/she recognizing a problem. In future studies, we intend to modify the rubric by adding a new subcategory under *Triggering Event* for instructor initiated *Triggering Events*. Further, increased reliability may be achieved in future studies by providing additional training to coders on distinguishing between exploration vs. integration, exploration vs. not cognitive, and triggering event vs. exploration.

References

Barrett, P. (2001). Assessing the reliability of rating data. Retrieved March 25, 2002 from The University of Liverpool: http://www.liv.ac.uk/~pbarrett/rater.pdf

Danielson, W. A. & Lasorsa, D. L. (1997). Perceptions of social change: 100 years of front-page content in *The New York Times* and *The Los Angeles Times*. In Text Analysis for the Social Sciences: Methods for Drawing Inferences from Texts and Transcripts, edited by Carl W. Roberts, 103-115. Mahwah, NJ: Lawrence Erlbaum.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: computer conferencing in higher education. The Internet and Higher Education 2(2-3), 87-105.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. American Journal of Distance Education 15(1), 7-23.

Georgia distance learning numbers increase dramatically; more statewide have internet access, according to Georgia GLOBE research. Yahoo!Finance. Retrieved December, 17, 2001, from the World Wide Web: http://biz.yahoo.com/prnews/011211/attu016_1.html

Moore, C. (12/11/01). E-learning leaps into the limelight. CNN.Com/Sci-Tech. Retrieved December 17, 2001, from the World Wide Web: http://www.cnn.com/2001/TECH/internet/12/11/elearning.leaps.idg/index.html

Riffe, D., Lacy, S., and Fico, F. G. (1998). Analyzing media messages: Using quantitative content analysis in research. Mawah, New Jersey: Lawrence Erlbaum

Bridge over troubled water: Creating effective online support for the metacognitive aspects of problem solving

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Abstract: In the context of higher education, the development of students' problem solving skills continues to be an area of much ongoing research. Effective teaching of problem solving requires the adoption of process-based approaches that reveal to students the ways that experts solve problems, and the coaching of students in higher order and metacognitive skills that lead them away from a preoccupation with finding solutions and towards building up a repertoire of problem solving strategies. It is suggested that online environments and computer resources can scaffold the acquisition of domain knowledge and systematic problem solving skills. This article acknowledges that there are multiple ways to support complex problem solving, and that online environments hold great promise in creating effective instructional interactions. This study focuses on the metacognitive aspects of problem solving and more particularly on those aspects of technology-based scaffolding that support reflection, process support, and the anchoring of skills to domain knowledge.

Problem solving skills as central to learning

In tertiary education, there is an urgent need for professionals who can solve real problems, anticipate and predict problems and find realistic solutions. To meet this need effectively tertiary educators must now reexamine methods of teaching problem solving. In discussing pedagogical approaches, Hobden (1998; 223) states that:

> *"It (problem solving) is a routine activity occupying a large proportion of curriculum time and plays a central role in student's experience of classroom life. From the first days of science instruction, sets of routine problem tasks assigned by the teacher have been part of classroom life. As a teaching strategy, they have largely been used uncritically. It would appear that nearly all physical science education, and especially the physics component, seems to be based on the optimistic assumption that success with numerical problems breeds an implicit conceptual understanding of science."*

These comments apply to the way problem solving has been taught in the past, and to approaches that rely on traditional 'show and tell' where students do not engage actively with the problem or context. The traditional method of showing examples of solutions to problems followed by student practice represents a rather primitive approach in contrast to the teaching of acting, music or a sport, where the skills required for competent performance are taught in context, often in real world scenarios, and integrated so that expert performance results. Taconis et al (2001) have recently analyzed articles appearing in international journals between 1985 and 1995 on the effectiveness of teaching strategies for science problem solving. Very briefly, this analysis showed that in student performance and achievement, knowledge of strategy and practice of problem solving turned out to have little effect, whereas accounts of effective teaching of problem solving all give attention to contextualised strategies related to mastery of domain knowledge. The learning conditions recognised by Taconis et al (2001) as significant for building problem solving skills were those which provide learners with guidelines and criteria they can use in judging their own problem solving processes and products. The provision of immediate feedback to learners is also essential. These conclusions are congruent with earlier research carried out by Alexander & Judy (1988), Clarke (1992) and Lajoie (1993).

The learning paradox

A number of contemporary designs for learning environments require student self-direction and high-level metacognitive control. Exploratory and open-ended learning environments enable students to generate knowledge and engage in critical thinking. Similarly, project based approaches assume that students are able to generate questions and produce a final product that represent knowledge integration. Many students however lack essential metacognitive skills and a repertoire of learning strategies to enable them to maximise their learning in innovative learning environments. Table 1 shows how a range of contemporary learning designs assume metacognitive knowledge.

Example	**Learning scenarios**	**Metacognitive skill needed**
Anchored instruction	Narratives, stories, real life anchors	Capacity to define problems and abstract from case
Open ended learning environment	Multiple scenarios and viewpoints	Self-direction and self management
Project based learning	Collaborative, task based learning environments	Management of information, self and others
Problem based learning	Presentation of cases and events that present potential problems	Capacity to identify the problem and select resources to solve it

Table 1: Metacognitive requirements of contemporary student –centered learning environments

These learning environments though highly successful, assume that students are goal driven and self-directed. Yet, these expectations bring with them a range of assumptions, primarily that students have metacognitive skills to enable them to cope with self-direction learning. Other research has shown that the processing demands of these environments are problematic and need to be investigated. One of the issues of most concern is that of the learning paradox noted by Schank & Cleave (1995) *"How can students learn by doing what they do, when they do not know how to do what they have to do to learn?"*. Stated quite simply, project and problem based learning assumes that students can access and apply knowledge and metacognitive strategies and engage in self-regulated learning. It is well established that in order to learn effectively, a repertoire of learning strategies and the capacity to manage one's own learning are fundamental (Boekaerts, 2000; De Corte et al, 2000). It is this range of skills that we refer to as metacognition.

The role of metacognition in learning and problem solving

Metacognition is a learner's knowledge about his or her processes of cognition and the ability to control and monitor those processes as a function of the feedback the learner receives via outcomes of learning (cf. Metcalfe & Shimamura, 1994; Schraw 1998b). Metacognitive knowledge refers to what the learner understands and believes about a subject matter or a task, and the judgments s/he makes in allocating cognitive resources as a result of that knowledge. Metacognitive control refers to the strategies the learner uses to achieve specific learning goals - strategies like planning and organizing, allocating attention to relevant and irrelevant factors, looking for relationships and patterns, monitoring comprehension, identifying and testing procedures, evaluating outcomes, and reflecting on learning (cf. Jacobs & Paris, 1987). Schraw (1998a) explains that attentional resources, existing cognitive strategies, and awareness of breakdowns in comprehension, are all enhanced by training in metacognitive knowledge and skills. While there are examples of successful metacognitive instruction in the literature, the most effective ones involve providing the learner with both knowledge of cognitive processes and strategies, and experience or practice in using them. Simply providing knowledge without experience or vice versa does not seem to be sufficient for the development of metacognitive control (Volet, 1991). It is also essential that learners have an opportunity to evaluate the outcome of their efforts, to reflect and self-assess their own approaches to learning.

Four categories of metacognitive knowledge are recognised as important and affect task performance and achievement of distance learners (White, 1999). These are as follows:

☐ **Self-knowledge:** Self-knowledge entails individual capacity to recognise their strengths and weaknesses and to evaluate themselves.

☐ **Task-knowledge**: This involves understanding the demands of tasks and what they require.

☐ **Strategic knowledge**: This refers to the knowledge of usefulness of strategies available for achieving learning goals.

☐ **Knowledge of plans and goals:** This refers to learner's capacity to set and maintain goals and to record what they intend to do through their learning.

Design of learning environments for metacognitive support

In response to a perceived need to support problem solving, an on-line tutorial designed in WebCT, called metAHEAD, has been created for first year science students in Biology, Biophysics and Chemistry. The aim of the tutorial is to help students explicitly develop their metacognitive skills in science problem solving. The tutorial comprises four modules - an introduction to thinking and learning, knowledge maps, explanations and descriptions, problem solving. In developing the resource, instructional design was guided by current research on constructive learning, and metacognitive skills development. Lin et al (1999) in considering the technological design of learning environments have noted that four features are important for effective scaffolding of reflective thinking by students. These are *process displays, process prompts, process models* and *reflective social discourse*. The first module of metAHEAD introduces students to key aspects of learning and problem solving and allows them to rate their own problem solving skills on a standard metacognitive inventory test. The second module helps them to build concept maps for topics in their subject areas. The last two modules concentrate on the sorts of skills needed for explanations and descriptions (as most often needed in Biology) and quantitative problems (more often needed in Biophysics and Chemistry).

As students tackle problems in the modules they are asked to engage in a number of the following activities: predict their own expected success on problems; discuss their success with other students during and after attempting the problem; explicitly consider strategies for use with particular problems; examine other students' answers and comments on them; listen to audio clips, view video clips or read transcripts of other students as they worked on problems and comment on these; rate other students' answers; post their answers to a bulletin board for discussion with other students; view lecturer's model answers and comment on them.

Students maintain an on-line logbook to record their responses to the various prompts throughout the tutorial and to record their answers to problems. In metAHEAD particular attention has been paid to supporting the four categories of knowledge identified as essential for development of metacognitive skills (White, 1999). Process prompts and process models are in evidence in the learning activities, which precede the solution of example problems, and in the many worked answers of students and lecturers and comments thereon. Bulletin board discussion of strategies and problem solving skills together with the creation of collaborative teams provide opportunities for reflective social discourse.

Evaluation of *metAHEAD*

It was intended to carry out a formative, integrative evaluation of metAHEAD in order to improve the design and to refine various aspects of the resource. Oliver (2000) has remarked that while a range of methodologies exists, each may be restricted in its use and in the range of situations it can be applied to.

From our pragmatic perspective, we found the Open University model as described by Jones et al (1996) a useful framework. This approach focuses on three main themes: context, interaction and outcomes. This is outlined in table 2, and shows that range of data that was collected and analyzed. As practitioners, we sought an evaluation approach that was broad and flexible enough to suit our situation, which was the introduction of an innovative resource within a university context. From the outset, data has been gathered on the design and use of metAHEAD from pilot studies, practitioners' opinions, instructional designers who have used and developed the program and academic staff who have used sections in their teaching. It was important to include this data in our evaluation, as we needed a holistic picture of its benefits.

	Context	**Interactions**	**Outcomes**
Rationale	Need for metAHEAD at UNE; curriculum context	Need to look at student interactions with the resource.	Learning outcomes; problem solving outcomes; changes of perception and attitude must be considered
Data	Designers aim; principles underpinning design; pressing iterations	Records of students' interactions, student diaries, and online logs	Measures of effective problem solving, changes in attitude, strategy, perception of self.
Methods	interviews; written records;	Observations, videos, diaries, computer records, product data generated by students	Focus groups, tests and questionnaires

Table 2: Features of the evaluation approach adopted

As *metAHEAD* is embedded in Web CT, it allows for the gathering of the following types of data for the evaluation of metacognition, data collection was relatively standard self-rating quiz data taken at beginning and end of semester; students' self predictions of level of success with particular problems and reflection upon these on completion of the problem; on-line log book entries including students' notes on strategy use and actual problem solutions; bulletin board discussions. These data are complemented by further data gathered from small face-to-face focus group discussions. As a further elaboration of our evaluation approach, we collected a range of data relating to the interactive and scaffolding features of metAHEAD. These are summarised in table 3.

Data source	**Type of evidence**
Journal entries	Progress logs (process data)
Oral discussion	Online transactions (process data)
Learner's self assessment	Prediction of success (process data)
Solution logs	Solutions to problems (product data)

Table 3: Evaluating metacognition in online environments

Evaluation and data analysis

Data has been gathered from focus groups giving feedback on technical issues and development of problem solving skills. There are two main areas of feedback gained from this evaluation. Students have greatly appreciated the availability of other students' answers and particularly the comments on them. This has allowed them to put their own answers into a better perspective and to give a clearer idea of what the lecturer expects. (The fact that assessment and lecturers' expectations drive the majority of students cannot be escaped.) These do provide process models and support reflection by the students on many aspects of problem solving. Coincidentally, other student answers help some students to feel more of a part of a group and that they are "not so stupid after all", which can affect student motivation to succeed along with others. Students have identified that their motivation often parallels their success in the subject. Becoming part of a community of students working on a unit is particularly important for distance education students, who may be otherwise rather isolated. The ability to discuss issues on the bulletin board has been helpful for these students.

Students have also mentioned that planning and analysis of problems, whereby parts can be tackled step by step has been helpful to them. Becoming more aware of and practicing such skills has been beneficial for students who in the past may have been daunted by a problems and given up too soon when it seemed too difficult. While we have provided some models and coaching online, students appear to need a more staged approach, with step-by-step examples and support. This 'cognitive apprenticeship' approach is in tune with the constructivist principles underpinning the design of metAHEAD. Table 4 shows a summary of student comments gained from the evaluation.

Comments on what students gained from metAHEAD
Helps think about level of confidence and predict degree of success.
Helps motivation somewhat.
Helps with ways to understand the question better in order to tackle it successfully.
Helps with breaking up tasks – something they didn't commonly consider explicitly.
Talking to other students is helpful, hear other views.
Getting feedback from lecturer, hearing them explain and comment on lecturer's answers.
Appreciated other students' answers, so they could compare their own answers, and lecturer's "metacomments" on these were important.
Other students' answers also show other ways of solving problems.
Information about learning and thinking processes – eg chunking information.
Comments on limitations of metAHEAD
Can't replace face to face. Need personal tutor for motivation.
Notebook tool has great technical deficiencies particularly for science answers involving formulas and equations.
Needs to help students with more practice.
Needs more models and demonstrations of how to work through problems step by step.
Technical difficulties. Eg Plug-in for Quicktime movies.

Table 4: Summary of comments from evaluation data

Implications for instructional design

The aim of metAHEAD was to design a learning resource to offer students support in metacognition and problem solving and a learning experience that was different from traditional teaching in first year (freshman) study. The focus was on building student self-awareness of metacognition and strategy development infused into disciplinary content (chemistry, physics and biology). Our initial evaluation has shown both positive and negative aspects of the resource, and insights gained will be used to design the resources and improve its capacity to support problem solving. Our choice of evaluation approach has been effective and worthwhile, providing valuable data on context, interactions and outcomes of the resource. Continuing evaluation will assist in refining the resource, tailoring to student needs and improving its relatedness the context in which it is being used i.e. the support of metacognition at tertiary level.

References

Alexander, P. A., & Judy, J. J. (1988). The interaction of domain-specific and strategic knowledge in academic performance. *Review of Educational Research, 58*(4), 375-404.

Boekaerts, M., Pintrich, P. R., & Zeidner, M. (2000). *Handbook of self-regulation*. San Diego: Academic Press.

Clarke, R. E. (1992). Facilitating domain general problem solving: Computer cognitive processes and instruction. In E. DeCorte, M. C. Linn, & H. Mandl (Eds.), *Computer-based learning environments and problem solving* (pp. 265-283). Berlin: Springer Verlag.

Davidson, J. E., & Sternberg R. J. (1998). Smart problem solving: How metacognition helps. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 47-68). New Jersey: Lawrence Erlbaum.

DeCorte, E., Verschaffel, L., & Op'Teynde, P. (2000). Self-regulation: a characteristic goal of mathematics education. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of Self- Regulation* (pp. 687-722). San Diego: Academic Press.

Dunlosky, J. (1998). Linking metacognitive theory to education. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 367-381). Mawah, New Jersey: Lawrence Erlbaum Publishers.

Gredler, M. (1997). *Learning and instruction: Theory into practice*. Upper Saddle River, New Jersey: Merrill.

Hobden, P. (1998). The role of routine problem tasks in science teaching. In B. J. T. Fraser, K. G. (Ed.), *International Handbook of Science Education* (Vol. Part 1, pp. 219-231). Dordrecht: Kluwer Academic Publishers.

Jacobs, J. E., & Paris, S. G. (1987). Children's metacognition about reading: Issues in definition, measurement and instruction. *Educational Psychologist, 22*, 255-278.

Jones, a., E, S., Tosunoglu, C., & Ross, S. (1996). Evaluating CAL at the Open University: 15 years on. *Computers in Education, 26*(1), 5-15.

Lajoie, S. (1993). Computer environments as cognitive tools for enhancing learning. In S. P. Lajoie & S. J. Derry (Eds.), *Computers as cognitive tools* . Hillsdale, New Jersey: Lawrence Erlbaum.

Lin, X., Hmelo, C., Kinzer, C., & Secules, T. J. (1999). Designing technology to support reflection. *Educational Technology Research and Development, 47*(3), 43-62.

Metcalfe, J., & Shimamura, A. P. (1994). *Metacognition*. Cambridge, Mass: The MIT Press.

Oliver, M. (1999). A framework for evaluating the use of educational technology. *ELT REPORT 1, online at http://www.unl.ac.uk/tltc/elt/elt1.htm*.

Schanck, R., & Cleave, J. (1995). Natural learning, natural teaching: Changing human memory. In H. Morowitz & J. Singer (Eds.), *The mind, the brain, and complex, adaptive systems* (pp. 175-202). Reading, MA: Addison-Wesley.

Schraw, G. (1998a). Promoting general metacognitive awareness. *Instructional Science, 26*(1-2), 113-125.

Schraw, G. (1998b). On the development of adult metacognition. In M. C. Smith & T. Pourchot (Eds.), *Adult learning and development: perspectives from educational psychology* (pp. 89-108). Mawah, NJ: Lawrence Erlbaum.

Taconis, R., Ferguson-Hessler, M. G. M., & Broekkamp, H. (2001). Teaching science problem solving: An overview of experimental work. *Journal of Research in Science Teaching, 38*(4), 442-468.

Volet, S. E. (1991). Modeling and coaching of relevant metacognitive strategies for enhancing university students' learning. *Learning and Instruction, 1*, 319-336.

White, C. J. (1999). The metacognitive knowledge of distance learners. *Open Learning, 14*(3), 37-46.

Experiential Learning On-Line:The role of asynchronous communication tools

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Abstract

The needs of learners are changing rapidly and continually in response to an environment that is characterised by change at economic, political and technological levels. There is greater pressure on universities to work more closely with employers in contributing to the process of economic development through the creation of a skilled workforce. Universities are becoming increasingly flexible in their responses to meeting the lifelong learning agenda. Online experiential learning is an essential element in the move towards more situated and professional orientations and with the drive to providing students with real world working knowledge. Asynchronous communication tools and tasks are ideal conduits for the refinement of professional skills. This case study profiles an on-line approach to developing professional project management skills for multimedia developers and presents snapshot views of an online learning environment in which students developing real projects for industry clients.

Theoretical Framework: Experiential Learning

Through the design of an asychronous online learning space, learners to were introduced to situations and ways of working with others that were experientially based. The processes of learning were emphasised from the outset and students were encouraged to have ownership of the learning, assessment and reflection processes. For Kolb (1984), the actual experiences people go through become the starting points for learning, and this underlying educational approach was reflected in the design of the online environment. Emotion and reflection are also an integral part of the cycle of learning, and reflective processes are intrinsic to learning from experience.

In an experiential learning cycle, the learner passes though each of four stages: concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Our design ensured that we linked the experiential learning cycle to the online environment and the collaborative tools afforded by the technology as follows:

- *Active experimentation:* Students engaged in the discussion and resolution of problems through online discussion using multimedia tools to support the display of responses (eg., Cox, 1994).
- *Task engagement*: Peers analysed the output of the task, and compared problem-solving approaches through discussion, email and conferencing activity (Bonk & Cummings, 1998).
- *Reflection:* Individuals analysed and reflected on the learning tasks, group processes and self-development as they tested new ideas and perspectives in virtual learning groups (English & Yazdani, 1999).
- *Formation of abstract concepts:* Utilising peer and tutor feedback, students developed understandings of key course concepts through engagement with new ideas supported via communications networks (Collis, 1998).

Experiential learning was reinforced in various ways through the course pedagogy, which focussed on both process and content aspects of learning. Students participated in decision-making processes by choosing and defining a topic for their project, creating and managing their own development team and negotiating peer assessment. The design was based on pedagogical and curriculum philosophies that acknowledge group work, peer feedback and support as essential to the development of independent learners and practitioners (Candy, 1994; Schrum, 2000). Reciprocity in giving and receiving peer feedback provides learners with opportunities to deepen their interpersonal skills. Through these processes they also developed reflective skills, and learnt to monitor their own learning and appreciate the contribution of others to their learning (Biggs, 1999).

Thus, by focussing on learning process and peer supported activities, the learning activities took on a broader perspective, to include the totality of the learning experience while consolidating those aspects of professional learning that would enable the learners to develop transferable skills. This process is illustrated in Figure 1, which shows a focus on using learner-centered strategies that encourage learner independence and peer support, which in turn promotes the development of professional skills and process knowledge. These then directly contribute to deep and meaningful learning experiences, and as part of the authentic learning experience, students were able to share their knowledge and experiences with their peers through the Listserv.

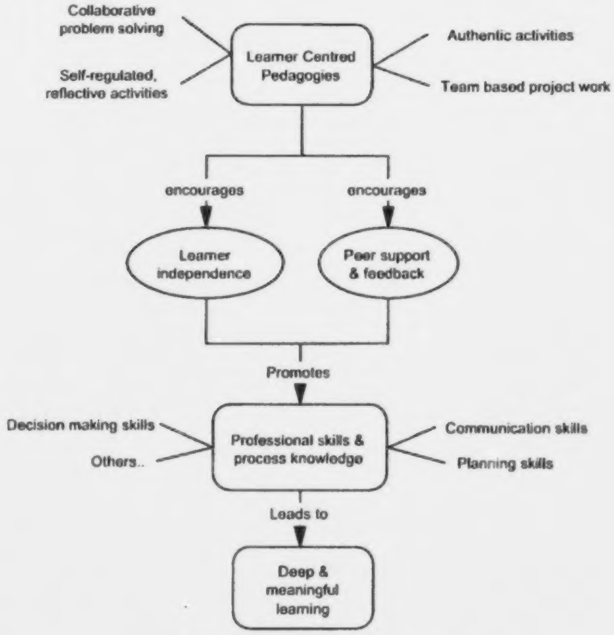
Collaborative problem solving
Self-regulated, reflective activities
Learner Centred Pedagogies
Authentic activities
Team based project work
encourages
encourages
Learner independence
Peer support & feedback
Promotes
Decision making skills
Others..
Professional skills & process knowledge
Communication skills
Planning skills
Leads to
Deep & meaningful learning

Figure 1: Student Learning Process

Context of the study: Course description

At Edith Cowan University, final year multimedia students are required to complete IMM3330/4330 "Industry Project Development". The aim of the unit is to consolidate core multimedia skills learnt in other units, while at the same making industry contacts and developing a portfolio item to assist with job applications. Students are provided with industry projects made available through the Faculty, or they can negotiate a project of their own, as long as it fulfils the course requirements, team-based, commercial in nature and not trivial. As part of the unit requirements, students are required to perform a needs analysis, provide a design specification, develop the web site, evaluate it, implement it and produce the required documentation (legal, procedures, metrics, templates and standards). The course objectives were closely linked to the professional competencies required for multimedia development in the industry and integrated authentic assessment tasks where learners could develop multimedia products in a team environment, thus replicating the skills required of them in the workplace.

The unit runs over a fifteen-week semester, with three hours allocated per week for tutorials and lectures. There are no formal face-to-face classes, the unit is largely run online from a Listserv, which provides a rich arena for advice, comments and feedback as there is about one hundred participants subscribed on the List, including industry representatives and ex-students. The constructivist approach used in structuring the project work and the Listserv activities was that students should benefit from the experiences of other students, industry representatives and academic tutors in an environment that promotes the exchange of ideas.

A salient feature of the assessment tasks was the focus on learning processes, rather than mastery of content as this matched the orientation of the course towards skills development. The assessment tasks and associated learning processes are presented in Table 1.

Table 1: The assessment tasks and associated learning processes

Assessment task	Learning processes
Web-based product development	• Team work, planning, decision making project management
Self and peer assessment of team products	• Higher order thinking and analysis • Development of criteria for assessment • Giving feedback to peers • Reflection on feedback leading to revision of ideas
Student learning contract	• Self-directed learning
Team progress reports to the list serv	• Metacognitive skills and

To initially motivate students in using the Listserv, assessment was included which acknowledged individual contributions (for "quality" feedback and advice) as well as submitting team progress reports, which included students posting design ideas and prototypes and requesting feedback from others. Students were given templates to use in preparing these reports as well as rules or "netiquette" they were required to use when posting information to the Listserv. Encouraging students to initially use the Listerv by allocating marks was necessary, as proven by previous experience. However, in all cases, as the semester progressed, students became more comfortable with using the Listserv, and were posting on a variety of topics.

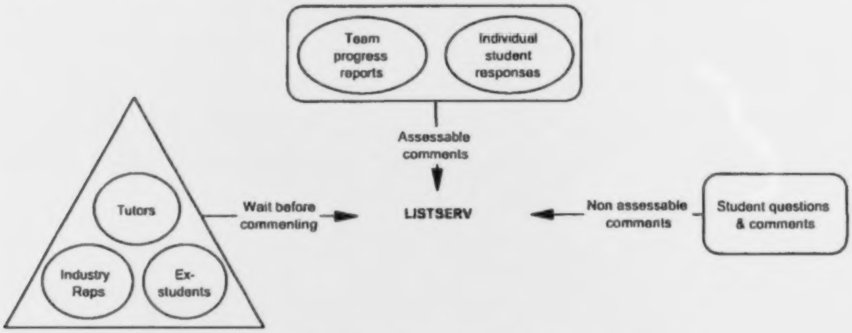

Figure 1. A model for online discussion based on peer partnerships

The tutors' involvement on the Listserv was structured to be non-interventionist so that they acted more as facilitators by focusing discussion, rather than as the "fonts of all wisdom". Figure 1 outlines the model used for promoting discussion on the Listserv. Issues were generated from team progress reports or from individual queries about technical, content, procedural, client, communication, team/peer through to how to get employment in the industry! However, as time progressed, students more freely contributed to the Listerv with many other issues, some of which were more philosophical in nature and posted without the objective of obtaining marks.

An example of how the Listserv was used to promote real world learning is as follows. The unit had 72 students, and the number of posts made to the Listserv over the semester was 1035 in total. In the example given below, a student is seeking help on a difficult issue i.e. how do you develop web sites which are compatible across all browsers? This problem has no real solution and is also a problem for professional developers in the industry. So this is a rich, authentic topic for discussion, in which students can assist their peers by giving their opinions or help on the issue. Another 12 replies follow in this thread, where the students kept debating the issue:

- *Initial Post "BROWSERS GRRRRR" - Hi all Scamers, I have come to a stage in the project where I just wish that there were a universal Web browser that combines Internet Explorer and Netscape!! It is Frustrating to design and program a website that will look exactly the same on both browsers, well it doesn't!! Not even with CSS style sheets that is the biggest nightmare I have been going through... Furthermore how the browsers for the different platforms ex Mac and Pc reads the content but does not display it the same.. I believe that it is a common problem that web developers have to deal with and I wonder if one have to be a fascist and say.. Ok The site is gonna look best on IE assuming that 70 % of the market is using it! And forget about the rest!!! It is a nightmare and I just cant get my head around it , Just want to continue the development of the clients site. Oh and our client is aware of the problem and has given us a Ok to ignore the small errors between the browser but still this is something that we have to deal with in future projects/ I will be glad is somebody has a good solution for my problem..*

- *Reply 1 - It is just a problem that exists, and seemingly always will, the CSS sheets will look different because Microsoft have one set of codes, and there is another for Netscape preferences. If you think the differences between Mac & PC are bad, I wouldn't recommend looking at what Unix would do to your code, furthermore the world does not end at MAC & PC if you get lucky and enough money see what a Sun system does they're maybe around $20k - apparently lots of fun with graphics and 3d. The only thing I could perhaps suggest is survey a portion of the target market early in the project to see what the majority of users have as browsers.*

- *Reply 2- Don't forget Amigas. I actually know one guy who has browsed the net with a Commodore 64 :) And soon Dreamcasts and Playstation 2. X-Box? But you have to draw the line somewhere, don't you?*

- *Reply 3- I don't know that you can, when it comes to your customers. It seems fairly certain that web developers, and web development technologies themselves, will have to grow to accommodate the fact that the web is now being viewed on everything from 35" monitors to mobile phones.*

- *Reply 4-As designers we need to design *for* the medium, not expect the medium to conform to our design. The nature of the web is just so variable that its stupid/lazy to just design for one browser or platform. As mentioned by Oliver, its just going to get worse when people start wanting to get web content on phones and PDA's. Remember that content is what people Content is mostly textual and text will go anywhere. Its not impossible to design an engaging site that will view correctly in all browsers from v3 upwards on all platforms (including *nix / webtv / dreamcast / palm) its just requires a bit of creativity. Something every designer should have an abundance of. I really want to see that c64 browser.*

- *Reply 5-I don't think there is a solution - other than creating very standard html sites that can be viewed from lynx to ie 5.5. But that's a bit boring... Create for the majority, that's my solution. I'm concerned with the ie4.75 on Mac that does not seem to support dhtml. Other than that I've been able to create a site that works the same on ie and NN 4.x and above. That's good enough for the client so I'm happy.*

This example shows how students supported each other through the virtual community and in doing so helped to develop their skills in communication, problem solving, and giving/accepting positive criticism from others. This community provided a "conduit" for the students in which they could share their experiences and knowledge, and provided a platform to constructively help each other.

Evaluation

As part of the project requirements, students were responsible for making contact with the client and discussing the scope and legal aspects of the development (educational software, IP, etc). These had to be negotiated so that the client had their needs satisfied, while at the same time the students were involved in producing a web-site that conformed to the requirements of an academic unit. This often involved firstly understanding the client's needs and "educating" the client about web production, maintenance and costs.

From the evaluation questionnaire conducted at the end of the unit it appeared that the students were very positive about the structure of the unit and the use of the Listserv. Almost all the students wanted to remain subscribed on the List as a form of graduate Listserv (as well as offering advice to other students who will be enrolled in the future). Grounding the industry project in a commercial environment with the use of a Listserv for inter-team and inter-student communication was clearly successful, and added value to the students' experience in this unit. Contributing factors that led to its success include:

- The Listserv was treated as a mainstream activity which replaced face-to-face classes, and was integrated into the assessment system
- The industry partnership involved students dealing with authentic commercial, client and technical problems in the workplace and using the Listserv to ask for advice and share experiences

The tutors acted as a facilitators and not experts by not fostering discussion rather than questions; dealing with inappropriate responses offline; and identifying underlying issues and redirecting these as questions back to the Listserv for students to reflect on and discuss where appropriate.

Critical success factors

In this online unit, project based learning combined with asynchronous learning tools enabled students to develop a relationship with a client, create solutions to a design problem and develop a project brief. In the approach adopted here, the practice has added to it the learning aims, specific learning processes, assessment processes and the learning outcomes. Each of these involved partnerships with industry clients with learners taking advantage of the real world context to gain professional knowledge.

The success of the unit can be attributed to the following factors:

- A virtual community was formed through the use of a Listserv, which encouraged collective and collaborative learning rather than individualistic. The online social environments provided scope for group interaction, sharing and discussion and in depth exploration of issues.
- The content of the course was opened ended, and students had access to a website where they could add resources or choose the most relevant ones (see Figure 3). Access to relevant knowledge resources was oar of the "just in time "approach to planning, i.e. the choice of selecting resources is left to students who have to identify a learning need;
- The development of networked collaborative learning requires a focus on the processes of collaboration, and the well-being and development of the collaborative group (McGrath, 1990). In summary, this involves:
    - openness in the educational process
    - self-determination in learning
    - a real purpose in the cooperative learning process
    - a supportive learning environment
    - collaborative assessment of learning
    - assessment and evaluation of the ongoing learning process.

The notion of professional development and growth was recognised by learners to be more important than learning facts, figures and project management procedures. Students had to work closely with an industry client, develop a project brief and then communicate and negotiate the final product to a group of peers. Peer learning enabled student to reflect on the experience and learn from it.

Conclusion

The study illustrates an effective learning design involving experiential real world learning, which was integrated into the final year of tertiary multimedia course. The unit aimed to consolidate core multimedia skills learnt in other units, while at the same time having students making industry contacts and developing portfolios item to assist with their job applications.

Through authentic settings, students were engaged with industry projects, clients and assessment tasks. This was complemented with a virtual environment and asynchronous conferencing in which students exchanged ideas and helped each other cope with these authentic tasks. This, in combination with client negotiations, promoted the development of professional skills and process knowledge, which supported both process and product skills.

References

Bonk, C. J., & Cummings, J. A. (1998). A dozen recommendations for placing the student at the centre of Web-based learning. *Educational Media International, 35*(2), 82-89.

Candy, P., Crebert, G., & O'Leary, J. (1994). *Developing lifelong learners through undergraduate education*. Canberra: Australian Government Publishing Service.

Candy, P. C., & Crebert, R. G. (1990). *Teaching now for learning later: The transfer of learning skills from the academy to the workplace.* Paper presented at the Paper presented at the 8th annual Australasian learning and language Conference, Brisbane, July 1990.

Collis, B. (1998). WWW-based environments for collaborative group work. *Education and Information Technologies, 3*, 231-245.

Cox, R., & Brna, P. (1995). Supporting the use of external representations in problem-solving: The need for flexible learning environments. *Journal of Artificial Intelligence in Education, 6*(2/3), 239-302.

English, S., & Yazdani, M. (1999). Computer-supported cooperative learning in a virtual university. *Journal of Computer Assisted Learning, 15*(2), 2-13.

Kolb, D. A. (1984). *Experiential learning*. Englewood Cliffs, N.J.: Prentice-Hall.

Schrum, L. (2000). Online professional development: A case study of an MBA program through its transition to an online model. *Journal of Asynchronous Learning Networks, 4*(1), http://www.aln.org.

Language learning in different modes: Does technology make a difference?

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Abstract: In the past decade, the use of technology for foreign language instruction has expanded rapidly and with it has come the expectation that online methods of teaching will supersede other more traditional methods of language learning. This article reports on a longitudinal study of Australian students studying French in three different modes. The results indicate that performance and achievement in 'open learning' mode where students self-direct their own learning, has the most successful approach, and that multimedia enhanced teaching of foreign languages is highly successful.

Literature review

A number of benefits for students related to the general use of technology for foreign language learning. These include improved motivation, self-concept and mastery of basic skills, increased student centered learning and engagement in the learning process (Stepp-Greany, 2002). Use of multimedia technologies for low achieving students have been shown to have facilitate learning when used to illustrate concepts and factual information (Nowaczyk, 1998). For networked classrooms, Beauvois (1998) found that more student-student interaction promoted communicative awareness, as self-disclosure through conversation was common. While technology enhanced learning has been applauded in the research literature as enhancing and supporting language learning, it is the theory of constructivism that underpins instructional design of technology that drives new approaches to language learning (McLoughlin & Oliver, 1998). The present study provides evidence that technology enhanced learning promotes successful outcomes when compared with more traditional methods of language teaching.

A longitudinal study of different language teaching modes

Longitudinal research, which has monitored three discrete types of students learning French *ab initio, has been carried out* at the University of New England, Australia, since 1992. The three modes investigated were for a (i) on-campus (on campus) students, who received face-to-face teaching (ii) off-campus (distance education) students, studied at a distance except for a four-day intensive on-campus workshop each year; and (iii) Open Learning students, who learnt entirely by correspondence and had no face-to-face contact with academic staff. See table 1.

Student Cohort	**Methodology**	**Learning approach**
Group 1 – On campus, face-to face mode of study	*Bonjour, ça va?* is a traditional method of teaching French developed in North America. It is a traditional, grammar-based course with explanations in English.	Traditional ie teacher directed
Group 2 – Off-campus distance learners	The off-campus students selftaught and selfdirected their own learning except for a brief, intensive residential school six months after the start of their studies.	Independent, with some face-to-face sessions
Group 3 – Open Learning (Selfpaced, resource-based learning)	The open learning students used an innovative multimedia course, *French in Action*, developed at Yale. A semi-immersion course, it comprises twenty-six 30-minute videos entirely in French, together with related text/workbooks.	Independent, with no face-to-face sessions

Table 1: Student groups and modes of study

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The study provides evidence that technology enhanced learning promotes successful outcomes when compared with more traditional methods of language teaching (Hutchinson & Koplin, 1998).

Confirmatory evidence of the success of the open learning mode

In 1993, the results showed that Open Learning students performed significantly better than the students in the other two groups but, again, a controlled statistical study was not possible, as there were still data limitations (See Table 2). The question was raised, of course, as to whether this was merely a chance occurrence and, if it were not, then why the Open Learning students outperformed the others so convincingly when they appeared to be the most pedagogically disadvantaged?

Mode of Study	**Average Final Mark (with standard deviation in parentheses)**
Open Learning	77.80 (9.26)
On-campus	68.47 (13.28)
Off-campus	72.46 (11.70)
On-campus + Off-campus	71.18 (12.25)

Table 3: Relative performance of modes of study

Further investigation involving a comparison of the performance over *three* years of all *French in Action (multimedia)* students (from 1996-2001) with that of all students studying a more traditional method, showed that students learning with the multimedia course had outperformed those learning in a more traditional manner (Hutchinson & Koplin, 1997). The results of the study support the findings of Dywer (1996) and Weiss, 1994). In summary, the results indicated that students studying without any direct teacher contact outperformed students in the other two groups because of the use of a multimedia learning package which allowed self-paced, self directed learning to occur.

Conclusions

The purpose of the longitudinal study was to investigate the comparative academic achievement of these modes of language learning, and to apply lessons learnt to the creation of improved models of language teaching. The solid performance of students using a self-directed multimedia package, when compared with other students of French following a more traditional course, even with online enhancement, shows the pedagogical benefits of the multimedia learning environment.

References

Hutchinson, H. and Koplin, M (1998). "Home alone with *French in Action:* successful language learning in isolation at tertiary level", *AUMLA*, 89, 67-78,

Hutchinson, H. and Koplin, M. (1997). *"French in Action: is face-to-face language teaching really necessary?"* AULLA Paper presented at the Australasian Language and Literature Association) conference, Sydney University, February, 1997

Beauvois, M. (1998). Conversations in slow motion: Computer-mediated communication in the foreign language classroom. *The Canadian Foreign Language Review, 54*(2), 198-217.

Dywer, D. (1996). A response to Douglas Noble: We're in this together. *Educational Leadership, 54*(3), 24-27.

McLoughlin, C. & Oliver, R. (1998). Maximising the language and learning link in computer learning environments. British Journal of Educational Technology, 29 (2), 125-136.

Nowaczyck, R. (1998). Student perceptions of multimedia in the undergraduate classroom. *International Journal of Instructional Media, 25*, 367-368.

Stepp-Greany, J. (2002). Student perceptions of language learning in a technological environment: implications for the new millennium. *Language Learning and Technology, 6*(1), 165-180.
Weiss, J. (1994). Keeping up with the research. *Technology and Learning, 14*(5), 30-34.

Multiple perspectives on the evaluation of online discussion

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Abstract: This paper attempts to examine different methods of content analysis for student inline discussion that takes place on bulletin boards. The purpose of that analysis is to determine whether higher order thinking can be distinguished within transcripts of dialogue. The context of the analysis was a higher education undergraduate course. A group of students were presented with a discussion topic and were given a series of criteria against which their work would be assessed. At the end of the discussion their dialogue was analysed using three different techniques which were then compared to identify whether any one method could be recommended to other practitioners. Suggestions for evaluation of bulletin board transcripts are made on the basis of this investigation.

The development of discussion boards as learning tools

Discussion boards or bulletin boards are part of a general category of CMC. Discussion boards allow students to interact with one another and with a facilitator and can be used for a variety of teaching techniques designed to stimulate cognitive and metacognitive skills.

An extensive literature base (Harasim, 1990; Mason, 1994) has developed which supports the educational value of CMC as a teaching and learning strategy. However, most investigations into the benefits of this form of interaction have tended to be quantitative in nature (McKenzie & Murphy, 2000; Nastasi & Clements, 1992) concentrating on either the number of exchanges that take place, or on diagrammatic representations of the pattern of interaction between participants. During the last decade however, methods of analysis have been applied to this communication technique to identify more precisely the varied educational dimensions that may be found within the online text (Henri, 1992; Gunwardena et al, 1997). Different forms of 'content analysis' have been developed and refined to aid the categorisation of dialogue produced in any debate or online seminar. MacKinnon and Aylward, (2000) for example, have used a system of coding online dialogue using 'cognotes', where the e-moderator attaches icons to ongoing text in order to indicate the nature of the interactions which are occurring. This is intended to encourage higher student achievement and more positive relationships between the participants.

Aim of study

Currently, content analysis has been seen as a time-consuming activity which, while it can produce valuable insights for educational researchers, does not lend itself to practical application by teachers who might want to evaluate the online discussion element of their programmes. This pilot study seeks to compare the relative strengths and limitations of established content analysis techniques and then propose a simpler method that is useful and practical. This would then allow course providers to decide whether their course participants are displaying cognitive and metacognitive aspects of learning at the level they expect.

Depth of learning

McLoughlin and Oliver (1998) have indicated that Higher Order Thinking (HOT) is not easy to define but can be recognised when encountered. These authors have summarised recent debate on the definition of

HOT as referring to thinking which is complex, multi-faceted, self-directed and one in which the learner plays an active role (1998, p. 242). This is in line with Sternberg's (1985) theory of intelligence that considers the basis for higher order cognitive processing to be executive processes used in planning, monitoring and decision making. For the purpose of this paper cognitive skills are generally regarded as applying to student understanding, reasoning, and the development of critical thinking and problem solving skills, while metacognition relates to knowledge of one's own cognition and the further regulation of that cognition (Hara, Bonk and Angeli, 2000). Henri and Parer (1992), in addition to their model of content analysis, also identified the level of information processing as 'surface' or 'in-depth'. They recognised surface processing to include: making judgements without justification; stating that one shares opinions already stated; repetition; and irrelevant questions. In-depth processing, Henri stated, was demonstrated when participants linked facts and ideas; offered new elements of information; discussed advantages and disadvantages; and made justified judgements.

The study

A group of 10 adult learners on a higher education programme took part in an online discussion which was an obligatory part of their course assessment. None of these participants had previously experienced online discussion. The asynchronous computer conferencing software used was the discussion board contained within *BlackBoard CourseInfo*, a web course management system. The discussion was entitled: "Integrating technology into education - a constructivist approach". The students were required to take part on at least four occasions in a discussion on the topic within a four-week time frame. The criteria upon which their contributions were assessed in the course were obtained from Campbell's experiences (1999) and were: regularity of contribution, links to the comments of others, sharing of ideas and experiences, and reference to readings or Websites.

Evaluation by content analysis

Content analysis involves comparing, contrasting and categorising elements of written dialogue for meaning, as opposed to discourse analysis which examines the process of communication including specific speech acts. A range of examples of models have been selected for this study including those developed by Henri (1992) and Gunwardena, Lowe and Anderson (1997) and an earlier method of determining the complexity of student responses, the Biggs' SOLO taxonomy (1982). Modifications to these schemes are also incorporated in the analysis, 'since every computer conference will have its own unique attributes, researchers may have to design electronic discussion group evaluation criteria on a case by case basis,' (Hara, Bonk and Angeli, 2000, p.143). In particular the models were chosen to enable higher orders of thinking to be identified in the dialogue, as this is frequently identified as a required outcome in tertiary level education programmes.

Table 1: Gunawardena, Lowe and Anderson content analysis model (1997)

CATEGORIES FOR DATA ANALYSIS	EXAMPLES
Phase 1: Sharing and Comparing	Observations, examples and descriptions, basic agreement
Phase 2: Discovery and exploration of difference	Questions re differences, clarifying statements
Phase 3: Negotiation of meaning and co-construction of knowledge	Identification of common ground, statements of compromise
Phase 4: Testing and revision of ideas	Testing of ideas against personal knowledge
Phase 5: Awareness of newly constructed	Metacognitive statements, reflection

Model 1: Gunawardena, Lowe and Anderson's (1997) criteria for content analysis
This model was originally designed to examine the construction of knowledge within online debates in a similar manner to the design of Nastasi and Clements (1992) who considered that the resolution of cognitive conflict could be used as a measure of cognitive learning. See table 1.

Model 2: Henri and Parer's qualitative criteria for content analysis (1992)

This model identifies five dimensions within the framework of the content analysis: participative, (examined by quantitative analysis), social, interactive, cognitive and, metacognitive. Each of these have operational definitions and related indicators, however only the latter two have been examined in this study as the focus of the study was to analyse participants' learning outcomes rather than the collaborative process of achieving that result. Nevertheless, it is recognised that in a constructivist learning environment, where collaborative learning is occurring in a social setting, interactions between the participants must play a significant role in the achievement of understanding.

Categories for data analysis	**Definitions/Indicators**
Cognition	
1. Elementary classification	Observing a problem and its linkages, questions, basic descriptions
2. In-depth classification	Analysing a problem re beliefs and assumptions, referential criteria
3. Inferencing	Inducting and deducting (based on prior propositions), generalisations, conclusions
4. Judgment	Making decisions (I agree), appreciations, criticisms
5. Strategy application	Proposing actions, evaluations, decisions
Metacognition	
1. Metacognitive knowledge	Perceptions of oneself as learner and thinker, realisation of strategic knowledge
2. Metacognitive skills	Planning, regulation, evaluation and self-awareness

Table 2: The Henri and Parer content analysis model

Hara, Bonk and Angeli (2000) have added the categories 'reflection' and 'self-questioning' to Henri's list of metacognitive skills and these have been applied in this study. Even with these modifications, metacognition is not often clear, possibly because it occurs infrequently in the discussion being studied.

Model 3 – Biggs's SOLO taxonomy (Biggs and Collis, 1982)

This form of textural analysis, designed primarily for the print-based word, was an earlier attempt to examine the complexity of students' responses. Although it was not designed to function as a model of content analysis, it was trialed in this study to see if Biggs's categories of HOT would provide a useful alternative technique. The outcomes have the advantage of being generic, and provide a fairly clear cut-off between students' surface and deep learning approaches, at a point separating level three from level four.

Level of outcome	**Indicators**
1. Prestructural	Irrelevant information, no meaningful response
2. Unistructural	Answer focuses on 1 relevant aspect only
3. Multistructural	Several relevant ideas, but not co-ordinated
4. Relational	Integrated, meaning is understood
5. Extended abstract	Answer goes beyond information given.

Table 3: Levels of Biggs's SOLO taxonomy

Method applied in this study

The fifty messages contributed by students, primarily in chronological order, were first listed by dialogue number. Remarks made by the e-moderator were deleted from this list. Initial entries placed on the board during the first face-to-face session were also removed as these did not pertain to the assignment but were designed to familiarise students with the process of contributing.

Following this preparatory stage the three main techniques described above were applied to the whole sequence at an entire dialogue message level. In addition, surface processing compared to in-depth processing following the Henri model was also evaluated. Within each message the category was selected on the basis of the highest order of thinking demonstrated within the dialogue. In other words, messages were not sub-divided into smaller units of meaning. There were three reasons for this; firstly, subdivision would have simply produced additional data indicating an increased amount of lower value learning levels without affecting the extent to which higher order thinking might be discerned. Secondly, this whole message analysis overcame the problem of deciding where to slice the dialogue to achieve appropriate subsections. Thirdly, it saved a large amount of analytical time. It did however obscure the precise identification of student performance, as described in Gunawardena's model where each of the five phases is categorised in more detail. To increase the rigor of this subjective process a second researcher examined every fifth entry and applied the same series of content analyses to this 20% sample.

Results

All models showed a distribution of rating scores from 1 – 5, with relatively few responses at the higher level of cognition. Table 4, indicating the relative ratings allocated by each model, shows that the Gunawardena model produced a greater proportion of low-level ratings than the other two. In the Henri model metacognitive references were also listed (M) which occurred mainly in the cognition category 5 ratings but also one occasion in the category 4. This table indicates overall comparative frequencies but does not indicate similarities or differences between the models per individual dialogue.

Content analysis rating	**Gunawardena**	**Henri**	**Biggs**
1	24	15	6
2	9	16	8
3	9	8	16
4	6	5 + 1M	15
5	2	6 + 3M	5

Table 4: Content analysis rating scores for all three models

To examine whether the three models did show consistency between the individual ratings a simple correlation analysis was applied to show degrees of association or similarities between them all (see Table 5).

	Gunawardena	**Henri**
Gunawardena	-	-
Henri	.7405	-
Biggs	.6624	.7025

Table 5: Correlation Coefficient between content analysis models

Table 5 shows that there is a strong correlation between the Henri and Gunawardena models and a lower one between the Gunawardena and the Biggs analyses. The reason for this difference is that results from the Gunawardena rating allocate 50% extra scores at the lower end of the learning level scale in comparison to Biggs (see Table 4). Nevertheless, all three models do show statistically strong degrees of correlation.

Conclusions

Two main conclusions can be drawn from this study. Firstly, practitioners wanting to apply one of these models will be able to do so quite readily if they select their categories at the level of the whole message, rather than sub-categorising the text. The consistent application of any appropriate technique will then indicate levels of HOT in their own online discussions which can then be used for modifying teaching techniques.

Secondly, the nature of the discussion and the expectations of the course providers should determine the choice of the primary model selected. If the aim is to encourage a collaborative learning environment, then the Gunawardena model provides more insight into whether or not that has been achieved. This model also incorporates metacognition into the main framework, which is essential if any evaluation of HOT is required. The Henri model, with its metacognitive aspect applied as a separate framework dimension tends to highlight individuals' success in displaying internal cognition in a more Piagetian sense, although within some of her categories there are opportunities to acknowledge the interactive nature of the discussions. A major criticism of Henri's model (McLoughlin and Luca, 1999, p.223) is that 'it was designed for contexts where there was a strong teacher presence, and is not readily applicable to a learner-centred conferencing environment'. These authors consider that the Gunwardena model a more suitable tool for reflecting collaborative and social factors, on the basis that it proposes a social constructivist approach to knowledge building in a online environment.

In the Biggs model the categories are clearly hierarchical which leads to an overall value judgement about the content of each message. This rules out completely the possibility that socially interactive functions are acknowledged as part of cognitive development. Although all three are structured to indicate levels of learning and deeper understanding demonstrated by the text, it is only the Gunawardena cognition model that relates this achievement to the degree of collaboration demonstrated.

In considering what model to apply and what modifications might be required, the nature of the student body should also be taken into account. The learning style of participants is one issue that should be considered and 'it is suggested that current research literature in the area of learning styles and strategies can provide instructional designers with insights into differences in learning and performance that can be factored into the design process' (McLoughlin, 1999, p. 223). Research has shown (Klemm and Snell, 1996) that unless discussions are summatively assessed, dialogue will be minimal. It might be asked if instructional designers are merely providing increasingly elegant hoops for learners to jump through.

Summary

The significance of this paper is that it should encourage online teachers to develop more effective teaching techniques by enabling them to evaluate the effects that their own online practices play in students' cognition and metacognition. A summary of the analysis approach for online transcripts can be summarised in there steps, and requires the selection of a content analysis approach that is congruent with the intended learning outcomes and pedagogy of the course of study.

The three stages for analysis are as follows:

1. First, analyse dialogue content at whole message level.
2. Second, allocate a rating according to highest level of thinking evidenced in message (See for example the scheme proposed by McLoughlin & Oliver, 1998).
3. Third, select or modify a content analysis technique that reflects the philosophy of the course in respect of student learning outcomes and pedagogy.

Data analysis and coding of transcripts can then be carried out to determine the forms of thinking and cognitive skills that are embedded in the dialogue.

References

Berge, Z. L., & Collins, M. P. (1995). *Computer mediated communication and the online classroom.* Cresskill, N.J.: Hampton Press.

Biggs, J. B., & Collis, K. E. (1982). *Evaluating the quality of learning: The SOLO taxonomy.* New York: Academic Press.

Campbell, N. (1999). Designing and implementing Computer-Mediated Communication Projects in Schools. In K.-W. Lai (Ed.), *Net-Working: Teaching, Learning & Professional Development with the Internet.* Dunedin: University of Otago Press, 107-141.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a Global Online Debate and the Development of an Interaction Analysis Model for examining Social Construction of Knowledge in Computer Conferencing. *Journal of Educational Computing Research, 17*(4), 397-431.

Hara, N., Bonk, C. J., & Angeli, C. (2000). Content analysis of online discussion in an applied educational psychology course. *Instructional Science, 28*(2), 115-52.

Harasim, L. (1990). *Online Education: Perspectives on a New Environment*. New York: Praeger.

Henri, F. (1992). Computer Conferencing and Content Analysis. In A.R.Kaye (Ed.), *Collaborative Learning Through Computer Conferencing: The Najaden Papers*. 90, 117-136. Berlin: Springer-Verlag.

Jaques, D. (2000). *Learning in groups: A handbook for improving group work*. (3rd ed.) Glasgow: Kogan Page.

Klemm, W. R., & Snell, J. R. (1996). Enriching Computer-Mediated Group Learning by Coupling Constructivism with Collaborative Learning. *Journal of Instructional Science and Technology, 1*(2).

MacKinnon, G. & Aylward, L. (2000). Coding Electronic Discussion Groups. *International Journal of Educational Telecommunications*. 6(1), 53-61.

McLoughlin, C. (1999). The implications of the research literature on learning styles for the design of instructional material. *Australian Journal of Educational Technology*. 15(3), 222-241.

McLoughlin, C. & Luca, J. (1999) Lonely outpourings or reasoned dialogue? An analysis of text-based conferencing as a tool to support learning. In J. Winn (Ed.), *ASCILITE 1999 - Responding to Diversity: Proceedings of the 16th annual conference of the Australasian Society for Computers in Learning in Tertiary Education* (217-228).

McLoughlin, C. & Oliver, R. (1998). Planning a telelearning environment to foster higher order thinking *Distance Education*. 19(2) 242-256.

Mason, R. (1994). *Using Communications Media in Open and Flexible Learning*. London: Kogan Page.

McKenzie, W., & Murphy, D. (2000). "I hope this goes somewhere": Evaluation of an online discussion group. *Australian Journal of Educational Technology, 16*(3), 239-257.

Nastasi, B. K., & Clements, D. H. (1992). Socio-cognitive behaviours and higher order thinking in educational computer environments. *Learning and Instruction, 12*, 215-258.

Sternberg, R. (1985). *Beyond IQ*. Cambridge: Cambridge University Press.

New Directions in Science Teaching Online: Value adding with ICT

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Abstract: Conducting scientific investigations and thinking scientifically are among the most complex intellectual activities that learners can pursue, yet the teaching of science in general has not fully adopted innovative and constructivist approaches to develop these skills. In addition, progress towards the practical, widespread implementation of technology to support constructivist teaching approaches has been limited. Where there is a smaller number of leaders who do embrace newer educational theories and attempt to incorporate research findings in their teaching, there continues to be a substantial gap between educational research and development projects and actual practice in science teaching overall. This paper discusses present barriers to adoption of ICT in science teaching, current thought on how ICT can transform science teaching and how technologies can support the development of scientific understanding.

Overview

A preliminary survey was taken of tertiary teaching staff to seek comments on their use of ICT and its impact on their teaching and their students' learning. Data obtained from first year science teachers in the few Australian universities offering science by distance education, together with the Open University in the United Kingdom and Athabasca University, the open university in Canada, reveals widespread use of ICT but fewer instances of innovative learning designs supported by principled application of technology. This evidence suggests that there may be a dearth of innovative teaching in the sciences us tiling ICT, and that while technology has the potential to play a role in supporting authentic scientific activity in the classroom, there are nevertheless barriers to the adoption and integration of ICT to teach science subjects at a distance. Specifically, while technology an place a greater range of tools and resources at the disposal of teachers and students, and increase the opportunity for social interchange at the heart of authentic science practice, there remain a range of problems to be addressed.

Barriers to ICT adoption in science

The focus of the remainder of this paper is on the teaching of first year university science by distance. Teaching tertiary level science subjects with practical components in the distance education (DE) mode present some particular difficulties and this may be one reason why teaching some science subjects at a distance is still relatively new in Australia. For exampel, simply makign resources available in flexible mode or online and expecting students to learn in neither realistic nor effective. Attention to new pedagogies and curriculum structures is essential to ensuring that technology is integrated with learning. There has been some reporting of teaching science at a distance in the literature, (Rowntree, 1992), (Bennett, 1994), (Druskovich, Klease, Teague, Lyall, & Mayes, 1996), (Hollingworth, 1998), (Kennepohl & Last, 2000).

Difficulties and problems which must be addressed in the teaching of science, include:

- There is a tendency for teachers to opt for 'content coverage" rather than teaching of higher order thinking skills.
- The need to foster understanding of concepts related to thinking processes in science. Hypothesis formation and generation, problem solving, critical thinking are higher order cognitive skills require advanced level teaching skills and use of ICT in innovative ways (Hollingworth & McLoughlin, 2000).

- Teachers need to focus on development of metacognitive awareness of students' own learning and their skills of reflection. At first year level many science students are at Perry's *basic dualism* stage of development (Perry, 1970).

Some further difficulties which must be addressed in online and distance delivery of science are:

- The need to provide adequate practical experience in the distance mode. This includes the physical difficulties of providing convenient laboratory facilities and timing difficulties, if it is desired to give a parallel presentation of theory and practical.
- The need to provide students with opportunities for social discourse with peers and lecturers in which knowledge of science concepts is constructed and more generic communication skills are developed.

These problems and others restrict the usefulness of educational technology in distance learning contexts. Other issues may be lack of teacher expertise with computers, issues of access and uptake and funding pressures that restrict innovative applications.

Current & future practice in science teaching at a distance

The average ratings on statements in the survey about the impact of ICT on lecturers' approach to teaching and their students' approach to learning are given in Table 1. Ratings were based on a 5 point Likert scale ranging from 1 = Strongly disagree to 5 = Strongly agree. Not all respondents were involved in both on campus and off-campus teaching, so some statements were not applicable to them.

ICT has impacted on:	Rating (Out of 5)
my approach to teaching on campus students	4.25
my approach to teaching off campus students	3.8
my on campus students' approach to their learning.	3.25
my off campus students' approach to their learning.	3.2
the way I support my on campus students' learning.	3.75
the way I support my off-campus students' learning.	3.8
The two modes of teaching are converging.	4.3

Table 1: Rating of impact of ICT on science teaching and learning

The most significant points to note from Table 1 are that strongest agreements are on the impact of ICT on campus teaching and on the convergence of the on campus and off-campus modes of teaching. The lack of impact of ICT on distance teaching may be due to the fact that off-campus students do not have as ready access to computer facilities as on campus students, and that print materials tend to dominate. One respondent commented: *"We have continuous competition between exploring new technologies to improve delivery versus staying with low technology to make the course materials universally accessible."* Convergence of on campus and off-campus teaching may be because of the contraction of staff numbers in science departments around Australia, there has been pressure to rationalise the teaching of on campus and off-campus students as much as possible. In addition, the availability of the Internet means that more and more of the learning resources being developed are as readily accessible to off-campus students as on campus, increasing convergence between the two modes of delivery.

Current practices in science teaching in distance learning contexts and the implementation of ICT may be evaluated with respect to a number of relevant criteria. Essentially, constructivist learning with technology should enable students to develop skill in designing and constructing new knowledge (Jonassen & Peck, 1999). Best educational practice would explicitly aim to enhance these skills. We discuss current practice and use of ICT under three main headings in the following.

Communicating and constructing new knowledge

Survey quotes: "Communications with off campus students is the major change." "Off campus students are sometimes reluctant to use discussion groups, but it is improving."

The survey showed asynchronous communication tools such as e-mail, bulletin boards, telephone conferencing and voicemail are in common use. The number of DE students having access to Internet facilities has increased markedly in the last five years from about 20% to 80%. Some lecturers have noted a reluctance on the part of students to participate in on-line forums, etc. experience in other areas shows this could be overcome in part by making participation assessable, (Fox, Herrmann, & Taylor, 1999) but there are still equity issues to be faced before making use of these avenues for communication mandatory. In the authors' experience reluctance to participate in discussion may be greater with first year science students, because they may have had limited previous experience in this. More mature students in DE units are often willing to participate. Few guidelines exist on how skills in communicating in the sciences are best developed online, but it certain that more attention needs to be given to supporting learning online (McLoughlin, Winnips & Oliver, 2000). Online teaching can improve the level of conversation beyond that of content transmission by allowing students to enter into dialogue with their peers and lecturers. This is in contrast to the more traditional transmissive style of pedagogy often encountered by on campus students in lectures.

Learning complex concepts

Survey quotes: *"Methods used in teaching DE, which require a more careful analysis of the way we teach, are useful when it comes to teaching on campus."*

"More supplementary resources are being built up (e.g. web pages in science). When enough of our students have access to technologies to make use of these, the materials will be become required."

The understanding of science requires an ability to operate and move between three levels, the microscopic, the macroscopic and the symbolic (Johnstone, 1991). Chemists have long been at the forefront of developments in computer visualisation, because of their need to visualise molecules and chemical processes, which cannot be seen directly. There are many examples of multimedia materials now being produced to address these problems (Tasker, 1998), (Russell et al., 1997). Example applications readily accessible on the Internet include Chime molecular visualisation plug-in program (MDL, 2001) and a range of science Java applets modelling chemical processes (Gargus, 1999). CD ROMs and CAL packages are also now available from many of the large publishing houses to assist students' understanding of chemical concepts (Kotz & Vining, 1999).

Numerous attributes of multimedia learning materials involving computer simulations, which are beneficial to learning, have been identified from recent literature (Gaddis & Anderson, 2000). They provide feedback to enhance conceptual understanding; provide dynamic animations to emphasize the molecular level of chemical reactions; permit students to generate and test hypotheses; engage students with high level of interactivity; present a simplified version of reality by distilling abstract concepts into their most important elements, making abstract concepts more concrete; standardize instructional pedagogy, teaching, and content across multiple topic areas. Reports in the literature tend to highlight the technology, but the pedagogical benefits of computer simulations are the ingredients that make them such a valuable learning tool. "It is the pedagogy, not the technology that counts" (Cottman, 1997). Participation in collaborative assignments can increase student motivation, which then leads to increases in both active participation and the quality of learning. According to Hilz et al (Hiltz, Coppola, Rotter, & Turoff, 2000)" when students are actively involved in collaborative (group) learning on-line, the outcomes can be as good or better than those of traditional classes, but when individuals are simply receiving posted material and sending back individual work, the results are poorer than in the traditional classrooms."

Experiential learning

Survey quotes: *"We use computer lab simulations (digitized stop-action video) to prepare students for in-lab work. .... the simulation students did slightly better on the in-lab quiz which tests for practical in-lab knowledge."*

Providing a convenient laboratory experience of sufficient quality is one of the major difficulties to be faced in teaching practical science subjects by distance education. This is a major reason for the reluctance of science educators to provide DE courses of study. In science some use has been made of microscale or full-scale kits, which allow experiments to be done in the home (Kennepohl, 1996) (Bennett, 1994) (Druskovich et al., 1996). Efforts have been made to produce low cost, low maintenance equipment (Hodges, Pillekers, & Hodges, 1991). In practice, students usually either attend short residential schools for concentrated practical experience or attend designated labs over the semester.

ICT can play a role in laboratory work through programs to collect and analyse data and increasingly through computer control of instruments, but at first year level, this is not yet very important. More significantly, with respect to teaching and learning, a range of simulations of simple experiments and instrument simulator software are now available on CD ROM and on-line and may provide a pedagogically sound DE laboratory component (Cartwright, 2000). The benefits of computer simulations are numerous: they can replace experiments that use hazardous materials; reduce cost; replace experiments that occur too quickly or too slowly to be done in a regular laboratory period; reduce cognitive noise, so that students can concentrate on the concepts involved in the experiments; allow rapid data collection; serve as pre-laboratory preparation to aid understanding of the lab. "In fact, computer simulations may provide a more cognitively meaningful laboratory experience than an on-campus laboratory class" (Gaddis, 2000).

Remote controlled labs are starting to become available on-line, for example CNC machines in engineering (Wong, Ferguson, Florance, Bantwal, & Jones, 1999) and the Scanning Probe Microscope. (IN-VSEE, 2000) The availability, variety and sophistication of such labs is expected to increase rapidly in the next few years and will bring the lab experience of DE students much closer to that of on-campus students. Such on-line labs will in the future provide the opportunity to perform experiments which have never before been possible for first year students at all. The distinct benefits of computer mediated collaborative learning tasks have been well documented (Saltiel, 1998). As an example in science, a virtual organic science lab, where on campus students worked collaboratively, produced significantly increased understanding in students. (Gaddis & Anderson, 2000)

Self-monitoring and metacognitive skills

In science subjects there is a great emphasis on content to the point that often this leads to surface approaches to learning as a coping skill by students. Science teachers may feel little inclination to include more generic skills as a part of their teaching. Studies show that interventions which improve strategy use, develop metacognitive awareness and skills and increase student skills of reflection can be very beneficial to students (Pressley & Wharton-McDonald, 1997). It is time to give more consideration to these factors as on-line learning resources are developed. As an example of an innovative ICT project, an on-line tutorial, metAHEAD, develop metacognitive awareness and to strengthen the metacognitive skills of first year science students. It provides students with ample opportunity for personal reflection and for reflective social discourse on their metacognitive and problem solving skills (Hollingworth & McLoughlin, 2001).

Summary

Table 2 summarises the current use and possible future directions for ICT in science education. It is evident that multimedia resources offer opportunities far superior to print materials for visualisation of chemical concepts. They can provide opportunities to explore chemical concepts and processes in more depth, to repeat simulations, to change variables in different scenarios, all leading to deeper understanding. Such materials have usually been professionally designed, often at very high cost by teams of professionals with a breadth of skills.

Technique	Current Use	Future Directions
CD ROM, multimedia materials	Widespread use. Publishing company packages with texts provide ease of distribution. Limitation is student access to computer facilities.	Will increase. More attention needs to be given to pedagogical aspects of the use of materials for the most effective learning.
Computer programs for concepts, theory	In general use. Some problems in distribution of individual applications to students.	Increasing numbers of applications of greater sophistication will be available to all on Internet.
Computer programs for laboratory	Limited usage. Pre-labs, data gathering & analysis, some CAL sessions.	Major educational benefits in development of simulated labs, on-line labs, collaborative labs at a distance
On-line unit	Some availability. Limitation is student access to computer facilities.	Increasing availability and range of learning resources and increasing student access.
On-line collaborative tasks	Assessment still presents a barrier to change	Essential area to increase for improved quality of DE experience.
Other web based activities	Some use, eg library & research projects	Need to increase student information gathering skills in Internet era.
email listserver	In general use mainly as a communication tool.	More use as an additional learning tool
Bulletin board	Some use, not compulsory.	More use as a collaborative learning tool
Telephone conferencing, Voicemail	Some use.	Will be overtaken by applications on Internet
Audio/Video cassettes	In general use	Will probably phase out as Internet bandwidth increases

As many have pointed out implementation of ICT in teaching and learning does not usually involve cost savings. In these times of financial stringencies it must also be noted that, to assure quality online courses, selection, support and development of faculty teaching skills are critical (Sener & Stover, 2000).

References

Bennett, S. (1994). Experimental work and distance learning. *International Newsletter on Chemical Education, 41*, 10-13.

Cartwright, H. (2000). Why should on-line experiments form part of university science courses? *CAL-laborate, 2000*(October), 6-9.

Cottman, C. (1997). *It is the pedagogy that counts, not the technology that counts.* Paper presented at the 13th Biennial Forum of Open and Distance Learning Association of Australia. Open, Flexible and Distance Learning: Education and Training in the 21st Century, Launce ton.

Druskovich, D. M., Klease, G. T., Teague, M., Lyall, R., & Mayes, R. (1996). Challenge 95: To develop tertiary level science at a distance and on a budget. In C. L. Fogliani (Ed.), *Australian Science Resource Book* (Vol. 15, pp. 178-186). Bathurst: Charles Sturt University.

Fox, R., Herrmann, A., & Taylor, P. (1999). *Multiple ways of knowing in teaching a science and mathematics web-based course.* Paper presented at the 14th Biennial Forum of the Open and Distance Learning Association of Australia. Open, Flexible and Distance Learning: Challenges of the New Millennium, Geelong.

Gaddis, B. (2000). *Learning in a virtual lab: Distance education and computer simulations.* Available: http://web.uccs.edu/bgaddis/leadership/topicfocus3D1.htm [2001, 30 March].

Gaddis, B., & Anderson, D. (2000). *Conceptual change in science through collaboration at the computer.* Paper presented at the American Educational Communication and Technology Conference, Denver, Colorado

Gargus, D. (1999). *Java Science Links*. 2Learn NetSteps. Available: http://www.2learn.ca/currlinks/2teach/netsteps/JavaChem.html [2001, 30 March].

Hiltz, S. R., Coppola, N., Rotter, N., & Turoff, M. (2000). Measuring the importance of collaboraive learning for the effectiveness of ALN: A multi-measure, multi-method approach. *Journal of Asynchronous Learning Networks, 4*(2).

Hodges, A. J., Pillekers, H. A., & Hodges, R. J. (1991). *Practical work in modern chemical analysis by distance education.* Paper presented at the 14th Biennial Forum of the Open and Distance Learning Association of Australia. Open, Flexible and Distance Learning: Challenges of the New Millennium, Geelong.

Hollingworth, R. W. (1998). *Science 123: A foundation level course for off-campus students.* Paper presented at the Bridging the Gap, RACI Chemical Education Division, 1998 National Conference, Rockhampton.

Hollingworth, R. W., & McLoughlin, C. (2001). Developing science students' metacognitive problem-solving skills online. *Australian Journal of Educational Technology, 17*, 1, 23

IN-VSEE. (2000). *IN-VSEE.* Available: http://invsee.asu.edu/Invsee/invsee.htm [2001, 30 March].

Johnstone, A. H. (1991). Why is science difficult to learn? Things are seldom what they seem. *Journal of Computer Assisted Learning, 7*, 75.

Jonassen, D., & Peck, L. (1999). *Learning with technology.* Upper Saddle River, New Jersey: Merrill.

Kennepohl, D. (1996). Home-study microlabs. *Journal of Chemical Education, 73*, 938-939.

Kennepohl, D., & Last, A. M. (2000). Teaching Science at Canada's Open University. *Distance Education, 21*(1), 183-197.

Kotz, J. C., & Vining, W. J. (1999). Saunders Interactive General Science CD-ROM (Version 2.5). Fort Worth: Saunders College Publishing.

MDL. (2001). Chime Plug In (Version 2.6): MDL Information Systems.

McLoughlin, C., Winnips, K., & Oliver, R. (2000). Supporting constructivist learning through learner support online. In J. Bourdeau & R. Heller (Eds.), *Ed Media-Ed Telecom World Conference on Educational Multimedia and Hypermedia* (pp. 638-644). Charlottesville, VA: AACE.

Perry, W. G. (1970). *Forms of intellectual and ethical development in college years*. New York: Holt, Rinehart and Winston.

Pressley, M., & Wharton-McDonald, R. (1997). Skilled comprehension and its development through instruction. *School Psychology Review, 26*, 448-466.

Rowntree, D. (1992). *Exploring Open and Distance Learning*. London, UK: Kogan Page.

Russell, J. W., Kozma, R. B., Jones, T., Wykoff, J., Marx, N., & Davis, J. (1997). Use of simultaneous-synchronized macroscopic, microscopic, and symbolic representations to enhance the teaching and learning of chemical concepts. *Journal of Chemical Education, 74*(3), 330-338.

Saltiel, I. M. (1998). Defining collaborative partnerships. *New Directios for Adult and Continuing Education, 79*, 5-11.

Sener, J., & Stover, M. L. (2000). Integrating ALN into an independent study distance education program: NVCC case studies. *Journal of Asynchronous Learning Networks, 4*(2).

Tasker, R. (1998). The VisChem Project: Molecular level animations in science - potential and caution. *UniServe Science News, 9*(March), 12-16.

Wong, K. K., Ferguson, C., Florance, J., Bantwal, B., & Jones, T. (1999). *Flexible delivery of practical learning experience through the Internet: The remotely operated CNC machine teaching project.* Paper presented at the 14th Biennial Forum of the Open and Distance Learning Association of Australia. Open, Flexible and Distance Learning: Challenges of the New Millennium, Geelong.

Self-moderation: Is it a useful strategy to encourage online collaboration?

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Abstract: A great deal of research has been conducted on the roles of online moderators and on support structures needed for successful online collaboration and productive learning. While some research indicates the need for highly structured environments with facilitation and tutor support, this case study suggests that by utilising well designed inquiry oriented tasks, students learn to self-direct their own activities. In the study presented here, the assessment of the task increased student motivation and task based interactions indicated that supportive feedback and social exchange was a characteristic feature of successful task engagement.

Introduction

On-line forums provide opportunity and potential for collaborative work, dialogue and study that can increase the flexibility of learning while motivating participants. By enabling teacher-learner and learner-learner dialogue computer-based course systems can support the essential elements of a learning conversation by providing scope for discussion, interaction, dialogue and reflection (Laurillard, 1995). Clearly, the opportunities for learner-centered activity, flexible access and asynchronous discussion creates new opportunities for adult learners and scope for self-direction and inquiry based learning.

Instructional designers and teachers alike must confront an envision the need for learner-centered pedagogies and provide opportunities for learners to have control over their own learning (Doherty, 1998). According to Hannafin & Land (1997) open-ended learning environments provide opportunities for self-regulated learning, collaboration learner driven inquiry and exploration. Instead of providing direct instruction, the teacher will foster expectations for increased learner control and knowledge generation. This study takes as its starting point the need for self-directed learning and provides an example of how a task focused environment online provides opportunities for learner self-direction.

Study Context

Computers in Teaching and Learning is a one semester unit that forms part of the Bachelor of Education and Master of Education programmes at the University of New England. It is offered online via the Distance Education mode using WebCT software. In this unit, students explore the use and integration into classrooms of a variety of software tools such as word processors, spreadsheets, databases, drawing and paint programs, multimedia and the Internet. To help achieve the objectives of the unit a number of compulsory learning activities and associated assessment items were designed around the online tools provided by the WebCT environment. These online activities contributed 80% of the final grade for the unit. The remaining 20% was allocated to a paper based assessment task.

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Table 1 provides a description of the online assessment tasks and their associated WebCT tools.

Assessment Task	Online tool	Weighting
Introductory posting	Bulletin Board	5%
Online summaries & discussions	Bulletin Board	5%
Group WebQuest	Bulletin Board, Assignment drop box	20%
Individual WebQuest	Student homepage	30%

Table 1: Summary of Online Assessment Tasks

Assessment tasks were designed to provide students with a range of online experiences from interacting on bulletin boards to working collaboratively online. These tasks also modelled for students the potential of the online environment as learning and teaching tool. As a consequence, the experience of completing the assessment tasks helped achieve the unit's objectives as much as the completed tasks.

Research Questions

The purpose of this study was to determine that to what degree students would moderate themselves if provided with a task with very little organisational structure. Berge (1995) has identified four roles of e-moderators and classified them as: Pedagogical, Social, Managerial and Technical. These roles as used as the basis of classification for the current study. In particular the following questions were to be investigated:

- If a task is structured to encourage self moderation is there evidence of any of these roles being dominant over the others?
- Would any increased responsibility required for self moderation interfere with the successful completion of the task?
- Is there any educational advantage for structuring a task to encourage self moderation?

Group WebQuest Activity

The assessment task forming the focus of this study was a group WebQuest activity.
Dodge (1995) describes a WebQuest as "an inquiry-oriented activity in which some orall of the information that learners interact with comes from resources on the Internet". The fundamental idea behind WebQuests is that they are designed to prevent students from aimlessly surfing on the Internet. A well designed WebQuest will help give students structure and guidance as they use the Internet as a tool to support their own knowledge construction. For the group WebQuest activity, students were expected to complete a WebQuest about WebQuests Figure 1. shows the introductory page for the WebQuest activity. This task involved students being placed in groups of four (except one group which was reduced to two members shortly before the task started) and each adopting one of four possible and evaluating the WebQuest using the criteria associated with each particular role.

These roles were:

Efficiency expert:	Does the WebQuest keep students on task?
The Affiliator :	Does the WebQuest encourage collaboration?
The Altitudinist:	Does the WebQuest encourage higher order thinking?
The Technophile:	Does the WebQuest make the best possible use of the available technology?

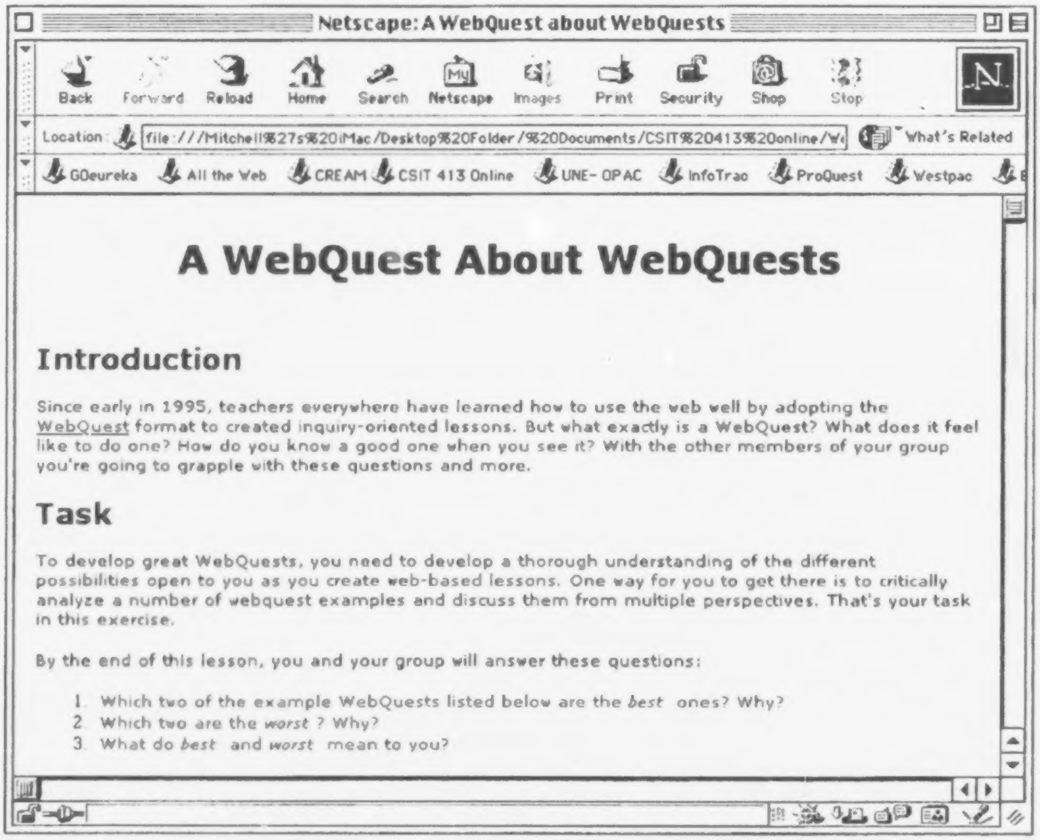
The individual component of this assessment task involved evaluations being done by the students within their selected roles. The collaborative activity involved students negotiating with each other via the bulletin board tool to answer the following questions:

1. Which two of the example WebQuests listed were the best? Why?

2. Which two were the worst? Why?
3 What criteria were used to base the group decisions upon?

The lecturer gave no guidance or direct assistance on how to complete this activity. Students were expected to organise themselves in order to successfully complete the task. This include setting up deadlines for individual submissions, providing advice, feedback and encouragement to each other and developing selection criteria to identify the best and worst WebQuests.

Once completed, students had to submit their tasks via e-mail. This submission included each student's individual evaluations and the collective evaluations from the group. Marking was based upon a combination of the individual and collaborative activities. The educational objective of this task was to provide students with the opportunity to observe how the concept of a WebQuest worked from a participant's point of view while at the same time, gain some exposure as to what constituted an effective WebQuest. Figure 1 shows a screen dump of the activity.


Netscape: A WebQuest about WebQuests
Back
Forward
Reload
Home
Search
Netscape
Images
Print
Security
Shop
Stop
N
Location: file:///Mitchell%27s%20iMac/Desktop%20Folder/%20Documents/CSIT%20413%20online/W
What's Related
GOeureka
All the Web
CREAM
CSIT 413 Online
UNE-OPAC
InfoTrac
ProQuest
Westpac

A WebQuest About WebQuests

Introduction

Since early in 1995, teachers everywhere have learned how to use the web well by adopting the WebQuest format to created inquiry-oriented lessons. But what exactly is a WebQuest? What does it feel like to do one? How do you know a good one when you see it? With the other members of your group you're going to grapple with these questions and more.

Task

To develop great WebQuests, you need to develop a thorough understanding of the different possibilities open to you as you create web-based lessons. One way for you to get there is to critically analyze a number of webquest examples and discuss them from multiple perspectives. That's your task in this exercise.

By the end of this lesson, you and your group will answer these questions:

1. Which two of the example WebQuests listed below are the *best* ones? Why?
2. Which two are the *worst* ? Why?
3. What do *best* and *worst* mean to you?

Methodology

Description of Coding System
Berge (1995) has identified four broad roles that e-moderators play in an online environment. These are: pedagogical, social, managerial and technical. Bulletin Board posts from students in the Group WebQuest assessment task were analysed and classified according to these categories. Decisions were based on the following criteria:

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- **Pedagogical**: Posts were classified as pedagogical if the majority of the post was directly related to the assessment task.
- **Social**: These posts involved interaction primarily at the social level for example: "How is the weather where you are?"
- **Managerial**: Posts that contained organisational information for instance setting up posting times or deadlines.
- **Technical:** Posts that contained advice at the hardware or software level. An example would be instructions on how to upload an attached file.

Once coded, the number of each type and the number of words per post was recorded. From this data the average words per post was calculated.

Results

Table 2 shows the number of messages classified by role and the percentage of each to the total number of messages posted (n = 306). The results indicate that the largest number of posts to the WebQuest forum were managerial in nature. Posts centred on discussion of the actual activity (Pedagogical) were the second highest, followed by social and technical respectively.

Type of Role	Number of posts	Percentage of posts
Pedagogical	89	29%
Social	86	28%
Managerial	95	28%
Technical	36	12%
Total	306	100%

Table 2 Posts Classified According to Roles

Table 3 provides the total number of words posted for each category and the average number of words per post. Posts classified as Pedagogical were on the average the longest messages (average = 96 words per post). Post classified as Managerial and Technical followed next, with posts classified as social in nature being the shortest messages on average.

Type of Role	Number of posts	Percentage of total
Pedagogical	8535	96
Social	1611	19
Managerial	3618	19
Technical	1188	33
Total	149952	100

Table 3: Total Words and Average Words per Post

Discussion

Due to the activity being largely student directed, it is probably not surprising that the highest number of posts were classified as managerial in nature (n = 95, 31% of total). Students had to spend time as a group organising themselves in order to complete the collaborative activities. However in terms of actual word length, managerial orientated posts did not dominate the discussions with the average length of each post being 38 words. Students were able to set up an organisational structure that did not appear to interfere with the educational objectives of the task. In fact, as a consequence of organising themselves, students may have been more motivated towards the task they had to undertake.

Posts classified as being pedagogical in nature were the second most extensive type of post in numerical terms. However, the average length of these posts far exceeded any other category (96 words per post on average). This suggests students were deeply engaged in the process of collaborating with each other in the construction of new knowledge.

Implications of the study

Despite a large percentage of social posts (n = 86, 28% of total), these were relatively short (19 words on average) and consisted of mainly short social exchanges or pleasantries. Nipper (1989) expressed concern that the process of social interaction online may overshadow its educational focus. However, in this instance, this appears not to be the case. These social exchanges in the group WebQuest activity appeared to form a "social glue" helping support group cohesiveness. Berge (1995:22) believes these types of exchanges are necessary for the creation of an environment that will "promote high quality and individual and social interaction for the student during the construction of knowledge".

There were relatively few posts that were technical in nature (n = 36, 12% of total). The unit had been in progress for several weeks before this activity so it appears that students had been given the opportunity of becoming familiar with using the WebCT software. The exchanges were also relatively short in nature (33 words per post on average) so it is unlikely that technical aspects had any major impact upon the collaborative activities and the shared construction of knowledge amongst students.

Conclusion

According to (Ragoonaden & Bordeleau 2000:368)

> the success of collaboration via the internet lies in the design of virtual courses and in the embedded pedagogical model. The collaborative process has to be an integral part of the course framework and activities based upon constructivist approach. In this manner, students are compelled to communicate and to work with distant partners in order to construct new knowledge.

Such was the case for the WebQuest activity. The deliberate lack of lecturer direction forced students into having to take on many of the multi-faceted roles of e-moderators individually. It can be argued, that as a consequence of this expanded role, students were more than simply participants but rather organisers of the activity. This led to deeper levels of engagement in the task at hand. By being given the opportunity of being able to take on the roles generally associated with e-moderators actually enhanced the students' ability to communicate and work with others on the successful completion of the group WebQuest activity.

References

Berge, Z. (1995). Facilitating Computer Conferencing: Recommendations from the Field, Educational Technology, vol 35, no.1, pp 22-30.

Dodge B. (1995) (Accessed 29th November 2001) *Some Thoughts About WebQuests*, accessed online http://edweb.sdsu.edu/courses/edtec596/about_webquests.html

Doherty, P. B. (1998) Learner control in asynchronous learning environments. *Asynchronous learning networks magazine*, vol 2, 1-11.

Nipper, S. (1989) Third Generation Distance learning and Computer Conferencing in R Mason and A. Kaye (eds), Mindwaeve: Communication, Computers and Distance Education, Oxford: Pergamon Press, pp 63 - 73.

Dodge, B. (1995) (Accessed 29 th November 2001) *Some Thoughts About WebQuests*, accessed online http://edweb.sdsu.edu/courses/edtec596/about_webquests.html

Hannafin, M.J., & Land S.M. (1997)The foundations and assumptions of technology enhanced student centered learning environments. *Instructional Science*, 25, 167-202

Laurillard, D. (1995). Multimedia and the changing experience of the learner. *British Journal of Educational Technology*, *26*(3), 179-189.

McLoughlin, C., & Oliver, R. (1998). Maximising the language and learning link in computer learning environments. *British Journal of Educational Technology*, *29*(2), 125-136.

Ragoonaden, K. & Bordeleau, P. (2000). Collaborative Learning via the Internet, *Educational Technology and Society* 3(3),
http://ifets.ieee.org/periodical/vol_3_2000/d11.pdf

Scaffolding the Development of Students' Cognitive Self-Regulatory Skills

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Abstract: Increasingly, universities are being asked by industry, government and funding authorities to help prepare students for industry with appropriate professional and life long learning skills. How can tertiary educators design and implement learning activities to help promote the development of these skills? In this paper we investigate a method of scaffolding the development of these skills through a conceptual framework based on self-regulated learning. This framework is applied to a third year higher education learning environment, and supported with a variety of on-line tools to scaffold students learning. These include an on-line validated professional skills testing instrument, an on-line self and peer assessment journals which are consolidated into streamlined reports for the tutor, and on-line student contracts, designed to encourage commitment and strategy formation early in the semester. Each of these are discussed, and also pre and post testing results are shown for a validated testing instrument, given to students to identify their strengths and weaknesses.

Introduction

With the rapid growth of Interactive technologies and on-line learning, there is a consistent demand for graduating students to have life long learning skills that enable learners' to continually upgrade their skills and knowledge through their own self-motivation and learning skills (Bennett, Dunne, & Carre, 1999; Candy, Crebert, & O'Leary, 1994; Dearing, 1997). An important aspect for achieving this goal is to help students take more responsibility for managing their own learning by helping them become more strategic learners. Biggs (1999) argues that there are certain limits to what certain students can achieve, and these are beyond the teacher's control. However many claim that such skills *can* be taught, that while they may be developmentally based, the fostering of general skills still requires proactive involvement and strategy forming (Zimmerman, 1989). The challenge for educators then is to find teaching and learning methods that can support the generation of life long learning skills that are relevant to a wide variety of professional contexts.

This paper will discuss three specific techniques that are used both to assess and enhance students' abilities to create life long professional and learning strategies. These strategies are framed within a theoretical model of self-regulation that identifies the psychological states, processes and outcomes that are inherent in independent learning. The aim of this study was to implement strategies that could be used within each of these levels to support the development of these skills.

A Definition of Self Regulation

Self-regulation is somewhat easier to define than understand. It has been described as 'the process whereby students activate and sustain cognitions, behaviours, and affects, which are systematically oriented toward attainment of their goals' (Schunk & Zimmerman, 1994, cited by Boekarts, 1997, p. 171). This definition is reinforced by Brooks (1997), who argues that that it is active and goal directed, resulting from self control of behaviour motivation and cognition. This emphasis on multiple constructs places Self-regulated Learning at the junction of several fields of research (Boekaerts, 1997). It emphasises students' reliance on their own internal resources to govern their learning, but these resources are not easy to delineate. Self regulated behaviour is an end process, dependent upon the affects and cognitions that precede it. These are to a certain extent inaccessible, since they are internally constructed and not always explicitly articulated by individuals.

Also, the notion of self-regulation is prone to multiple interpretations based upon educational philosophy. Zimmerman (1989) identifies it in terms of Phenomenological, Social Cognitive, Volitional, Vygotskian and Cognitive Constructivist Theories. All of these approaches bring a unique framework to the concept. Behaviourist approaches emphasise self-monitoring, self-instruction and self-reinforcement, while a phenomenological approach defines it in dimensions such as self worth, planning, and goal setting. Common to most of these however, is an acknowledgment of the interaction of affective and cognitive processes at a level of abstraction. Self awareness at a cognitive and emotional level appears to be the key process in the development of self-regulatory strategies.

A model of Self Regulation

A number of models have been developed to explain the processes that underpin Self-Regulated Learning. (Boekaerts, 1997) provides a six component model based upon the notions relating to cognition, metacognition, content and motivation.

These elements are co-dependent and interact with each other in the application and development of goals, strategies and domain-specific knowledge. Garcia & Pintrich (1994) articulate self-regulation in terms of knowledge and beliefs, strategies used, and outcomes. Each of these is moderated by motivational and cognitive components such as personal beliefs and conceptual knowledge, motivational and cognitive strategies, and quantity and quality of effort. Common to both models is an integration of both affective and cognitive issues:

> "*Neither motivational nor cognitive models alone can fully describe the various aspects of student academic learning, yet the two types of models are complementary due to the respective strengths and weaknesses of motivational and cognitive models.*" (Garcia & Pintrich, 1994, p. 127)

Figure 1 represents a synthesis of the above frameworks. It accommodates the role of both affective and cognitive aspects of self regulation, but also acknowledges the effects of external environmental factors upon an individual's ability to regulate their learning. Self regulation is viewed here as the intersection of self awareness at both a rational and emotional level. Metacognition and self concept are seen as the primary enabling process in this model, with self monitoring and motivation as subordinate processes which are involved in the development of cognitive and motivational strategies.

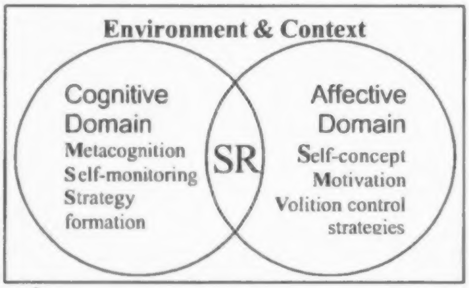

Figure 1: Conceptual Framework

Enhancing Cognitive Self-Regulation Through Scaffolding

There is a large body of work which examines ways in which the affective components of self-regulation can be targeted to increase students' motivation and persistence in their learning. Emotional factors are generally seen to be more accessible and amenable to change than the cognitive aspects. In fact, the two are not unrelated. Corno (1986), for example, argues for metacognition as the dominant controlling process; that "affect is the subjective perception of emotional states; thus associated attempts to control negative affect fall within the domain of metacognitive control" (p. 334). However, the focus of this paper is on the specific knowledge that students have about their abilities and the cognitive strategies they use rather than the subjective values which they attribute to themselves and their abilities.

The primary enabling state for cognitive self-regulation, Metacognition is a concept that this fraught with contention. Some have argued that it is an inherent psychological state that cannot be changed, although this view has come under increasing criticism. There is a growing consensus for example, that Metacognition is only mildly correlated with unalterable measures of ability such as IQ (Schraw, 1986). Recent theorists are starting to examine the construct of Metacognition from social and environmental perspectives. Rather than being developmentally fixed, the acquisition of Metacognition may be subject to instructional intervention (Boekaerts, 1997)

This, however, doesn't solve a major problem, which is how to design instruction that will actually enhance students' ability to regulate their learning. Does it come through modelling regulatory strategies, having students monitor their performance, or by attempting to raise general metacognitive awareness? This paper argues a process of scaffolding that may be implemented at each of the three cognitive levels of Metacognition, Self-Monitoring, and Strategy formation (Figure 1). At the broadest level, students need to be placed in the mode of reflecting on their own cognitive abilities. This may be general in nature, but can be enhanced through the use of self-monitoring. Also, cognitive strategies for regulation need to be enacted in a purposeful and structured way. This is not going to happen automatically; the role of scaffolding is to support the learner's transition from dependent learner to self-regulating learner.

Scaffolds are forms of learning support provided to bridge the gap between existing skills and potential skills. Central to the notion of scaffolding is Vygotsky's Zone of Proximal Development (Vygotsky, 1978), which can be seen as space between the level of actual achievement and the level of achievement possible with assistance. Just as physical scaffolding provides an framework during early phases of building, instructional scaffolds act as initial support which is gradually removed as the learner becomes more independent. Scaffolding can take many forms. Winnips & McLoughlan (2001), for example, propose video commentary, providing Web links, and linking to good examples of student work among others; but such scaffolds can exist within the following broader macro strategies proposed by Hogan & Pressley (1997):

- Pre-engagement
- Establishing a shared goal
- Actively diagnosing the understandings and needs of learners
- Providing tailored assistance
- Maintaining pursuit of a goal
- Giving feedback
- Controlling frustration of risk
- Assisting internalisation, independence, and generalization to other contexts

While many of these strategies are targeting the affective rather than rational components of self-regulation (for example 'controlling frustration and risk'), they still provide a useful heuristic in developing scaffolds to support the constructs of Metacognition, Self-Monitoring, and Strategy Development shown in Figure 1.

Scaffolds for Metacognition

Metacognition is self awareness at a global level, and exists independently from a specific context. Scaffolding for Metacognition, then, must be done at a level that can exist outside a particular knowledge domain. This may exist as explicit instruction, though the internalisation of such abstract concepts may be somewhat challenging. In this case, Metacognition was stimulated through the use of the WORKING assessment instrument (Miles & Grummon, 1996). The WORKING inventory is a self-assessment package for workplace skills, designed to help students understand what skills employers require, and how they rate against these. These skills are generally quite different to the regular academic and technical competencies students are normally tested for. They include the following nine skills: taking responsibility, working in teams, persisting, a sense of quality, life-long learning, adapting to change, problem solving, information processing and systems thinking.

The inventory does not just provide a tool to diagnose the understandings and needs of learners, but also acts as a means of giving customised feedback to the learners and is a vital tool to assist with learners' pre-engagement. In stimulating their perceptions of their own working abilities, the WORKING inventory works both to assess and assist in the development of Metacognition. The instrument was used in semester 1, 2001 with a class of ninety final year multimedia tertiary students studying project management methodology. It was given at the beginning and end of semester and showed an overall increase of 13% across the nine scales.

	Being Responsible	Team Skills	Persisting	A sense of Quality	Life Long Learning	Adapting to Change	Problem Solving	Info Processing	Systems Thinking	Total
Pre	52	49	44	48	51	56	49	52	59	170
Post	67	69	68	64	66	65	74	77	76	192

Table 1: Pre/Post WORKING Results

Feedback was given to each student, based on their overall scores. For example, "Level 1: Beginning ABE Literacy" is explained as: "*Has few or no effective workplace habits and skills; likely to lack a well-developed sense of flexibility, persistence, and quality; poor at problem-solving and learning. May have a low sense of responsibility*". Students were also given tailored feedback on each scale, which allowed them to target specific weaknesses, by trying to develop strategies to enhance these skills over the semester, supported with tutor help.

Scaffolds for Self-Monitoring

Weinstein & Mayer (1986) argue that all metacognitive activities incorporate to some extent the monitoring of comprehension, and all models of self-regulation, from behaviourist to social-cognitive involve self-monitoring as the core metacognitive process, whether described in terms such as self-monitoring, self-observation, or inner speech (Zimmerman, 1989). Self-monitoring strategies may involve tracking of attention while reading a text or listening to a lecture, self-testing through the use of questions about text material to check for understanding, monitoring comprehension of a lecture, use of test taking strategies (eg timing questions) in an exam situation (Garcia, 1994). Core to all of these however is the evidence of a reflective process on the part of the learner. One method of encouraging self-monitoring is to use the strategy of journaling. Journaling has been identified as a useful tool to increase self-awareness (Brooks, 1997) and is an ideal scaffold in that it assists the internalisation of new understandings as well as the setting of goals and monitoring of their achievement.

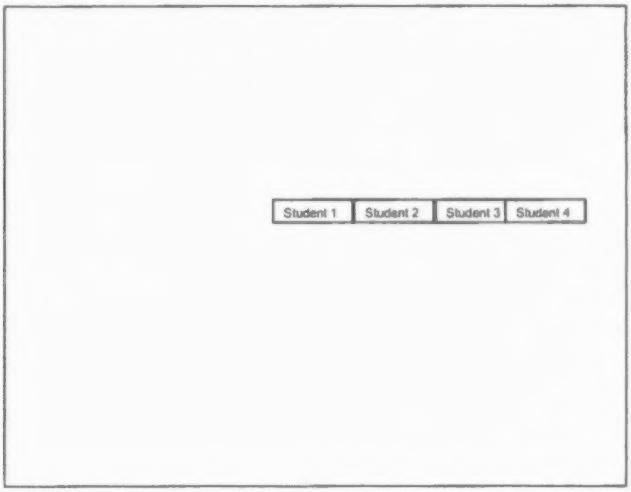

Figure 2: On-line journal for weekly peer assessments

In this study, students completed self and peer assessment journals each week through an on-line application. They completed self-assessment journals in which personal views of their progress were recorded. Here, students considered their success in finishing assigned tasks (scale from 1 to 5), the quality achieved (scale from 1 to 5), how successful they had been in managing their time (scale from –2 to +2), and comments justifying these scores. This was available for peers to view and consider before peer assessment took place, which was based on agreed tasks for that week (Figure 2). Students confidentially rated their peers on four criteria: attendance at meetings, collaboration, success in completing required tasks and quality of delivered tasks. Tutors used this confidential information to discuss progress and make decisions about transferring marks at "tutor led peer assessment sessions". These sessions provided a forum in which students could see the results of their self and peer assessments, and how accurate they had been in relation to the teams' interpretation and the tutor's summary.

Scaffolds for Strategy formation

Cognitive strategies are, in effect, the outcome of Metacognition and the self-monitoring process. These strategies are numerous, and include approaches for rehearsal, elaboration, and organization (Weinstein & Mayer, 1986). Certainly self-regulating students use techniques such as paraphrasing, highlighting and concept mapping, and these are skills that can be taught through direct instruction. Ultimately, however, the implementation of such strategies must be enacted by the learner. Assisting learners to articulate at the outset the strategies that they will be implemented within their projects provides a strong initial scaffold, as it allows the establishment of a goal, and the plan for maintaining the pursuit of that goal. The teacher can use this plan to tailor assistance, and the plan itself acts as a milestone against which learners can continue to assess their performance.

As a pre-engagement tool and to enhance the authenticity of their projects, learners in this unit were required to enter into a student contract (Figure 4). The contract was an agreement between themselves, their team members', and the tutor. Its purpose is to outline each student's responsibilities such as team role, responsibilities, topics for their portfolio, amount of time committed to achieve these tasks, and contributions they would make to help the group achieve its goals. This is completed in week 3, with a meeting in which a "Team Contract" is signed, were all team members agree that the roles, tasks and times allocated for all team members' are acceptable. This helped students commit to specific responsibilities in order to create a collaborative environment in which they would establish shared goals through an agreed plan.

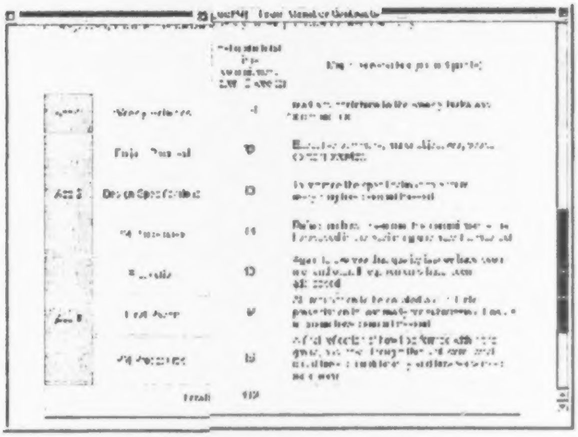

Figure 4: Sample Student Contract

Conclusion

There is currently much debate focused on creating optimal conditions in learning environments for self-regulated learning, to help students develop as independent learners. This paper has provided a conceptual framework to help identify important elements needed for self-regulation, and provided scaffolds to support Metacognition, Self-Monitoring and Strategy Formation. However, providing appropriate learning environments and valid assessment instruments to help students' develop these skills is not an eas y task. At which level should Self-Regulated learning be targeted? Should Metacognitive strategies be targeted before Strategy Formation, or should Self-Monitoring be practised first? We suggest that all of these cognitive elements need to be considered concurrently. The design of the learning environment must integrate appropriate learning activities as outlined above, to scaffold the development of these skills.

Students must actively engage with authentic learning activities, which are student-centred but scaffolded to give guidance and support. In the above examples, the WORKING inventory helped interrogate students' professional skills, and provided customised feedback on how to improve these, as well as providing tutor and on-line support. At the same time, students were continually monitoring self and peer performance through an on-line application that provided regular and consolidated feedback on their progress and viewpoints. These activities enabled students to regularly gain feedback on how successful their strategies had been as outlined in their contracts, and through reflective practice allowed them make continual improvement.

References

Bennett, N., Dunne, E., & Carre, C. (1999). Patterns of core and generic skill provision in higher education. *Higher Education*, 37(1), 71-93.

Biggs, J. (1999). *Teaching for Quality Learning at University*. Buckingham: Open University Press..

Boekaerts, M. (1997). "Self-Regulated Learning: a new concept embraced by researchers, policy makers, educators, teachers, and students." *Learning and Instruction* 7(2): 161-186.

Bogue, C. (1993a). *Studying in the content areas: Social science*. Clearwater, FL: H & H Publishing.

Brooks, D. W. (1997). *Web Teaching: a guide to designing interactive teaching for the World Wide Web*. New York, Plenum Press.

Candy, P., Crebert, G., & O'Leary, J. (1994). *Developing Lifelong Learners through Undergraduate Education*. Canberra: Australian Government Publishing Service.

Corno, L. (1986). "The Metacognitive Control Components of Self-Regulated Learning." Contemporary Educational Psychology 11, 333-346.

Dearing. (1997). *Higher education in the Learning Society*. London: HMSO.

Garcia, T., Pintrich, P. R. (1994). Regulating Motivation and Cognition in the Classroom: The Role of Self-Schemas and Self-Regulatory Strategies. *Self Regulation of Learning and Performance: Issues and educational applications*. D. H. Schunk, Zimmerman, B. J. Hillsdale, N. J., Erlbaum: 127-153.

H&H Publishing (2001). On-line at http://www.hhpublishing.com

BEST COPY AVAILABLE

Haught, P. A., Hill, L. A., Walls, R.T. & Nardi, A. H. (1998). Improved Learning and Study Strategies Inventory (LASSI) and Academic Performance: The Impact of Feedback on Freshmen. *Journal of The First-Year Experience*, 10, 2, pp. 25-40.

Loomis, K. D. (2000). "Learning Styles and Asynchronous Learning: Comparing the LASSI Model to Class Performance." *Journal of Asynchronous Learning Networks* 4(1): 23-31.

Miles, C., & Grummon, P. (1996). Working. Clearwater, FL: H & H Publishing Company.

Olejnik, S., & Nist, S.L. (1992). Identifying latent variables measured by the Learning and Study Strategies Inventory (LASSI). Journal of Experimental Education, 60, pp. 151-159.

Pressley, M., Van Etten, S., Yokoi, L., Freebern, G., & Van Meter, P. (1998). The Metacognition of College Studentship: A Grounded Theory Approach. In D. J. Hacker, J. Dunlowsky, & A. C. Graesser (Eds.), *Metacognition in Educational Theory and Practice*. Malwah, New Jersey: Lawrence Erlbaum & Assoc.

Risemberg, R. (1996). "Reading to Write: Self-Regulated Learning Strategies when Writing Essays from Sources." Reading Research and Instruction 35(Summer 96): 365-383.

Schraw, G. (1998). "Promoting General Metacognitive Awareness." Instructional Science 26: 113-125.

Vygotsky, L. S. (1978). Mind in society. Cambridge, MA: Harvard University Press.

Weinstein, C.E., Palmer, D.R., & Schulte, A.C. (1987) Learning and Study Strategies Inventory. Clearwater, FL: H & H Publishing.

Weinstein, C. E., & Mayer, R. (1986). The teaching of learning strategies. In M. Wittrock (Ed.), Handbook of Research on Teaching. New York: McMillan.

Winnips, K. & McLoughlan, C. (2001). Six WWW Based Learner Supports you can Build. Paper presented at EdMedia 2001, Tampere Finland, July 2001

Zimmerman, B. J. (1994). Dimensions of Academic Self-Regulation: A conceptual framework for education. In D. H. Schunk & B. J. Zimmerman (Eds.), Self-regulation of learning and performance: Issues and educational applications. Hillsdale, N. J.: Erlbaum.

Zimmerman, B. J. (1989). Models of Self-Regulated Learning & Academic Achievement. In B. J. Zimmerman & D. H. Schunk (Eds.), Self-regulated learning and academic achievement : theory, research, and practice. New York: Springer-Verlag,.

Implementing Technology in Higher Education: The Management of Multiple Dimensions

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Abstract:

The paper will explore the environment of intense change that characterises most Australian universities (and indeed universities in much of the world). In this environment, universities have had to reassess their fundamental business and the way they go about it. Information Technology (IT) is viewed as an important factor in streamlining their operations and all universities are investing heavily in systems and services. If this implementation is not managed in a collegial way there is a very real danger that academic teachers will resent the changes being made and undermine the investment. Polarity theory will be described and a model will be developed which shows that the 'zone of effective change' in universities requires that several dimensions need to be managed at the same time. Examples of these dimensions are:

- top down *versus* bottom up decision making
- management *versus* scholarship
- systems *versus* services
- central *versus* devolved
- focus *versus* variety
- mass change *versus* growing individuals
- competition *versus* collaboration

It will be argued (with examples) that changing '*versus*' to '*and*' allows a new perspective to be added to university implementation of policies and practice.

The Changing Terrain of Higher Education

This paper is based on two sets of experiences; the first is the ongoing experience of working in academic staff development in three large Australian universities over the last ten years, and the second is directing a recent national study about the uptake of technology for teaching and learning across the Australian higher education sector.

Universities are currently in an environment of intense change. They are being required to educate more students, from an increasing variety of backgrounds, with decreasing government funding. Universities are required to compete vigorously for student enrolments and external sources of funding. In this environment, universities have had to reassess their fundamental business and the way they go about it. Information Technology (IT) is viewed as an important factor in streamlining their operations and all universities are investing heavily in systems and services. The implementation of technology covers aspects like IT infrastructure (networks, standards, hardware, etc.); online learning management systems (such as WebCT or Blackboard); academic management systems (e.g. PeopleSoft) which may be fully integrated with the learning management systems and financial systems; digital library investments; and extensive staff development.

Yetton et al. (1997) make it clear that communication and information technologies will be a major part of future university planning. Yetton's research team examined 20 universities' management of IT. They noted that an organisation's performance is a fnction of fit among five factors: strategy, roles and skills, management processes, structure and technology. They noted the need to change terms and conditions of employment in universities and the need for rationalisation. "There will be winners and losers" (p. xiii). In this paper I will discuss a few ideas about how universities might manage internal policy development and their approaches to collaborative ventures in order maximise their chances of being 'winners'.

Innovation and Change

We should not underestimate the difficulties involved in innovation and change. Marris (1986) parallels the sense of loss during bereavement to the resistance one can feel when letting go of known ways of doing things and embarking on new strategies. For many academics the increasing emphasis on the use of computer technology for administration, research and teaching is highly threatening. We need to recognise these fears and devise plans that build staff confidence and motivation, and provide adequate support and training opportunities. Changing educational practices and styles can produce many negative reactions and this negativity needs to be acknowledged and managed effectively. Change should be introduced and implemented within a supportive environment. The culture of the organisation needs to be able to embrace change while offering staff opportunities to manage their own levels of comfort with the change.

Conventional texts on management often define organizations as groups of people united by a common goal, but our common experience (and our common sense) would tell us that organizations are only rarely so united and so rational. Ford et al. (1996) acknowledge the complexity of modern universities and provide descriptions of various perspectives of people who work in and with higher education. However, some of the passion and trauma of change seems to have been sanitised out of this book and others like it. The authors operate on an evolutionary approach—"the principle that diversity and change are forces to be managed and harnessed rather than resisted" (p. 2). The strength of individual innovation seems stifled, and yet such innovation is one catalyst for change.

It is important to consider how innovation leads change, and how inappropriate management strategies can either stifle the innovation or cause a long time delay between the innovators developing and evaluating their work, and the results moving into other areas of the organisation.

Argyris (1991) discusses how relatively simple models of problem-solving such as action learning do not go far enough because they focus on "identifying and correcting errors in the external environment" (p. 99). He suggests that the way problems are perceived and defined needs attention as well.

Senge (1990) argues that the modern organisation needs not only knowledge at all operational levels, but also the capacity to learn. His model of a 'learning organisation' draws on the work of Argyris and Schon (1978) on single and double loop learning; single loop learning is simple problem solving; double loop learning looks at fundamental organisational structure and embeds individuals' discoveries, inventions and evaluations in organisational memory (Argyris & Schon, 1978, p. 19). For Senge, teams are the learning agents that can achieve double loop learning and translate individual work into new theories of action for the organisation. This, at least, is closer to what my experience of effective change has been. Senge suggests a range of strategies—personal mastery, building mental models and shared visions, and forming learning teams.

Polarity Theory

Instead of thinking of a range of problems, issues or options that needs to be considered during the implementation of an innovation, Johnson (1992) suggests that it is more realistic to consider a series of polarities. He claims that polarities are sets of opposites which can't function well independently. Because the two sides of a polarity are interdependent, it is not possible to choose one as a solution and neglect the other. The aim of polarity management is to get the best of both opposites while avoiding the limits of each. The solution resides within the tension between polarities. For example, we can view collaboration and competition as being at two poles; they are not mutually exclusive, but rather both need to be accommodated in our strategic planning. Polarity theory does not offer defined solutions to organisational problems. It emphasises that change is a messy and dynamic situation; as the appropriate balance point for one set of polarities shifts, this will influence others. Fig. 1 shows a series of polarities, intersecting in what I have called the 'zone of effective change'. I will make a few comments on and/or provide illustrations for each of these polarities in turn; no priority is indicated by the order of discussion.

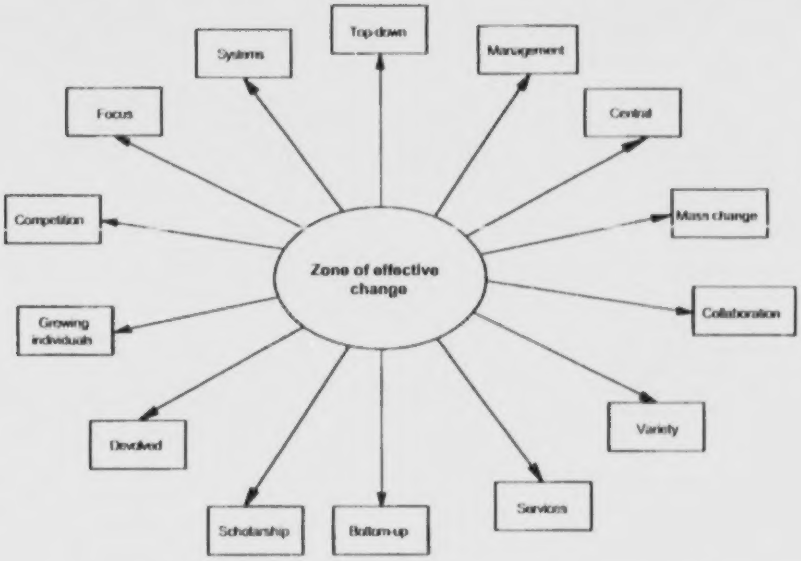


Figure 1: Effective change as the management of multiple dimensions or polarities

Top down vs Bottom up

Large scale 'social re-engineering' from the top can get a process going but it is too difficult to sustain unless genuine commitment develops locally. Over the past few years, RMIT University in Australia has made a substantial investment into the use of online learning technology, aimed at improving the quality of programs by reviewing their educational design and adding greater flexibility to modes of studying them. This initiative, called the IT Alignment Program (ITAP), has involved investment in infrastructure, enterprise computer-based systems which are IMS-compliant (http://www.imsproject.org/), Library resources, staff development, and program and course renewal (http://www.lts.rmit.edu.au/renewal/). RMIT has tried to move on several fronts at once, and many of the policies and processes that have been developed are still being refined (Kenny & McNaught, 2000). While the original vision for how technology might enhance the processes and procedures for the University came from the top (Fallshaw, 2000), the success of the implementation will be determined by the take-up in faculties and departments. Kenny (2001) explores this tension in the area of courseware development at RMIT. Based on several years experience of working with RMIT staff, he proposes a model to combine the benefits of project management for ensuring quality educational outcomes and a return on investment to the institution, with scholarship and ownership within the project teams to ensure individual commitment and satisfaction.

Management vs Scholarship

Bowden and Marton (1998) depict the 21st century university as the University of Learning. All aspects of university work—teaching, research and community involvement—are forms of learning for the individual, the collective scholars at a discipline level, and for the local (and increasingly global) society. All these types of learning involve growth and change, often in unpredictable directions. Yet, universities are large organizations and need to have some defined parameters. Willets (1996) has written a humorous article, entitled 'The best ways to survive reengineering. Expert tips on how to reinvent your attitude'. But there is a great deal of irony beneath his light advice. The sense of powerlessness that organizational change can often engender is very real. One strategy for universities is to keep the nature of the business which is scholarship at the forefront of management meetings. 'Will this process enhance scholarship?' is the question that must constantly be debated.

Systems vs Services

Quality assurance systems are a good way to illustrate this tension. Evidence must be scholarly, not just an audit trail. If information about the quality of academic work does not feed back into quality improvement, it is hard to justify the resources used to collect the information. Quality assurance systems must also provide service to the organisation. One example is the ISO9000 system (http://www.iso9000.org/). It has 125,000 registered and certified organizations who use, and pay for, its methodology. This may be fine for several types of businesses but universities need to question how applicable it is for higher education. "Despite more than a decade and three evolutions of ISO9000, the model has made little significant impact on higher education. This is not surprising because, despite tinkering with it, ISO9000 was never fundamentally designed for an educational context" (Harvey, 2001, p. 59).

Central vs Devolved

There are many tensions in the central/ devolved debate. One major issue is whether university funding for courseware design and production should be through central or faculty-based processes. Faculty staff want the skills and expertise that exists in central units, but wish to have it provided without reduction in funding to faculties. The requirement to pay for services from central units can set up resistances. Most universities use both approaches (McNaught, Phillips, Rossiter & Winn, 2000). It is finding the appropriate balance point that is the challenge. Tab. 1 summarises the arguments for and issues associated with each approach.

Centralised funding	**Devolved funding**
Points in favour of:	
Can reduce duplication of expensive services by funding a range of projects, the design ideas and products of which can be used in other faculties. Can foster cross-faculty collaboration and communication.	Can fund projects based on local knowledge of curricula and faculty culture. Can develop stable ongoing teams for future developments.
Can allow university strategic priorities to be enacted.	Can allow local ownership and commitment to grow.
Can foster the integration of outside funding with university priorities.	Can source funding from discipline and industry-related bodies.
Issues associated with:	
If the funding committee is not broadly constituted, this can result in a restricted range of models being favoured.	Traditional practices in the discipline can dominate, and it may be difficult for some innovative projects to be funded.
Can be dominated by a few strong university personalities; this may disadvantage certain faculties.	Can be dominated by a few strong faculty personalities; this may disadvantage certain departments/ schools.

Table 1: Pros and cons for centralised and devolved funding (McNaught et al., 2000, p. 113)

Focus vs Variety

Coordination is the key here. If administrative or academic support units have too many functions, their energy can be dissipated. If they have too narrow a focus, then the result may well be isolated units who do not see 'the big picture'. Clearly articulated functions and effective coordination between units is the answer.

An example of how diverse the range of services offered by university units is given in this list I made at a national meeting of 20 Directors of Staff Development of Australian universities in May 2001. Each of these items was supported by several of the universities present; minor or unusual services are not noted. This list refers to teaching and learning support. This list is *in addition to* the courseware production aspect of several units which are part of large flexible learning centres.

- Graduate Certificate in Higher Education programs;
- series of workshops and seminars across the university;
- academic induction programs;
- activities based at local faculty or department/ school level;
- student evaluation service;

- support for sessional staff, both onshore and offshore;
- post-graduate supervisor training;
- support for heads of departments/ schools linked to development of local policy;
- support for graduate capabilities, especially for programs leaders/ coordinators; and
- liaison with learning skills and library staff in course renewal teams.

So, academic staff development units are in danger of having too much variety. While some liaison with student support and library staff was noted, the focus of discussion remained on coping with the variety of internal activities, rather than on coordination with other units within each university.

Mass Change vs Growing Individuals

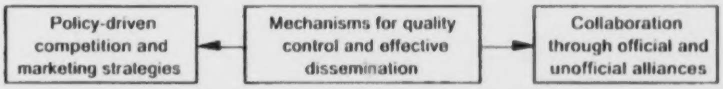
One example to illustrate how individual growth can dovetail with overall strategic directions is a recent academic staff development program run at RMIT University. A Learning Technology Mentor (LTM) program at RMIT ran from mid-1999 to the early part of 2001. The LTM program provided for 120+ academic staff to have one day per week time release over one semester, in order to:

- learn how to use the University's recently established online education system,
- design and implement online learning in their faculty's education programs, and
- promote and support similar activities among colleagues in their departments.

The aim of making a significant investment in learning technology mentoring by academic staff—rather than establishing a specialist online design and production unit to service them, for example—was to achieve widespread adoption of online learning as part of effecting a change in the culture of academic work. Extended time release of more than one semester was required to achieve useful outcomes in some cases; these academic staff were called Experienced Learning Technology Mentors (ELTMs). Over this time, in several faculties, a network of individuals developed that remained after the formal end of the program (McNaught, 2001; Gray & McNaught, 2001).

Competition vs Collaboration

There are benefits in both perspectives. Fig. 2 summarises the drivers for both collaboration and competition. If the aim is to produce high quality educational offerings there are drivers for both collaboration and competition relating to quality standards, financial viability and raised prestige.


Policy-driven competition and marketing strategies
Mechanisms for quality control and effective dissemination
Collaboration through official and unofficial alliances

Quality standards based on: student demand; industry needs	*Quality standards based on*: combined intellectual input; broader contextual experiences
Financial viability based on: developing potential for new markets for courses	*Financial viability based on*: efficiencies in resource terms; sharing of expenses
Raised prestige based on: creating a niche, a particular cultural identity in the marketplace	*Raised prestige based on*: pooled reputation of all partners; possible increased publication output

Figure 2: Summary of drivers for both competition and collaboration
(after McNaught et al., 2000, p. 160)

Summary

One simple summary of polarity theory and its applicability to higher education today is the reframing of the set of dimensions I chose as follows:

- top down *and* bottom up decision making
- management *and* scholarship
- systems *and* services
- central *and* devolved
- focus *and* variety
- mass change *and* growing individuals
- competition *and* collaboration

Remove all oppositional 'versus' thinking and replace it with ways to consider how to gain maximum benefit by embracing both ends of poles. The zone of effective change can only be formed by the inclusion and balancing of both ends of each dimension.

References

Argyris, C. (1991). Teaching smart people to learn. *Harvard Business Review*, May/June, 199-209.

Argyris, C., & Schon, D. (1978). *Organisational learning: A theory of action perspective*. Reading, Mass.: Addison-Wesley.

Bowden, J., & Marton, F. (1998). The university of learning. Beyond quality and competence in higher education. London: Kogan Page.

Fallshaw, E. (2000). IT planning for strategic support: Aligning technology and vision. *Tertiary Education and Management, 6*, 193-207.

Ford, P., Goodyear, P., Heseltine, R., Lewis, R., Darby, J., Graves, J., Satorius, P., Harwood, D., & King, T. (1996). *Managing change in higher education*. Buckingham: SRHE & Open University Press.

Gray, K., & McNaught, C. (2001). Evaluation of achievements from collaboration in a learning technology mentoring program. In G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds) *Meeting at the crossroads*, (pp. 217-224). Proceedings of the 18th annual Australian Society for Computers in Learning in Tertiary Education 2001 conference, University of Melbourne, 9-12 December. [Online]. Available: http://www.ascilite.org.au/conferences/melbourne01/pdf/papers/grayk.pdf [30 April 2002].

Harvey, L. (2001). Quality in higher education. In *Management education for the 21st century: Managing in the digital age*, Conference proceedings, Management education section, (pp. 53-63). Swiss-AIT -Vietnam Management Development Programme & School of Industrial Managemant, HCMC University of Technology. Ho Ch Minh City, Vietnam, 11-14 September.

Johnson, B. (1992). *Polarity management: Identifying and managing unsolvable problems* Amherst Mass.: HRD Press.

Kenny, J. (2001). Where academia meets management: A model for the effective development of quality learning materials using new technologies. In G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds) *Meeting at the crossroads*, (pp. 327-334) Proceedings of the 18th annual Australian Society for Computers in Learning in Tertiary Education 2001 conference, University of Melbourne, 9-12 December. [Online]. Available: http://www.ascilite.org.au/conferences/melbourne01/pdf/papers/kennyj.pdf [30 April 2002].

Kenny, J., & McNaught, C. (2000). Promoting quality outcomes in higher education using new learning technologies: Processes and plans at RMIT. In R. Sims, M. O'Reilly & S. Sawkins (Eds) *Learning to choose. Choosing to learn*, (pp. 655-664). Proceedings of the 17th annual Australian Society for Computers in Learning in Tertiary Education 2000 conference, Southern Cross University, Coffs Harbour, 9-14 December. [Online]. Available: http://www.ascilite.org.au/conferences/coffs00/ [30 April 2002].

Marris, P. (1986). *Loss and change*, revised edition. London: Routledge & Kegan Paul.

McNaught, C. (2001). A model for staff development for using ICT in teaching and learning: The RMIT experience. *The power of 3*. Educause in Australasia 2001 conference. Gold Coast. 20-23 May. [Online]. Available: http://www.gu.edu.au/conference/educause2001/content2a.html [30 April 2002].

McNaught, C., Phillips, P., Rossiter, D., & Winn, J. (2000). *Developing a framework for a usable and useful inventory of computer-facilitated learning and support materials in Australian universities*. Evaluations and Investigations Program report 99/11. Canberra: Higher Education Division Department of Employment, Education, Training and Youth Affairs. [Online]. Available: http://www.detya.gov.au/highered/eippubs.htm#99_11 [30 April 2002].

Senge, P. (1990). *The fifth discipline: The art and practice of the learning organisation*. London: Random Century Group.

Willets, L. G. (1996). The best ways to survive reengineering. Expert tips on how to reinvent your attitude. Reengineering Resource Center. [Online]. Available: http://www.reengineering.com/articles/sept96/reengsurvival.htm [30 April 2002].

Yetton, P. and associates 1997. *Managing the Introduction of Technology in the Delivery and Administration of Higher Education*. Evaluations and Investigations Program report 97/3, Australian Government Publishing Service, Canberra. [Online]. Available: http://www.detya.gov.au/highered/eippubs1997.htm [30 April 2002].

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Web-based Computer Simulations for In-Class, Individual, and Small Group Work

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Abstract

Introductory college chemistry can be "taught" by a mode of instruction other than lecture and careful use of the web can alter the way chemistry is learned. The web provides a means to deliver educational resources via a universally accessible platform. The medium is relatively easy to develop materials for and provides a level of interaction that cannot be provided in a textbook. The interactive nature can be used to deliver simulations of chemical and physical processes (animations of phenomena) or interactive simulations of experiments that may (or may not) be done in the laboratory portions of a general chemistry course. This paper discusses a variety of the interactive materials that have been tested in the author's first semester general chemistry course. The simulations presently involve material from approximately three quarters of the course. The interactive web-based activities serve as the starting point for small group classroom discussion and assignments. It is important to make the use of simulations an integral part of the course, provide a motivation for individual students to perform the simulations, and to provide a setting in which the students can exchange ideas and insights. The positive aspects of the learning tools discussed in the paper will be highlighted. However, the web cannot solve all of the challenges of teaching chemistry. Therefore, brief discussion of the difficulties encountered in using web-based simulations for small-group assignments will also be discussed.

Introduction

When deciding upon making changes to any course, there are several questions that instructors typically consider. First, "What works in the present course and are there 'problems' that need to be addressed?" Second, "Who are the students in the course?" and "What is the nature of the institution?". The answer to these questions will suggest what ought to be changed and help the instructor decide what changes best fit the needs of the students and the institution. A final question that is key to the success of any changes in the course is "Who is the instructor and what role are they comfortable with in the classroom?".

The following conditions apply at the author's institution. Wilkes University is a private, co-ed, comprehensive institution founded in 1933. Wilkes serves approximately 2,000 full-time undergraduate students from 20 states and 15 foreign countries and it has a School of Pharmacy. The freshman chemistry courses serve approximately 175 students in the fall semester. The author's course is the four credit "Elements and Compounds" course (offered in the fall semester) that meets for four 50 minute periods per week plus one "three hour" lab. The students enrolled in this course are nearly all traditional age students, over 95% are first semester freshman, and are nearly all required to take the course as part of their major. Most are pursuing a bachelor degree in engineering or science (but few are chemistry majors). The largest majors represented in the class are pre-Pharmacy, Pre-med, biology, and engineering majors. The class size ranges from 45 to nearly 85 at the start of the semester (this year there were three sections offered at different times). The on-line simulations were originally developed and implemented at the author's previous institution, The Pennsylvania State University - Hazleton Campus. There were two problems the author wanted address: (a) students were not spending adequate time engaging the course material and (b) some topics covered in the lecture portion of the course either had too little, or no, coverage in lab.

Aside from the adjustments to the "normal" structure of their lives that traditional age freshman must make when they enter college, there are a number of factors that make the first year college chemistry course challenging:

- the quantity of the material covered
- the variety of material covered

- the requirement to perform calculations (especially solving "word problems")
- the requirement to relate the abstract to the concrete
- the misconceptions, alternate conceptions,(1) from prior courses or life experience

Traditional lecture and recitation sections do not capture the interest of students and suffer from other difficulties: (a) little time for remediation of basic skills, (b) ineffective for some learning styles, (c) students cannot control time, place, or pace, and (d) interaction with the instructor is avoided (especially in medium to large classes). As a result, students do not actively engage the course material nor do they develop the depth of understanding that is desirable. For some students, learning and grades suffer because interest in the course is low. A recent study also indicates that a general chemophobia may contribute to lower achievement in chemistry.(2)

Some of these difficulties can be addressed by using modes of instruction other than traditional lecture. As many instructors know, a major key to improving student learning is getting the students to spend time engaging the course material. It is in this area that the web can be useful as a way to "teach" chemistry. The web provides a universally accessible platform for the delivery of interactive educational resources. The medium is relatively easy to develop materials for and provides a level of interaction that cannot be duplicated by a textbook. Additionally, students can control (to some extent) the place, time, and pace of interaction with the material. The interactive nature can be used to deliver simulations of chemical and physical processes (animations of phenomena) or interactive simulations of experiments that may (or may not) be done in the laboratory portions of a general chemistry course. A variety of interactive materials have been developed and tested in the first semester of the author's general chemistry course. Attempts (both successful and not so successful) to implement web-based course materials, especially small group use of simulations, will be described.

Interactive Web Based Simulations

The author has developed a series of interactive simulations for use in the first semester of a college general chemistry course. Students are exposed to assignments that require active participation and these simulation assignments serve as the starting point for small group discussions. The activities require students to "perform experiments", collect and analyze data, and arrive at conclusions about the behavior of matter. This is more consistent with the practice of science than the traditional lecture mode of teaching. This allows the students to:

- become involved in the process of learning,
- develop a sense for the process of doing science,
- and learn to think more independently relying less on a textbook for answers and more on their own ability to understand and correlate data.

The simulations (found at http://www.hn.psu.edu/faculty/dmencer/chemsims.htm, the author's old web site) address areas of content typically found in the first year college curriculum.

- density of solids and liquids- perform density determinations on liquids and solids
- mass laws - investigate mass changes in reactions to "discover" (a) mass conservation, (b) law of definite proportions, and (c) law of multiple proportions
- compound stoichiometry - determine empirical formulas using a simulation of combustion analysis
- reaction stoichiometry - investigates mass changes in reactions to "discover" (a) limiting reactant and (b) theoretical yield
- ideal gases - investigate relationships between pressure, volume, temperature, and number of moles of an ideal gas
- investigations of bonding - the effect of electronegativity difference on bond strength

- calorimetry - simulations of both a bomb calorimeter and a coffee cup calorimeter
- heat and work - investigate relationships between heat and work in both constant pressure and constant volume systems

Other activities (without simulations) explore periodic properties, the atomic mass scale and the mole, atomic structure, and aspects of intermolecular forces.

Small Group Work

Small group work was employed because research has shown that cognitive learning has an important social aspect.(3) Small group use of the interactive web-based activities has been attempted using two methods in the author's course. In the first and second year of use (at PSU-Hazleton), students were clustered into groups of three to five students and assigned a simulated experiment to complete. A worksheet was available to guide them through the exercise. They had to analyze the data and determine the significance of the results. Based upon their interpretation of the data, the group then developed a lesson for the rest of the class. Prior to teaching these lessons, the groups met with the instructor as a quality control check for the lesson plan. Students received an individual and a group grade for their efforts.

The "Ideal Gases" simulation was used by four groups to investigate simple gas laws as shown in Table 1. Students worked as a group to collect and analyze the data. They were not told the name of the gas law they were to investigate prior to the meeting with the instructor. Each group collected several sets of the requested data. Each data set was collected using different values for the constant variables. For example, in the Boyle's Law case, P vs. V data would be collected with one set of n and T values, then again with a new set of n and T values, and finally a third time with one more set of n and T values. The worksheet prompted the students to determine whether the relationship between the two variables was direct or indirect (inverse) and to prepare a linear graph of the relationship. Students were also asked to write the relationship for their data as a proportionality. Students could then solve initial state/final state problems using the simple gas law they have "discovered". Students were also prompted to calculate $^{PV}/_{nT}$ for every data point. The four groups presented their finding in class and the instructor would use this as a starting point for discussion of the combined gas law and the ideal gas law.

TABLE 1. ASSIGNMENTS FOR "IDEAL GASES" SIMULATION

Group	Gas Law Assigned	General Directions
1	Boyle's Law	Vary V and measure P while holding n and T constant.
2	Charles' Law	Vary T and measure V while holding n and P constant.
3	Amonton's Law	Vary T and measure P while holding n and V constant.
4	Avogadro's Law	Vary n and measure V while holding P and T constant.

This small group method was not as successful the author had hoped. Students in the small groups learned the material well: they completed the assignment, developed a lesson plan, met with the instructor, taught the material, and fielded questions. This process increased the group members' success with the material. However, students who were not assigned to teach the material did not respond well to peer teaching: they did not use the simulations, they "turned off" during in-class peer teaching, and they did not develop good questions for the presenters. This method of using the simulations with small group peer teaching was also time consuming for the instructor. Assignments were developed and coordinated the for all of the groups (approximately 20) with each group requiring a minimum of a single half-hour meeting to review their lesson plan. Some groups needed a follow-up meeting. The same method was repeated for a second year with the hope that it could be made to work better. Questions based on the presentations were included on quizzes and exams to try to increase student involvement. However, student reaction to peer teaching was still poor. Other instructors might be able to employ this method of peer teaching successfully, however, the author tried an alternative method.

During the fall 1999 and 2000 (at PSU) and Fall 2001 (at Wilkes University), the author committed to getting **all** students involved in **every** activity. To achieve this goal, the class is divided into either three or four large groups. Each group is given a different investigation to perform using a simulation. In the case of the "Ideal Gases" example, four groups are employed and the assignments are the same as those listed in Table 1. Each student is required to complete his or her group's assignment working alone outside of class. Every student now has to access the web pages and use the simulation. On the assigned day, all students are required to bring the results of their investigations (compiled data/completed worksheets) to class. The students then split into small groups comprised of one member from each large group (in the "Ideal Gases" example each small group would have members from groups 1, 2, 3, and 4). The students share what they learned within their small group. Since each of the large groups have a different assignment, every student makes a unique contribution. Also, since each student completes a worksheet and graph for the assignment, they can more readily interpret data presented by others.

In order to provide external motivation to complete the assignments, the instructor can randomly collect completed data/worksheets from students. Students needn't know in advance whose assignment will be collected. Make-up assignments can be given, or not, and the assignment grades can be factored into the overall course grade. This method proved to be successful in increasing student involvement with the assignments. The logistics are somewhat simplified since the meetings with individual groups are eliminated. However, there are written assignments to grade, and some students hand in poorly completed worksheets or none at all.

Assessment of Effectiveness of Web-based Activities

Student surveys, and the author's personal assessment, have been used to assess the use of simulations and other on-line materials. Surveys assessed:

- reaction to the use of simulations (along with questions about the other on-line materials)
- interest in and/or attitude toward learning science/chemistry
- attitude toward science/chemistry as a process (vs. a set of facts and equations)
- self-assessment of their level of ability to carry out scientific data collection and analysis

The results of these surveys indicate a positive assessment of the simulations and other web-based materials (for example, on-line course notes). After completing the course with the simulations student self-evaluation also indicated improvement in the other three areas. However, data from a control group (a section of the course taught without the simulations) are not complete at the time of paper submission.

The author has also examined other means of assessing the new course materials. An interesting trend was observed in student course evaluations at Penn State (Student Ratings of Teaching Effectiveness, SRTEs). The students' overall evaluation of both the course and the instructor declined for the first two years that on-line course materials and simulations were employed (fall semesters 1997 and 1998). Several colleagues (in a number of different disciplines) at the same PSU campus have also noticed a decrease in course evaluation upon adoption of "nontraditional components" to their courses. The two most recent semesters for which data is available (fall 1999 and 2000) showed a reversal of this trend with evaluations climbing back to the level from the fall of 1996. Course retention rates have been evaluated from late drop data and have been compared to data from previous years of the author's course (1996 to present). Retention rates in the author's course have been declining steadily when referenced to his first year at PSU, 1996 (the only year with no on-line component). Class grade point average has also declined during the same period. Exams comparable to previous years were given and student averages on each quiz and exam have been compared to the same quiz or exam in the previous years. However, these comparisons do not account for differences from one semester to another in other variables linked to student success rates (average preparation level, motivation level, and other class demographics). The reasons for these trends may be related to the teaching methods used in this course, or they may reflect trends at the national or institutional level. In order to place the trends observed in the author's course into context, more data is needed (for example, average math and chemistry placement scores could be compared).

Improved performance of the "learning" taking place in the course is much trickier to assess. The author has anecdotal experiences that indicate use of the simulations and small groups can help students overcome misconceptions, better *understand* concepts and phenomena, and better *learn* "problem solving" skills (vs. using rote algorithmic methods to solve problems). For example, many students have deeply rooted misconceptions about density, displacement, and buoyancy. The density determination simulations serve as a good starting point to discuss phenomena related to density (for example Archimedes Principle). The simulation of solid density simulation relies on displacement for the volume determination. During the in-class discussions, the instructor carefully reviews the requirements for a solvent that can be used to determine the volume of a water reactive low density solid (like sodium, Na). The discussions invariably turn to other "real world examples" of displacement and buoyancy (for example the class has discussed ice cubes floating in liquid water and hot-air balloons). Students completing the simulated density experiments and the small group work appear to have a better understanding of the phenomena of displacement.

A second example involves mass conservation and the concept of limiting reactants. When performing mass conservation simulations some students are surprised to observe that excess reactant can remain after a reaction goes to 100 percent completion. Class discussion time is spent in careful examination of atomic theory to see how it can explain the Law of Conservation of Mass, the Law of Constant Composition, and the Law of Multiple Proportions. Even after this effort some students are still confused when the concept of limiting reactant is introduced in the following chapter in the context of mole calculations. The simulations are employed again, but this time students are expected to work in moles instead of in mass. Although the average quiz score on this chapter has not improved, the author has noticed a number of students employing mass conservation concepts (although sometimes incorrectly), mass ratios of elements in compounds, and other "interesting options" when solving stoichiometry problems. Although these methods are not always employed properly, it seems that some students are doing more than simple algorithmic problem solving on these questions; that is they seem to be thinking. The use of the simulations along with the small group work allows students to: (a) engage the material actively, (b) develop ideas/relationships, (c) test them, and (c) learn on their own and from other students. In-class examples and instructor led discussion are used to supplement the group work as needed.

One final difficulty with the assignments is the vast range of prior knowledge of the students in the course. The "best" students found some of the assignments trivial, while other students found some assignments (or perhaps just the instructions) confusing. It is clear from this work, and from other studies (ref. 4 and references within), that computer-based assignments can improve student performance and attitude toward chemistry. However, it is important that the level of the student and the assignment be well matched. It is also important to recognize that improved student performance on exams may not reflect increased *understanding*(1). Also, gains on exam scores may not be attributable to the particular type of assignment or the mode of delivery. A recent study of a web-based system of homework and testing showed a strong positive effect on exams scores. (5) One finding was that scores on practice exams increased with the number of times they were attempted. This may simply be a function of the time spent engaging the material. This needn't negate the positive aspects of computer-based assignments; but similar gains might be achieved by other assignments that increase "time on task".

Individual and In-Class Use

The simulations can be used to provide practice problems or to provide a starting point for in-class discussion. Students can attempt the problems and then check their answers against the simulation's result. The author also uses them to develop problems during office hours. The author plans to add more "drill and practice" types of exercises to the course site. These exercises are intended for students needing skill development or remedial work. These types of exercises should also help to address the increasing number of students who use their calculators poorly.

Conclusion

The web is an effective medium for delivering interactive course materials. Interactive tutorials and simulated experiments provide the means alter the way chemistry is taught. Although it is not the final solution to all of the challenges of teaching college chemistry, it does have some striking strengths. It is imperative to make the use of simulations an integral part of the course, to provide motivation for individual students to perform the simulations, and to provide a setting in which the students can exchange ideas and insights. If small groups are used, it is critical to take steps to minimize the difficulties created by group members that do not "do their parts". Also, students must be given time and guidance to successfully adjust to teaching and being taught by themselves and/or their peers.

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References

1. Lin, H. and Cheng, H., *J. Chem. Educ.* **2000** *77*, 235 - 238.
2. Eddy, R., *J. Chem. Educ.* **2000** *77*, 514 - 517.
3. Herron, J. D. and Nurrenbern, S. C., *J. Chem. Educ.* **1999** *76*, 1354 - 1361.
4. Pavlinic, S., Wright, A. H. and Buckley, P. D., *J. Chem. Educ.* **2000** *77*, 231 - 234.
5. Penn, J. H. Nedeff, V. M., and Gozdzik, G., *J. Chem. Educ.* **2000** *77*, 227 - 231.

Resources

In addition to the links found on various pages of my website (http://course.wilkes.edu/mencer), I also recommend the following.

1. A more detailed version of the small group methods discussed in this paper, and some additional on-line materials, can be found on-line at CONFCHEM: Conferences on Chemistry http://www.ched-ccce.org/confchem/2000/b/mencer/mencer.htm
2. More excellent papers on innovative teaching methods in chemistry can also be found at the CONFCHEM: Conferences on Chemistry archive site http://www.ched-ccce.org/confchem/past.html
3. A nice "Resource for Students and Teachers" (http://www.hwscience.com/smarsden/) is maintained Steve Marsden. Follow the link to topics and click on a topic (for example "Gases"). There are many links to tutorials, notes, and simulations (the links are footnoted with bibliographic information).

Choosing an Online Learning Platform focusing on Reusability of Learning Objects and its Implications for Comparison Schemata Design

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Abstract: *Project decisions about suitability of existing online learning platforms are often discussed by using project specific proprietary comparison schemata or via a comparison service offered in the world wide web. As educational material in form of learning objects becomes more available focusing on content reusability aspects is becoming more important for online learning platforms due to cost minimization in content production and preparation for content reusal. Exactly these reusability aspects can hardly be found in these comparison schemata. In learning platforms learning objects are stored in database management systems by using document management systems. Modularization of courses and course building elements as objects are essential for reusability. For effective administration, storage, search, and retrieval of these elements as a part of a reusability process metadata descriptions of the processed learning objects are neccessary and fundamental. Our approach to enrich comparison schemata by adding reusability specific elements fills the existing gap between metadata and reusability features implemented in available online learning platforms and popular used comparative analysis tools for online learning platforms, respectively.*

Keywords: *Reuse, Learning Object, LOM, Metadata, Online Learning, Comparative Analysis*

1 Introduction

This paper investigates which criterions for comparative analysis of online learning platforms are considered to be relevant for decisions focusing on content reusability aspects of these platforms when using currently available and often reviewed information systems like [Lan01], [Edu01]. The term online learning platform in this scope is defined by webbased applications to deliver or present educational multimedia course materials on a learner's side and to offer administration features on a tutor side through management of course relevant metadata while authoring support is offered by content management and content creation. Due to the lack of reusability specific categories in these information systems a set of already existing criterions is collected. Referring to this investigation this paper describes an approach for handling a criterion enrichment by adding reusability specific categories to comparative analysis tools.

Therefore the term reusability is described as it is understood in the context of the content of a learning platform as an object in section 2. As a result of this description a metadata schemata for learning objects named *Learning Object Metadata (LOM)* which is proposed by the *Learning Technology Standards Committee (LTSC)* of the *IEEE [LWG01]* is introduced which is especially useful for the attribution of learning resources [HFM+01]. After mentioning use cases working on *LOM* and currently not solved granularity problems in *LOM*, section 3 handles the reusability aspects of learning objects implemented in currently available learning platforms. Afterwards this paper is going on discussing included reusability specific criterions in the comparison schemata of [Bat99], [Edu01] and [Lan01]. The following section 4 states a proposal of a hierarchically structured set of criterions with specific categories and elements to allow comparative analysis among online learning platforms. Finally this paper ends with a conclusion and an outlook of its discussed subject in section 5.

2. Reusability

Reusability in general is a possible method for saving monetary and non monetary costs. In the context of learning platforms reuse of learning system components - the implementation itself in modularized form as it is used in different online courses - or its content can be established. While modularized configurable implementation is a well solved problem in recent online learning platforms like *Lotus Learning Space* by *Mindspan Solutions*[1], *Netcoach* by *Orbis Communications*[2] or *Hyperwave eLearning Suite* by *Hyperwave*[3] - e.g. by configuration of hiding or including a chat or a discussion forum to specific courses for online learning platform users - reusing content as learning objects in form of documents, images, other multimedia components or a collection of such components is recently a matter of research [LWG01]. In the scope of this paper reusability has to be understood as reusability of content representing documents or objects as a part of a document in form of educational multimedia material used for testing of knowledge or transfering knowledge to a learner.

Content oriented reuse of course material can be done by copying a selectable collection of course documents in whole or building templates from formerly used courses - e.g. like it is done in *Lotus Learning Space*, *WebTycho*[4] or *Hyperwave eLearning Suite* which are based on document management systems (DMS) on top of *Lotus Notes / Lotus Domino*, or *Hyperwave*, respectively. At least if content oriented reuse on a more detailed layer is focused, the typical automatically generated metadata of such DMS have to be replaced by more abstract and learning specific metadata schemata.

2.1 Knowledge Representation through LOM

To describe a coherent context of a complete reusable unit in [LWG01] the term learning object is used. The metadata of a learning object *LOM* is the information about this object. When storing learning objects in local or distributed repository systems, this metadata can be used to provide effective retrieval, management, transfer, and use of learning objects, e.g. from a repository system into a course context, by working on the corresponding *LOM* entries instead analysing the content of a learning object. Beside that additional metadata information which is not part of the learning object itself can be stored in *LOM*. Consequently, the result of the use of metadata is a reduction of costs through reusability of the described learning objects while facilitating the maintainance of learning objects. *LOM* offers data elements and a structure for these data elements to describe metadata of a learning object. It contains nine main categories of metadata elements representing information about the related learning object as described in [LWG01].

Since other metadata schemata like those from *ARIADNE*[5] - a consortium of 20 European universities and 5 international corporations - provide mappings to *LTSC*[6]'s *LOM* and the *IMS*[7] *(Instructional Management System)* metadata specification model which is compliant with *LOM* [MBG+01], the relevance of *LOM* is becoming increasingly fundamental for online learning platforms.

2.2 Retrieval and Repository Administration

In online learning platforms working on top of a DMS the automatically generated metadata can be used and often is used on its own to establish the administration of learning documents. A more detailed access to learning resources on a sub-document layer results in the need of adding an additional metadata schemata, if comfortable retrieval mechanisms for learning objects should be realized.

So the learning platform repositories should consist of a content repository separated from the metadata repository. Retrieval is done through explicit usage and search on metadata which references other metadata or its represented learning object.

2.3 Granularity

As mentioned before it is of enormous importance, if either reuse should be done on a document oriented layer or on a sub-document layer inside the DMS environment of a learning platform, too, because in a DMS accessibility of documents is fundamental, but accessibility of element parts of a document is usually not supported by the DMS without programmatical effort. Furthermore it can easily be seen that metadata descriptions of more detailed reusable content compared to a document level can also be used on higher non detailed abstraction levels.

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1. URL: http://www.lotus.com/home.nsf/welcome/learnspace
2. URL: http://www.orbis-communications.de/index_nc.htm
3. URL: http://www.hyperwave.de/e/products/els.html
4. URL: http://tychousa.umuc.edu
5. URL: http://www.ariadne-eu.org
6. URL: http://ltsc.ieee.org
7. URL: http://www.imsproject.org

For an increased support of this functionality a granularity element is included in the *LOM* schemata describing the type and abstraction layer of a learning object. One not yet solved problem in *LOM* is that this granularity describes a two dimensional area while [LWG01] describes the granularity as a single one dimensional field with no further specification or description about the vocabulary which build the entries for this *LOM* element. The horizontal direction of the granularity represents the type - not format - of the learning object (e.g. explanatory text section of a learning unit or in contrast questionary text of an exam), while the vertical direction of the granularity represents the abstraction layer (e.g. icon, chart, image, explanatory text section, chapter, document, lesson, course; see [HFM+01]).

3. Current Situation

At the moment commercial and non-commercial well-known online learning platforms only attempt to support *IMS* or *IEEE/LOM* or rather announce development of this features in near future [Edu01]. So on the producer and researcher side developers of online learning platforms see the need to support detailed metadata specifications and those features are partly implemented.

The currently available versions of comparison schemata in general do not contain any category named reuse or reusability and only one well referenced comparison schemata [Edu01] contains information regarding metadata in its *general* section.

3.1 Learning Platforms

The following learning platforms were investigated for this paper to see whether they already support any type of metadata for learning objects or whether support is planned or if it is possible to add an own support via a framework or an application programmers interface if existent.

WebTycho

At the *UMUC* home campus in Adelphi, Maryland, a web-based education delivery system named *WebTycho* has been developed. It is based on *Lotus Notes / Lotus Domino* and due to the replication features of this platform *WebTycho* is offered via several servers located in Germany, Japan, and the United States. *WebTycho* itself is neither freely available nor commercially offered but often counts as a reference system when comparing online learning platforms.

Its current authoring support for reusability of course content offers storing of template objects ranging from whole courses to single documents. Subdocument layer elements reuse has to be done manually. Metadata support beside that of *Lotus Notes / Lotus Domino* is not implemented so far.

Lotus Learning Space

For practical investigation purposes version 3.5 of the *Lotus Learning Space* was used in this scope. In general the same reusability options like those from *WebTycho* are supported.

Corresponding to [Edu01] *Lotus Learning Space* version 4.0 allows import of *AICC* courses while *IMS* support is announced. Import and export of course content and course state in XML format is already supported.

Since *Lotus Learning Space* is a database template for *Lotus Notes / Lotus Domino* with partly open course design (partly changeable sources), actors with designer or manager rights in their *Notes* access control list can apply implementation specific changes to the learning platform via *C/C++-API*, *Java-API*, *Lotus Script* and *Lotus Formula Language*.

Netcoach

The *Netcoach* system is implemented in *Lisp* and uses the server's local filesystem as the storage system and repository for all user and course specific data. Courses, exams and user data are stored in different but task immanent files in single *Lisp* structures.

Although this results in a well modularized form, reusability of data is only supported per exporting of courses. Exported data is proprietary so that it can only be imported in *Netcoach* servers again.

Netcoach uses its own metadata structure of course content. The current implementation does not offer mappings or imports and exports to other metadata formats.

Hyperwave eLearning Suite

The online learning platform *Hyperwave eLearning Suite* is running on top of the *Hyperwave Information Server* which is a document management system which stores its documents in an object relational DBMS (*Hyperwave* recommends *Oracle*). The *Hyperwave Information Server* and its related additional components are developed at the *Technical University Graz, Austria*.

The underlying document management system offers superficial support of metadata while the *Hyperwave eLearning Suite* itself does not support metadata description of learning resources. System immanent development of metadata support or access to course content via an application programmer's interface is supported but results in high efforts.

Direct reuse of courses or course documents above subdocument layer is possible through system functions.

Ilias[1]

The open source *Ilias* online learning platform is developed at the *University of Cologne, Germany*. It uses a modularized architecture based on *LAMP (Linux, Apache, MySQL, PHP)*. *Ilias* uses a proprietary format named *VRI (Virtual Resource Index)* to refer to the modularized learning objects dynamically. It directly uses this addressing type of learning objects to support reusability.

The *Ilias* metadata system *VRI* is based on the concepts of *IMS, ARIADNE* and *Dublin Core*. This allows direct mappings from *VRI* to these target formats. It is used on the course layer, the learning unit layer, the documents layer, and subdocument layers like pages or page elements of the learning platform contents.

Since *Ilias* version 2.0 XML templates can be used for increased reusability of course content and course properties.

3.2 Comparison Schemata

In [Bat99] Bates suggests an online learning platform comparison schemata named *ACTIONS*. This name is derived from its main comparison categories: Access, Costs, Teaching, Interactivity, Organisational issues, Novelty and Speed. Without classifying a specific online learning platform it can be implied that the reusability criteria costs and speed are influenced in form of *pre-programmed multimedia* and the amount of needed *re-programming* of course materials when stored in repositories or not. The terms reuse or reusability of learning materials itself are not mentioned. Further aspects that can be treated as content reusage oriented aspects are not discussed.

The *LandOnline* service offered in the world wide web [Lan01] compares different commercial and non-commercial online learning platforms. It is updated and reviewed frequently and its comparison schemata consists of 3 main categories with a total of 15 subcategories containing a total of 62 criterions. At the moment 55 different platforms are reviewed. Regarding the classification of mentioned platforms in reusability contexts the criterion *IMS_compliance* is the only criterion giving information about learning object reuse.

While *Edutech* is offering a detailed comparison analysis service in general it is superficial regarding reusability. It is updated frequently and compares 108 criterions on 9 learning platforms. Only its *general* section handles all available authoring support with reusability oriented criterions.

The obtained list of the considered criterions with reusability aspects over all mentioned comparison schemata therefore consists of the following elements: *IMS* compliance, standards / metadata support (*IMS, IEEE, AICC*), XML support, programming interfaces, web technology compatibility (compatibility of presented learning objects with common web media types), import / convert existing material, flexible resource pool (for the course developer).

4. Adding Reusability Features in Comparison Schemata

Summarized it can easily be seen and implied that currently offered popular comparative analysis tools do not comply with online learning projects needs when decisions have to be made regarding which online learning platform should be used.

In this section of this paper a proposal is introduced to add reusability features in comparison schemata. The introduced main category of the comparison schemata enrichment is named *reusability* and consists of subsections named *basic*, *learningObject*, and *additional*.

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[1] URL: http://www.ilias.uni-koeln.de/ios/index-e.html

The notation follows the rule that a higher section identifier is separated from the included subsection identifier by the separation character '.' (e.g. *reusability.learningObject* means that *learningObject* is a subsection of the category *reusability*).

4.1 Fundamental Reusability Specific Criteria

- **reusability.basic**: Category grouping general information for reusability support.
- **reusability.basic.architecture**: Category describing the general architecture of the online learning platform.
- **reusability.basic.architecture.type**: Data element describing the fundamental type of the online learning platform (e.g. monolithic or modular architecture).
- **reusability.basic.architecture.DMS**: Data element describing the document management system of the online learning platform (e.g. no clean separation in architecture, *Lotus Notes / Lotus Domino*, *Hyperwave Information Server*, *Zope*).
- **reusability.basic.architecture.ServerServerReplication**: Data element decribing if the system provides server-server replication to reuse the same course content at a different location through distribution.
- **reusability.basic.development**: Category grouping developmental aspects of the online learning platform code.
- **reusability.basic.development.systemTemplate**: Data element describing if the online learning platform is a template system as an included application for a DMS (*Lotus Learning Space*, *Webtycho*, *Hyperwave eLearning Suite*) or if it is an encapsulated code (*Netcoach*).
- **reusability.basic.development.sourceCodeAccess**: Data element describing if platform source code is accessible (*Ilias*, *Hyperwave eLearning Suite*, partly available in *Lotus Learning Space*).
- **reusability.basic.development.APIs**: Data element describing which programming languages are supported through APIs.

4.2 Learning Object Specific Criteria

- **reusability.learningObject**: Category grouping learning object specific information.
- **reusability.learningObject.access**: Category grouping information about accessibility of learning objects.
- **reusability.learningObject.access.type**: Data element describing the type of access to a learning object (programmatic through API functions, manually by author through platform function).
- **reusability.learningObject.access.granularity**: Data element describing on which content layer the access of learning objects is supported (course layer, document layer, subdocument layer, element collections, single elements).
- **reusability.learningObject.metadata**: Category describing metadata support.
- **reusability.learningObject.metadata.type**: Data element describing the type of metadata representation in the platform (proprietary, *LTSC LOM*, *ARIADNE*, *IMS Global Learning Consortium*, *Dublin Core*).
- **reusability.learningObject.metadata.version**: Data element describing the version of supported metadata.
- **reusability.learningObject.metadata.mappings**: Data element describing which mappings exist to other metadata formats.
- **reusability.learningObject.metadata.supportLevel**: Data element describing the level of metadata support in the used metadata format (fully, partly, percentage value).
- **reusability.learningObject.metadata.cardinalityType**: Data element describing the number of metadata sets associated to the number of learning objects (1:1, 1:n, m:1, m:n associations).
- **reusability.learningObject.metadata.usage**: Data element describing how metadata is used by the platform (used in retrieval process; import-/export functions).

4.3 Additional Criteria

- **reusability.additional**: Category describing additional criteria with content reusability support.
- **reusability.additional.interoperability**: Data element describing the ability to integrate the platform in an existing computer infrastructure (e.g. to use common webservers, protocols, data standards and programming languages).
- **reusability.additional.contentStorage**: Category describing the platform content storage system.
- **reusability.additional.contentStorage.type**: Data element describing the type of database used (filesystem; proprietary platform build-in; external RDBMS, ORDBMS, XML DB, object-oriented DB).
- **reusability.additional.contentStorage.dataFormat**: Data element describing the format of the stored content (XML, relational tables, proprietary, BLOB, CLOB).

- **reusability.additional.contentStorage.accessType**: Data element describing the content access type (programmatically through API, macro definition/manually by platform function).
- **reusability.additional.metadataStorage**: Similar to reusability.additional.contentStorage but for metadata.
- **reusability.additional.metadataStorage.type**: Similar to reusability.additional.contentStorage.type but for metadata.
- **reusability.additional.metadataStorage.dataFormat**: Similar to reusability.additional.contentStorage.dataFormat but for metadata.
- **reusability.additional.metadataStorage.accessType**: Similar to reusability.additional.contentStorage.accessType but for metadata.
- **reusability.additional.export**: Category grouping data export specific information about the platform.
- **reusability.additional.export.datatype**: Data element describing which type of data can be exported (courses, documents, images, text sections, audio, video, applications, exams, &c.)
- **reusability.additional.export.format**: Data element describing the format used to export the corresponding data type (XML, object specific format)
- **reusability.additional.import**: Similar to reusability.additional.export but for import.
- **reusability.additional.import.datatype**: Similar to reusability.additional.export.datatype but for import.
- **reusability.additional.import.format**: Similar to reusability.additional.export.format but for import.
- **reusability.additional.transcoding**: Data element describing to which formats learning objects or metadata can be automatically/manually transcoded (format conversion) by the platform.

5. Conclusion and Outlook

This work proposes a criterion enrichment by adding content reuse specific categories to comparative analysis tools to support architecure decision making in an online learning environment. After analysis of existing learning platforms and their reusability features implemented in currently available versions an abstract description of decision making on learning platforms was investigated and afterwards concrete existing often refered comparative analysis tools were analysed. Referring to this analysis a proposal has been stated following a logical structure and associates online learning platform properties and features, stored learning object and their metadata properties to significant and meaningful identifiers in comparison schemata design for online learning platforms.

Investigated online learning platforms fit in the proposed schemata enrichment very well. Future work might result in implementing the proposal into existing comparative analysis tools. Furthermore an introduction of project characteristic coefficients describing a typical specific property rating spectrum of a project will be investigated. This might allow a more specific choice of an available set of target platforms due to the large scale and variety of different types of reusability demands in online learning projects.

References

[Bat99] A.W. Tony Bates, *Technology, Open Learning and Distance Education*, Routledge Studies in Distance Education, 1999

[Edu01] Edutech, *Comparison of Web Based Course Environments*, http://www.edutech.ch/edutech/tools/comparison_e.asp, 2001

[HFM+01] Stefan Hoermann, Andreas Faatz, Oliver Merkel, Ansgar Hugo, and Ralf Steinmetz, *Ein Kurseditor für modularisierte Lernressourcen auf der Basis von Learning Objects Metadata zur Erstellung von adaptierbaren Kursen*, in *LLWA 01 - Tagungsband der GI-Workshopwoche "Lernen-Lehren-Wissen-Adaptivität"*, pages 315-323. October 2001

[Lan01] Bruce Landon, *Landonline*, http://www.c2t2.ca/landonline, 2001

[LWG01] LOM working group, IEEE P1484.12/D6.1, IEEE Learning Technology Standards Committee, *Draft Standard for Learning Objects Metadata*, http://ltsc.ieee.org/wg12/index.html

[MGB+01] Erica Melis, Jochen Büdenbender, George Goguadze, Paul Libbrecht, Carsten Ullrich, *Knowledge Representation and Management in ActiveMath*, in *LLWA 01 - Tagungsband der GI-Workshopwoche "Lernen-Lehren-Wissen-Adaptivität"*, pages 173-179. October 2001

WCET e-Learning Projects and Resources (http://www.wcet.info)

Introduction

This brief paper offers an overview of several key e-learning projects at the WCET (Western Cooperative for Educational Telecommunications). These projects include: a web-based resource that is designed to develop specific tools for the higher education community; a project developing web-based student services including models, resources and processes for their implementation; and the "technology costing methodology" project that enables institutions to calculate the cost of technology within and across higher education.

e-Learning Technologies Projects

WCET was awarded a major grant from the William and Flora Hewlett Foundation to support several critical eLearning projects. This grant is providing generous support for several projects:

- The first, *e-Learning Technologies: Web Resource for Comparisons,* will provide a resource to help educators analyze and compare vendor-produced course management tools, software products, outsourcing vendors, and e-learning policies.
- A second, just underway, is exploring the need for develop and implement a simple-to-use system for evaluating distance learning courses available from third-party vendors.
- The final project involves the Hewlett Foundation and WCET staffs working together to explore policy issues that are likely to have an impact on policy for the successfully integrating technology into higher education. Based on this work, a paper on open source course management systems will be released early this summer.

e-Learning Technologies: Web Resource for Comparisons (www.edutools.info)

Of the Hewlett Foundation funded projects, the Web Resource for Comparisons is well underway to being implemented and will be highlighted in this section. For colleges to quickly implement online courses, many course management software products have been developed. These tools make it easier to adapt curriculum to the Web and to give the student a common "look and feel" in each course.

Over the next two years, this project will redesign and expand the existing site. The new website will be called EduTools (www.edutools.info). We will also develop three new companion sites that apply the same decision-making models for comparisons of other tools. The three new sites will analyze: 1) electronic student support services, 2) instructional technologies, and 3) policies relating to the use of educational technologies.

Beyond the Core: Creating Web-based Student Services for Online Learners

Students participating in distance education academic programs must also have access to student support services. However, one of the biggest gaps in online education is institutions' inability to provide time- and location-independent access to a complete array of student support services. Higher education institutions and other providers must take advantage of technology to deliver student services to online learners in a way that effectively meets their unique needs. This project will focus on Web-based student support services, defined broadly, and will result in:

- Student services models developed at three partner institutions.
- A set of guidelines for institutions interested in building their own "home-grown" Web-based services.
- Detailed case studies of the institutional change processes required to implement Web-based student services.

The project uses the Web to collaborate and disseminate information on online student services. The project leaders also produce a monthly Webcast series called, Providing Student Services to Distance Learners. Guest experts define best practices and demonstrate effective and innovative online services. This project will result in a number of models and resources for institutions to draw upon.

Technology Costing Methodology (TCM) and TCM2: Completing the Toolbox Project

The original Technology Costing Methodology (TCM) project began in September of 1998 with the goal of developing an authoritative costing methodology (and related procedures) for calculating technology costs (1) within an institution to determine if proposed instructional approaches, that make heavy use of technology, actually do serve to contain costs; and (2) across institutions allowing data to be compared legitimately for different instructional or technological approaches, which will benefit legislatures, state-governing boards, state coordinating boards, and federal agencies.

A follow-on project, Technology Costing Methodology: Completing the Toolbox Project (TCM2), focuses on refining the methodology and assisting decision-makers in exploring and understanding the policy implications resulting from additional costing information.

About WCET

The Western Cooperative for Educational Telecommunications (WCET) is a recognized leader in—and advocate for—the effective use of educational telecommunications. Its membership is open to higher education institutions and government agencies, non-profit organizations, schools, and corporations—regardless of location—that are providers and users of educational telecommunications. Six countries and 43 states are represented among the nearly 250 members. WCET, established by the Western Interstate Commission for Higher Education (WICHE) in 1989, serves its members and the broader higher education community in the following ways.

- Central clearinghouse for information and expertise.
- Source of professional development and assistance including the annual conference will be held in Denver, CO Nov. 6-9, 2002, and the Institute for Managing and Developing E-Learning (MDE) will be held in Park City, UT on July 21-25, 2002.
- Leader in facilitating cross-institutional projects in mediated education.
- Advocate for effective policies and practices supporting e-learning.
- Evaluator and researcher on quality uses of educational telecommunications.

From PBL to e-PBL

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Abstract: A completely new engineering curriculum has been introduced in September 2000 by the School of Engineering of the Université catholique de Louvain (UCL). This curriculum is entirely based upon active and collaborative learning by students. Surprisingly enough, very little is readily available to *effectively* support this type of pedagogy by means of technology. This contribution looks at available general and special-purpose tools from the point of view of their suitability for problem- and project-based learning. It also points to areas in which adequate support is still needed. Finally, it looks into technology as a way to allow participation by remote learners and tutors and it makes the case for ubiquitous access to learning tools.

Introduction

Active learning as embodied in either problem- or project-based learning has been around for more than 30 years. Many authors testify to the benefits of active learning both from the point of view of learning outcomes and from that of student and teacher satisfaction [Vernon, Blake 1993], [Gijselaers 1996].

After a long and extensive study, the School of Engineering of UCL decided in 1999 to embark upon a complete overhaul of its curriculum in order to implement active learning approaches. We took advantage of this opportunity to precisely define the expected **learning outcomes** – not to be confused with the customary tables of contents. The new curriculum was launched in September 2000 (for the first year of our 5 year program) and will, over 5 years, gradually replace the traditional approach.

Active learning is the central principle of this model: students are continuously exposed to activities which require direct participation and which stimulate learning. *Problems* are designed and run in much the same fashion as in by now "classical" Problem Based Learning (PBL) [Boud, Feletti 1997]. *Projects* are different from what one often finds in engineering curricula in that they are a means for acquiring new knowledge and competences, not merely for demonstrating an ability to apply previously acquired capabilities. We use projects mostly to develop interdisciplinary and longer-term (11 weeks) approaches, while problems are used mostly within a single discipline and during a shorter time span (1 week). Our hypothesis is that problems allow students to delve in a more controlled way into disciplinary topics than projects, thereby ensuring that essential topics would not be merely glanced over.

A second major principle of our approach is **collaborative** learning: groups of 7 or 8 students are constituted randomly at the onset of every trimester. Many – but not all – activities are tackled collectively by all students belonging to a group: this concerns mostly the preparation of individual learning, the planning of subtasks, and the sharing of results. Some of the group meetings occur in the presence of a tutor; much necessary work is done either individually or in groups without presence of tutors. Meetings are run (by the students themselves) according to a set of guidelines, but a lot of leeway is given for organizing both collective and individual work (provided it is organized).

A third essential concept in our new curriculum is a focus on (self-)assessment of progress and on systematic **reflection** about one's learning process. Indeed, we try to make the learning process as explicit as possible, since we believe that awareness about one's learning process is a necessary condition for success.

This instructional model fits nicely with the learning theory we adhere to: socio-constructivism [Jonnaert, Vander Borght 1999] [Seely, e.a 1989]. Problems and projects are situated in realistic professional contexts and incite our students to build upon existing knowledge to acquire new knowledge; communities of learners stimulate individual learning.

In this pedagogical approach, the role of faculty and other staff is totally transformed: from teachers and assistants we morphed into tutors and facilitators, entirely new roles for most of us. From providing answers we switched to asking questions, to guiding progress, to pointing to resources.

The role of technology

We decided to look at ways to use technology firstly to facilitate and enhance learning by students and secondly to lighten the overall load on our staff. It would of course have been preferable to design and implement necessary tools along as we designed and implemented our new curriculum, but scarcity of resources and the fact that curriculum design and implementation is an ongoing iterative process prevented us from following a concurrent approach. It is thus only after one year of experience with the new curriculum that we started looking into ways to use technology to support our pedagogical approach.

Two kinds of tools may be considered when looking into ways to use technology in education: widely available general purpose presentation and communication tools and special purpose teaching/learning tools. We looked into both categories from the point of view of their suitability for supporting our own brand of active learning. The next part of the paper presents a typical problem based learning cycle and reviews possible uses of technology.

From PBL to e-PBL

In our flavor of PBL, a ***problem*** is tackled by a group of students during a time span of one week. The work is organized as follows:

- In the first scheduled meeting, the kick-off meeting, the group will analyze a new problem situation; it will take stock of existing knowledge which may help tackle the problem and it will try to produce a set of specific (learning) tasks which it feels should be accomplished in order to increase its available knowledge in the areas related to the problem and in order to produce whatever outcomes are needed according to their understanding of the requirements of the given problem statement. Resources will then be allocated to the various tasks. The group will also update its weekly schedule in order to reflect its own planning of the work related to the problem at hand. A tutor is present to make certain the group reaches the objectives of the meeting (not to answer questions about the material). Since we have quite a large number of groups, a single "floating" tutor handles three groups simultaneously. A series of questions about the problem may be handed over to the group to help focus their analysis.
- After the kick-off meeting, students will do whatever they have themselves decided to do to get closer to the solution of the problem, trying to keep to the schedule they have set for themselves. They may work alone, in subgroups or in the full group, according to their own preferences and availability. This phase involves identifying and reading of course material and other resources, discussion among group members about issues raised by individual learning, resolving exercises, etc.
- Two or three days after the kick-off meeting, there is a second scheduled meeting in the presence of the tutor. In this meeting, progress towards solving the problem is analyzed and discussed, and intermediate results are shared by the members. This is usually an occasion which raises further learning issues and which may impact the weekly schedule since new subtasks may be identified.
- After the intermediate meeting, students will again pursue their own learning activities and execute whatever tasks the group has allocated them.
- At the third and final scheduled meeting, the group finalizes its production; it may be asked by the tutor to present its solution or any other product of the work. Sometimes, the group is asked to answer questions about the course material which is relevant for the problem.

We won't dwell further on ***projects***, which are run in a way similar to the one outlined above for problems, albeit over a longer time span and with weekly scheduled meetings between groups and their tutor.

If one looks at technology and wonders how it could be marshaled in order to support the process outlined above, one will immediately figure out straightforward ways to use, say, the Internet. Problem statements, resources, focus questions and the like can be made readily available through a Web site. E-mail may be used to communicate among members of a group and with the tutor. Chats may help group members pursue discussions even when not all members are physically present and threaded discussions forums may help a group focus on a given issue until it is satisfactorily resolved. Calendar and planning software may be used to handle the scheduling and planning tasks. Finally, students may be encouraged to write their own Web pages in order to record information they wish to share with other members of their group or with other groups.

Of course, one should immediately point out that using the Web to make resources available to students is still traditional transmissive pedagogy: a book with hyperlinks is still a book. Very few course delivery platforms manage to provide a truly personalized learning experience and, to judge by the amount of paper printouts of Web-delivered course materials, students have not yet been convinced to opt for a paperless society ! It is also worth noting that chats, while eminently suitable for synchronous communication between remote people, are very volatile: they leave no or little useful record of the exchanges for later perusal. On the other hand, if threaded discussion forums are not monitored closely, they may perpetuate and disseminate incomplete or erroneous information. Also, their very nature forces them to grow and become unwieldy: here again, intervention by a qualified teacher is needed to summarize and condense information into an exploitable form.

A first conclusion may be drawn from this mundane usage of the Internet: even though setting up everything that's needed may require more than a casual effort, very little of this usage is actually related to *learning* ! We shall therefore discuss some tools which could provide true scaffolding for the learning process in PBL by looking at some of the activities which occur in this process, some of which are managerial, while others are truly cognitive:

Analyzing a problem situation
Formulating hypotheses, ideas, proposals
Restating the problem
Identifying sub-problems
Preparing or modifying a list of learning issues
Preparing or modifying a list of tasks and milestones
Allocating resources to tasks
Scheduling tasks and meetings
Structuring knowledge
Sharing knowledge
Making choices
Making all ideas, opinions, decisions known to all group members
Finding out how work has progressed with respect to the schedule
Proposing paths to solutions
Evaluating paths to solutions and solutions
Assessing the group's progress in the various tasks
Assessing one's own mastery of the course material
Preparing the expected production, results, outcomes
Assessing other groups' production
Identifying and resolving conflicts

What we are looking for are tools which support and encourage learning through discovery and peer interaction (i.e. interactions which affect learning positively and deepen student understanding) and which promote collaboration and group cohesion.

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Shared workspaces

Shared workspaces such as BSCW [Appelt 1999] provide the basic mechanisms for cooperative work between members of various communities, thus also – potentially – between the members of a PBL group (including the tutor). Shared workspaces are used to collect, structure, and present any kind of information needed for the work at hand, usually arranged in a hierarchy based on commonly agreed upon structuring principles. They may also provide event services, which will inform members of a group that something worth their attention has happened. Additional features may include authentication, version management, search capabilities, discussion forums, etc. Integration of various synchronous and asynchronous communication means is usually provided, up to a point. There may be some support for the scheduling of meetings. Several of the group ***communication*** and ***management*** activities in the list above may be supported in some way by such shared workspaces, provided the learning curve is not too steep (for teachers as well as for students). However, as general-purpose tools, such workspaces fall short of providing support for cognitive activities. Still, our intent is to deploy such a system next year in order to find out which of the features will be adopted by our students to support their collaboration.

A next step up the evolutionary ladder is exemplified by environments such as the CoVis Collaborative Workbook [Edelson e.a. 1996]. In this system, the objects manipulated by the tools are not just any kind of document, but they are *typed* according to their use in a learning process. For instance, in the Scientific Notebook, one distinguishes the following types of objects (called "pages"): question, conjecture, evidence-for, evidence-against, plan, step-in-plan, information, and commentary. Students add pages and links between pages as they proceed along their inquiry, which helps structure the process and thus leaves more time for working on the content. The resulting web of pages provides a *trace* of the *process* and certainly helps tutors provide better feedback than that which may be provided by looking only at the final results of a group's work. The authors of the system report on several successful uses of their tool in project-based learning.

Still higher on the scale of tools providing effective support for cognitive activities are tools exemplified by IHMC's Concept Mapping Tool CMap [Canas, e.a. 1999]. With this tool, students may collectively build a graphical representation of concepts and relationships between concepts as their understanding of a domain evolves over time. Threaded discussions may be associated with concepts and with links, and a system for managing propositions is also available. The way students model their knowledge by means of such tools provides deep insight in their thinking processes and allows even more effective tutor interaction and feedback. We shall soon look into ways to integrate CMap in our problem and project-based approach since we feel that its knowledge representation power will help us make learning more explicit (as sequences of evolving concept maps).

Time management

As they find out quite quickly for themselves, the scarcest resource for students (and for teachers) is time. Very few of our students manage to successfully juggle the various assignments and tasks which run concurrently. Since we wish to develop self-sufficiency, we refrain from providing complete work schedules for every group. Instead, we schedule only pre-planned activities such as lectures and tutored meetings. We wish therefore to incite our students to pay serious attention to issues such as planning, scheduling, milestones, deadlines and accountability. This is an area in which none of the available software packages we looked into fit our requirements, our needs, and our budgets. Most calendar and planning software is designed for professional use and is much too complex and constraining for student use. Besides, such tools may allow one to enter a schedule, check its consistency, and verify its execution, but do they help one learn how to prepare a valid schedule ?

Assessment and feedback

A central tenet of problem and project-based learning is that a student should be constantly aware of his/her progress (or lack of it). Self assessment, peer assessment, and assessment by teaching staff are thus an intrinsic part of any PBL approach. Indeed, some form of assessment necessarily precedes reflection upon one's learning. Since it would be too costly to provide on-demand assessment by staff, numerous attempts have been made to provide on-line interactive assessment tools. Here too, the situation is less than encouraging, since most tools fail to allow assessment of higher order cognitive skills: how does one write a tool to check the validity of a proof, the correctness of a design, the adequacy of a line of reasoning ? How does one distinguish between shallow and deep learning ? How does one reveal incomplete understanding ?

Our experience with on-line multiple choice / multiple answers quizzes shows that they tend to give a false sense of knowledge and understanding and thus fail to promote self questioning and meta-reflection: students tend to stop trying to learn as soon as their marks reach a "satisfactory" level: scoring high becomes the main goal, instead of acquiring knowledge. Besides, we would like our students to set their own learning goals, not only to try and reach those we set for them. Providing effective on-line self-assessment for student-set learning goals is even harder to imagine !

About the human cost of technology

When we decided to switch from traditional pedagogy to active learning, we knew it would require a lot of effort to design and implement the new curriculum. It turns out that using technology to support collaborative learning has significantly added to our work load: deploying and maintaining tools to help our students is far from cheap with respect to staff costs. Several of us have paid dearly to set up devices whose pedagogical efficiency remains in doubt. The lesson we draw is that, when planning for the use of technology in education, one should run a cost/benefit study taking into account the real added value of technology rather than expectations.

From e-PBL to d-PBL to m-PBL ?

We now briefly contemplate what happens when one adds new dimensions to the issue of using technology to facilitate problem- or project-based learning.

A first possible extension consists in allowing some of the members of a group to participate in the various activities while not physically on the premises with the rest of the group. In this case, one mostly worries about alleviating the effects of distance on the dynamics of collaborative work [Davis, Schlais 2000].

Some of the tools such as e-mail, chats and threaded discussion forums, which fail to provide significant support for PBL when all participants are present in the same room, now start playing a much more effective role since they help bridge the physical distance between participants and allow more asynchronous operation of the group. The other tools described earlier will certainly be as useful as in the case of "traditional" PBL. Of course, one should not underestimate the negative impact of distance on social issues such as group identity building, group cohesiveness, and individual motivation (every one of which is essential to the success of PBL) and one should probably not overestimate the power of technology to truly compensate for this impact. Still, this case may be one when videoconferencing might prove useful (certainly for Europeans learners) to overcome the distance barrier between participants.

Another issue which must be faced is that of the availability of technology-based tools to learners. We feel that learning tools should be available whenever and wherever a learner feels like using them. This means that, whenever possible, a variety of terminals (PC, PDA, cell phone) should allow access to these tools with a minimum of technical fuss: what's the use of a powerful agenda tool if it is not available day and night ? We are now in the process of providing wireless access to a part of the city of Louvain-la-Neuve in order to facilitate ubiquitous connectivity and mobility. We expect that 3^{rd} generation GSM mobile phones will widen the coverage within a few years. Still, not many of the existing tools cater to terminals in the PDA to cell phone range, which rather limits the usefulness of wireless coverage.

Conclusions

A single year has been concluded at the time of the writing of this paper: it is therefore too early to draw conclusions about the actual learning outcomes of our new curriculum. Still, one thing is quite clear: many of us feel a strong need to use technology in order to enhance the quality of students' learning and, if possible, to relieve staff from some of the pressure inherent to active pedagogy. An overview of existing technology-based tools reveals that few of those which are readily available are really effective in their support of the learning process in PBL. A first challenge is thus to identify and deploy tools specifically to enhance and facilitate ***learning*** and related activities, rather than merely automate some of the clerical and managerial work.

A second challenge is to provide ubiquitous access to existing and future tools: learning activities should be possible in every occasion when a learner is (1) available and (2) willing to learn. We feel that too many learning opportunities are missed because technology is not yet available in every case when both conditions are met.

A last – but not the least – issue concerns the overhead for both staff and students for using technology-based tools: these tools need to be simple and easy to use in order to allow both categories of participants to focus their attention and devote their efforts to the essential aspects of their respective jobs (i.e. instructional design, tutoring, collaborating, and learning), and not on the use of the tools themselves or the mastering of their interfaces.

References

Appelt, W. 1999: *WWW Based Collaboration with the BSCW System*, in Proceedings of SOFSEM'99, Springer Lecture Notes in Computer Science 1725, p.66-78; November 26 - December 4, Milovy (Czech Republic) (http://bscw.gmd.de/Papers/SOFSEM99/sofsem.pdf).

Boud, D., Feletti, G. (eds) 1997: *The Challenge of Problem-Based Learning*, Kogan Page, London.

Canas, A.J., Leake, D. B., and Wilson, D.C. 1999: *Managing, Mapping, and Manipulating Conceptual Knowledge* (http://www.coginst.uwf.edu/projects/caseBasedCapture/AAAICBRCMaps99.htm)

Davis R., Schlais D., 2000 : *Learning and Technology : Distributed collaborative Learning Using Real-World Cases*, Journal of Educational Technology systems, 29 (2), 2000-2001, pp143-156.

Edelson, D.C., Pea, R.D., and Gomez, L.M. 1996 : *The Collaboratory Notebook*, Comm. ACM Vol 39, No 4 (April 1996), pp. 32-33 (see also http://www.ls.sesp.nwu.edu/cnb/ and http://www.sfu.ca/~koneill/DKO%20Ed-Media%2094.pdf)

Gijselaers, W.H , 1996: *Connecting Problem-based Practices with Educational Theory.* in New Directions in Teaching and Learning, Jossey-Bass Quarterly Sourcebooks, number 68, Jossey-Bass Publishers.

Johnson, K.A., Foa, L. J. 1996: *Instructional Design: New Alternatives for Effective Education and Training.* American Council on Education, Oryx Press.

Jonnaert, P., Vander Borght, C. 1999: *Créer des conditions d'apprentissage. Un cadre de référence socioconstructiviste pour une formation didactique des enseignants.* De Boeck, Bruxelles.

Seely, B.J., Collins, A., Duguid P. 1989: *Situated Cognition and the Culture of Learning* (http://www.slofi.com/situated.htm)

Vernon, D., Blake R. 1993 : *Does problem-based learning work? A meta-analysis of evaluative research.* in Academic Medicine 68:550-563.

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From Parrots to Puppet Masters
– an Online Role-Playing Tool for Fostering Second Language Acquisition

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Abstract Language learners often leave school able to do little more than parrot second language formulae. This paper proposes a Web-based system for the construction, delivery and management of online language courses. The system and courses it supports are aimed at providing more timely and personalized instruction than learners normally have available. They also provide opportunities for practice in collaborative and creative communication. This paper illustrates an online ESL course driven by this system, and highlights a role-playing activity that encourages the appropriate use of language in social and business contexts. It allows students to gain facility with basic grammar, vocabulary and conversational language devices, as well as 'higher order' pragmatic linguistic skills.

A problem in language education

The need to educate a large and varied population in English as a *lingua franca* in SE Asia has given rise to a number of problems, which are in a general sense also faced in the teaching and learning of other types of knowledge and skills.

One of the most frequently discussed problems in SE Asia is the unhappy force-fed pedagogy in which many teachers and students find themselves trapped (e.g. Zeng, 1999). This problem is complicated by a dearth of qualified ESL teachers and a lack of time and resources to develop effective lessons. Educational theorists generally believe the teaching and learning practices based on 'teaching to the exam', which are the preferred methods in many public and private institutions in SE Asia, dampen students' desire and ability to learn (e.g. Paris, 1995). However, because of the face validity that norm-referenced standardized assessment promises, these practices often dominate the curriculum. While this problem is most keenly felt at primary (!) and secondary levels, even tertiary education is not free of it.

One of the shortcomings of these practices is that they habitually result in students merely learning how to parrot formulae. In the case of second language learning, stock phrases taught at school are often made to substitute for grammatical and communicative competence in the target language (Milton, 2001). This practice is not always the fault of the teachers, who are often victims of social pressure to teach test-taking strategies for short-term gains.

One proposal for dealing with the problem

The author was commissioned to produce online 'workplace English' courses for professionals, and 'bridging' courses for secondary school-leavers who have been out of school for a number of years and who wish to upgrade their English or to enroll in tertiary courses taught in English. These students are mainly Cantonese and Putonghua speakers at a wide range of English proficiency levels, requiring a broad array of receptive and productive English skills.

It was not immediately apparent how current multimedia technologies could be deployed quickly and cheaply in order to develop and deliver high-level interactive online language learning content. Despite the Web's potential to provide courses on demand, most content delivery systems appear to offer an unsatisfactory range of activity types and learning options for dynamic language learning.

It seems reasonable to expect an online content development and management system to assist materials developers and instructors (who often have limited time and resources) to create engaging and meaningful communicative, collaborative and problem solving activities. We should also expect the courses created on such a system to follow generally agreed educational principles and pressing logistic needs by:

- appealing to a wide range of learner proficiencies and interests;

- motivating low-proficiency students, who often suffer from low self-esteem, to engage in high-level interaction, while also enabling a transparent system of student and teacher accountability;
- providing quality, individualized instruction to a large number of varied learners;
- ensuring a coherent, planned and progressive curriculum, and the transmission of core information, while also providing opportunities for self-discovery, problem solving, participation and collaboration, creativity and the pursuit of individual learning paths (i.e. aim at the type of quality assurance outlined by Alley and Jansak, 2001);
- enabling and encouraging the teacher to act more often as a mentor, and less often as a pedagogue;
- integrating intrinsic, criterion-referenced and performance-oriented formative assessment into the learning process, thereby minimizing the need for extrinsic, norm-referenced summative assessment;
- providing quicker and more reliable reporting to the instructor, allow for easy, consistent grading, and also more effective and quicker feedback to learners; and
- allowing ongoing assessment of the content and methodologies by the students.

It was crucial that this online content development system allow for the specific pedagogical needs of language courses. This meant making it possible for students who may have little perceived opportunity to use the target language in their daily life to gain accuracy and fluency in all language skills. These skills include authentic listening, speaking, writing and reading activities.

Internet technologies potentially allow for a highly interactive educational model through retrieval of online data, as well as through enhanced communication among students and with the instructor. However, while access to expert support is important, it is both pedagogically and economically counter-productive to base online courses entirely on a teacher-led model. In the absence of reliable, affordable and widely available Artificial Intelligence systems for human language acquisition and production (e.g. natural language parsing), this requires the careful preparation of objectively scored activities – ideally aimed at 'higher-order' outcomes (e.g. Haladyna, 1997). These activities, content and technologies must of course be sufficient and appropriate to meet the learners' needs and learning styles, which in this case are extremely varied.

More importantly, an effective online language-learning framework requires the development of collaborative activities that make communicative use of the language the responsibility of the students themselves. Various studies (e.g. Johnson, 1993) suggest that a well-organized learner-centered curriculum, especially one that puts extensive resources at the disposal of teachers and students, enhances effective mentoring of students and increases the accountability of students for their own learning. Students in an online environment normally produce far more language (in this case, both writing and speech) than those in a traditional class (Selfe & Cooper, 1990), and the instructor has more often to play a mentoring than the conventional classroom pedagogical role.

Several currently available course delivery systems were evaluated, and while all permit basic information delivery and assessment, none applied the range of mechanisms for language learning suggested above. Also, most systems leave much to be desired in the ease with which content can be authored, the degree to which individual learners can be accommodated and social interaction encouraged. Internet technologies continue to make available new expanded forms of communication and participation, but these new technologies often take considerable time to be integrated into commercial course delivery systems, and most of these systems do not allow new technologies to be easily incorporated on an *ad hoc* basis. A careful look at the technologies involved suggests that – if it is pedagogically justified – database-driven Internet technologies have matured to the extent that it is technically and economically feasible to develop original, a customizable Web system with the features outlined above that can be used to create, deliver and manage interactive, individualized online content.

Among the parameters set for this system were that it must allow courses to be undertaken through a series of sequenced activities and units: learners are generally held accountable for completing a 'unit' within a set period. It must nevertheless allow for streaming so that more or less proficient and independent learners, or learners with different academic or job-related needs, can pursue different learning paths and activities within the same course. It must allow the creation of conventional 'objective' activities (i.e. activities that can be automatically graded, such as multiple choice, gap fill, drag-and-drop, matching etc.). Less conventionally, it must also allow the creation of open-ended activities beyond standard essay submission forms and threaded text discussions – for example, sequenced access by learners (via 'Voice over Internet Protocol' – *VOIP* technologies) to asynchronous and synchronous voice discussion Web boards. The remainder of this paper illustrates yet another, even less conventional open-ended module implemented in an online English course currently driven by this system: a module that learners can use to create and post animated role-plays on the Web.

Online Role Plays

Oscar Wilde observed, "Education is an admirable thing. But it is well to remember from time to time that nothing that is worth knowing can be taught." (1913). How to make known the unteachable may in some sense be answered by Muriel Rukeyser's 1960 remark that "The universe is made of stories, not of atoms." Allowing the language learner to adopt the role of narrator as a means of acquiring language skills is particularly relevant.

While not negating the role of the instructor, most academics accept that 'higher' levels of learning, such as 'critical thinking', which are not easily taught or assessed, are the preferred outcomes of the educational process. There is justifiable concern whether universities are currently producing students capable of achieving the higher order learning outcomes listed in Bloom's taxonomy of educational objectives (i.e. recall → comprehension → application → analysis → synthesis → evaluation). One term often used by linguists to describe the advanced communicative proficiency that make advanced level communication possible is 'pragmatic competence', which includes the ability to critically evaluate what is said or written and to respond in a contextually appropriate manner.

One way such outcomes have been encouraged is through role-playing activities, usually face-to-face or at a distance. These are used in many disciplines, with various online projects using 'virtual worlds' (e.g. MUDs) in simulations of business or academic projects. The benefits of role-playing for generalized educational settings are detailed in Jones (1985), and specifically for language learning in Ladousse (1987), Crookall & Oxford (1990) and Bambrough (1994).

In the course delivery system developed in response to the requirements sketched above, students use an online 'scripting tool' to manipulate animated characters on screen, assign them movements and gestures (including some body language) and to write dialogue that is synthesized and 'spoken' by the characters, whose mouths move synchronously with the dialogue. The technology that runs the animated characters ('Microsoft Agent') was originally developed to give a social dimension to the computer interface.

Via this technology, students can listen to their dialogues (or any other text on the Web page) rendered with standard American or British synthesized pronunciation. The current stage of development in freely available text-to-speech technology is such that the synthesized suprasegmentals (e.g. stress, rhythm and intonation) are not entirely human, but the students who have taken the course (almost 300 to date) rarely complain about the quality of the synthetic voices. Indeed, they report finding the relatively high accuracy in pronunciation useful (the voice synthesis can be replaced by a recording of a human voice if the student or instructor wishes – e.g. where prosodic modeling is crucial). This activity has the benefit of allowing teachers and students to script and edit conversational dialogue. It also allows the instructor, who has access to the written script, to supply detailed written feedback on the accuracy, fluency and effectiveness of the students' dialogues. Students have additional opportunities for direct practice in synchronous and asynchronous conversation with the instructor and with other students on the voice discussion boards mentioned above (e.g. http://ihome.ust.hk/~lcjohn/International_Voice.htm).

Several Second Language Acquisition (SLA) theorists recommend the use of dramatization, 'actualization' and narrative techniques for effective SLA, regardless of the age of the learners (e.g. Oller, 1993). Scarcella and Crookall (1990) also review research to show how simulation facilitates second language acquisition by giving students the opportunity to try out new language in a safe environment. The learning theories they discuss claim that learners acquire language when:

- they are exposed to large quantities of comprehensible input through being engaged in genuine communication as part of the roles assigned to characters;
- they are actively involved in worthwhile, absorbing interaction, which tends to make students forget they are learning a new language; and
- they experience positive feelings and attitudes.

Such studies argue that the dramatization of 'real life' problems helps students develop their critical thinking and language-related problem solving skills. Role-playing would certainly appear to be a useful language acquisition activity to the extent to which we view language as a vehicle for the realization of interpersonal relations and social transactions.

The particular role-playing activity which this system supports allows students to practice and demonstrate 'higher order' linguistic skills such as the pragmatic devices necessary for developing a narration, resolving a conflict, conducting a negotiation etc., while also being a useful vehicle for practice in basic grammar, vocabulary and conversational language devices. Students are guided in commonly avoided, misused or overused language devices. The activity gives students the opportunity to express and acquire cultural values and to be creative, while developing practical language strategies for handling business and social communication. Those who are normally shy to speak spontaneously in a classroom out of concern for their imperfect English appreciate the opportunity to practice using the language in this context. A serendipitous benefit of the activity is that it appears to give students who have limited technology fluency more confidence in the use of computer applications and enhanced Internet skills. Incidentally, it also appears less prone to plagiarism: students seem less inclined or able to copy holophrastically from other sources when they are scripting for the digital puppets – perhaps because the activity is not so closely associated with academic assessment and right/wrong answers, as is the standard essay question.

This role-play activity (normally assigned once in each unit or in alternative units) was designed to encourage students to work collaboratively at a distance. However, while role-playing may be an ideal participatory exercise in active learning, this ideal cannot be fully realized if students find it difficult to schedule online meetings in order to co-design plays. Most students who have taken the course to this point are professionals seeking to improve their English, and most have chosen not to collaborate with other students in writing their role-plays. A number of students do, however, work with family members in designing and scripting the plays. Even when they write the plays alone, they socialize through the public production of the scenarios, by giving and receiving classmates' feedback, and through the virtual relationships they establish among the animated characters. Several of the higher-order outcomes that are claimed for team-based role-playing activities are also possible in the creation of individually written role-plays, such as increased confidence in language production, heightened discriminatory skills, and the sheer fun that comes from the act of personal expression and creation. Collaborative elements can nevertheless be retained, even when the students choose not to work together. In addition to commenting on and grading each other's plays (by assigning 'stars'), students often spontaneously continue narrative lines from their classmate's plays.

A functional thematic context (e.g. telephone skills, encouraging and criticizing, the language of negotiation) is developed in each unit. Also, relevant grammar and lexis, along with the features of spoken language (e.g. stress, rhythm, intonation and pronunciation), are provided to students through a variety of high-interest interactive activities (including via licensed popular songs and lyrics streamed from our server). The spoken and written input are based on extensive research into the language learning difficulties of the students, and are more authentic and copious than can normally be made available in the classroom.

Instructors and fellow students supply feedback to each play, and students can re-write their scripts. Care is taken to make the purpose and structure of the role-plays clear, since many students are more accustomed to conventional essay assignments than they are to communicative methods of evaluation (see Li, 1999 for a discussion of the mismatch between student expectations for teacher-led instruction and the participatory methods often preferred by western-educated teachers).

The instructor can exemplify a wide range of language features in communicative contexts with this technique, including problematic or unknown grammatical structures and lexis. Scripts written by learners usually illustrate surprisingly authentic (albeit imperfect) dialogue. Learners are enabled to adopt opposing points of view and often make an effort to use problematic grammatical structures that are frequently avoided in conventional settings. Their errors provide teaching opportunities, and are evidence of involvement in genuine communicative acts, rather than the mere completion of academic exercises in error avoidance.

Conclusion

The system outlined in this paper allows language teachers and course writers to take advantage of ongoing advances in Internet technology to deliver instruction while encouraging participatory learning for 'higher order' outcomes. The online English course developed on this system seeks to address cognitive and affective learning needs and allows students to pursue their own language learning goals free of many of the logistic limitations of the classroom. The specific modality highlighted in this paper combines Internet delivery with database connection, computer animation and speech technology to enable language learners to experiment with manipulating the second language in simulated and supported contexts.

This role-playing exercise is one of the most popular activities in the current online English course: almost all students find this activity 'very interesting', and at the completion of the course, most mention it as one of their favourite activities. The approximately 300 students who have taken the course so far showed an average increase of 35% in their listening comprehension and 24% in grammatical accuracy over the length of the course, based on standardized pre- and post-tests.[1]

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[1] Changes in performance of productive skills (writing and speaking) have not yet been measured.

There are a number of plans to enhance the use of the narrative and dramatization devices discussed here. In addition to being able to write their own scripts, students should be given more control over the narratives provided by the course author. This will mean building in various forms of student-driven controls, including possibly voice recognition, and writing branched scripts so that interactions proceed according to choices made by the student.

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References

Alley, L. and K. Jansak. (2001).'Ten Keys to Quality Assurance and Assessment in Online Learning.' http://www.worldclassstrategies.com/papers/keys.htm

Bambrough, P. (1994). *Simulations in English Teaching*. Philadelphia: Open University Press.

Crookall, D. and R. L. Oxford (Eds.), (1990). *Simulation, Gaming, and Language Learning*. New York: Newbury House.

Haladyna, T.M. (1997). *Writing Test Items to Evaluate Higher Order Thinking*. Needham Heights, MA: Allyn & Bacon.

Johnson, D. W. (1993). *Reaching out: Interpersonal effectiveness and self-actualization* (6th ed.). Needham Heights, MA: Allyn & Bacon.

Jones, K. (1985). *Designing Your Own Simulations*. London: Methuen & Co. Ltd.

Ladousse, G. P. (1987). *Role Play*. Hong Kong: Oxford University Press.

Li, Ming-Sheng. (1999). *Perceptions of the Place of Expatriate English Language Teachers in China*. PhD Thesis. La Trobe University. (http://my.glasscity.net/~xiong/tic/li.html)

Milton, J. (1999). 'Lexical thickets and electronic gateways.' In C. Candlin and K. Hyland (Eds.) *Writing: Texts, Processes & Practices*, Harlow: Longman. 221-243.

Milton, J. (2001). *Elements of a Written Interlanguage: Institutional Influences on the Acquisition of English by Hong Kong Chinese Students*. Research Reports (Vol. 2). Hong Kong: HKUST.

Oller, J. W., Jr. (1993). 'Reasons why some methods work.' In J. W. Oller, Jr. (Ed.). *Methods that Work*. Boston, Massachusetts: Heinle and Heinle. 374-385.

Paris, S. G. (1995) 'Why Learner-Centered Assessment is Better than High-Stakes Testing'. In N.M. Lambert and B.L. McComb (Eds). *How Students Learn: Reforming Schools Through Learner-Centered Education*. Washington, DC: American Psychological Association. 189-209.

Rukeyser, M. (1960) *The Speed of Darkness*. Random House. 111.

Scarcella, R. and D. Crookall. (1990). 'Simulation/gaming and language acquisition.' In D. Crookall and R. L. Oxford (Eds.). 223-230.

Selfe, C. & M. Cooper (1990). 'Computer conferences and learning: Authority, resistance, and internally persuasive discourse'. *College English* 52 (8). 847-869.

Wilde, O. (1913) 'The Critic as Artist.' In *Intentions*. London, Methuen & Co. 104.

Zeng, K. (1999) *Dragon Gate: Competitive Examinations and Their Consequences*. London: Cassell.

A Computer-Based English Exercise System through Pictures Using TTS

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Abstract:This paper describes a computer based English exercise system through pictures using TTS(Text to Speech). With the help of TTS technology, this system can provide the phonic check function of a learner's input answers in order to overcome the shortcoming of language learning coursewares that must rely on sound files. This system can also provide check functions of word spelling and grammar for the learner. The TTS technology can fully display the advantage of computer multimedia teaching and realize the real computer based interactive teaching.

English Exercise System Base on TTS

In an English lesson, a teacher often draws the content of course on a picture in advance and asks the students some questions about the picture in classroom This kind of teaching method makes a point of the student's participation and enhances the student's initiative to a certain degree. So this method is in favour of training the learner's ability of studying the foreign language. Different learners will have individual perceptions as well as different language foundations, so they will give different interpretations of the pictures and give different answers. Because of the restriction of course time and the teacher' energy, it is impossible for the teacher to check all answers. Some partial outstanding student's reply may usually replace the entire class student's reply, some partial outstanding student's reply may usually replace teacher's explanation, simultaneously the teacher's answer only can take the reference.

Under this condition, the majority of students may be occupied in the passive study and therefore the student's initiative study and the positive thought can not be manifested fully. Therefore it is very important for a language courseware to provide interactive functions.

In every kind of couresewares, the process of sound mostly adopts sound files, namely recording sound of teaching contents in advance to become the sound files, and plays them in the class. The learners can't usually check the pronunciation of their own answers and it is also impossible in advance to record the sound files of all the answers. Regarding any language practice system, it is impossible to enumerate all possible answers, but if it only stipulates one standard answer, it will not conform to real life language. So it is impossible that the coursewares to provide interaction functions for the learners. The TTS technology solves this problem in computer-based language teaching.

This paper designed a computer-based English exercise system using TTS. This system takes the advantage of computer multimedia, specially the vividness and interaction of computer multimedia for overcoming the shortcoming of the traditional teaching, at the same time this system also can overcome the shortcoming of the usual computer-based language exercise systems that are unable to pronounce the learner's input answer. Therefore this system has the ability for the learner to feel the different pronunciation between the different sentences.

The system is effective because a learner must see the picture using his eyes, and think of the answer using his head, then type the answer using his hand, pronounce the answer using his mouth at last. All of above may bring the learner's enthusiasm, enhance the study effect.

Database design

Designing a database for storing all the picture files path and exercise contents. Furthermore, all the learner's information is stored in the database.

Most of the language exercise systems use database to store the datum. This paper also selects database to store the picture file path, exercise contents and the learner's information including the study degree of progress. At the same time in order to use the sound files provided by the teachers, the function is set for switching TTS and sound files which means that the fields of question sound file path and answer sound file path are established.

Word spelling and grammar check

Providing the functions of word spelling and grammar for the learner to check the input answer by himself in exercise.

Because the self-practice is provided for the learners, it is very important to provide the functions for checking word spelling and grammar. This paper uses the check function of word spelling and grammar in Microsoft WORD for providing the reference about word spelling and grammar. This function may not only let the learner understand the possible mistakes, and but also can help the learner to understand the related knowledge, similar to providing a privately owned instructor. Of course, one question can proceed iteratively.

Checking standard answer

It will be useful for the learner to understand the study contents by the way of comparing reference answers.

Comparing the reference answers will let the learners understand the point contents of the exercise.

Pronunciation Using TTS

This paper selects the Microsoft's Speech API (SAPI) which is well established as the leading platform for adding speech recognition and text to speech capabilities to desktop PC applications. TTS is used to convert the learner's answer into speech. Simultaneously when a question and its answer does not have the sound files, TTS will convert them into speech. This enables the teacher to ask ad hoc some questions in class and let the learners practice them at once.

Conclusion

In brief, the union of computer multimedia technology and the traditional teaching method will cause the students to become fully involved. Through studying the scene created by computer multimedia, the study enthusiasm of students is stimulated, the thought angle will be opened up and cause the student's thought quality to take a great leap forward. The stimulation of the student's thought process will incur an avalanche effect and result in a very high role of learning retention.

References

Microsoft Speech SDK White paper, TTS Engine Vendor Porting Guide, Microsoft Corporation

Microsoft Speech SDK White paper, Simple TTS Guide ?Speak to a File and Speak a File, Microsoft Corporation

Microsoft Speech SDK White paper, Speech Telephony Application Guide, Microsoft Corporation

Microsoft Speech SDK White paper, SAPI 5.0 SR Properties White Paper Simple TTS Guide, Microsoft Corporation

A Design Method for Multi-Language Support Web-Based Chinese Learning System Using ASP

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Abstract: This paper describes a method for supporting multi-language display in a web-based Chinese learning system created by ASP(ActiveX Server Page). The proposed method uses both databases and ASP dictionary objects to display different language prompts for a learner of Chinese with different mother languages. With multi-language support, the developer of web-based Chinese learning system can avoid massive repeated development. The proposed method based on database and ASP technology provides one extremely good method for realizing the expansion of the web-based language learning system from one language to other languages.

Chinese Learning System Supporting Multi-Languages

When a web-based Chinese learning system is designed, Chinese character must be displayed in all the web-pages. Meanwhile it must be considered that the learner may come from different countries. It means the mother language will be different. For a Japanese, Japanese will be also displayed but for an American, English will be displayed in the same web pages. So it is necessary for a web-based Chinese Learning System to support multi-language display. This question may be considered as using some method to realize fast transformation of the page contents by obtaining the suitable data from a database and then display the data using the ASP dynamic demonstration. All the text and image files of different languages in the web site are stored in the database. All the pages carry a variable to identify which language the site is also to be displayed except Chinese. Based on the language of every learner's browser, the content is pulled out from the respective tables for the language chosen, and displayed.

Choosing Character Encoding

The first thing is decision of character encoding when designing a web site. For a web site of Chinese learning system, it needs to use two languages on a web page. The web page might include scripts with both Japanese and Chinese string literals. In these languages, the web pages may also have static HTML segments and dynamic information acquired from a database. For instance, if Chinese is declared, then the Japanese text will be misinterpreted. So this paper declared UTF-8 which supports many languages as character encoding to format all pages.

Design Text and File Path Database

When the browser language changes, it is hoped that there is no need to modify the ASP pages but only add data to database. For example, if the prompt text in English is "yes", then when the browser language changes to Japanese, the word "yes" will be altered to Japanese word " ,Í,¢ " meaning yes in Japanese. Hopefully, no modification of any ASP pages is needed. Based on above requirement, the database is designed as below.

Two tables are created for saving the prompt text. One table is common strings to save the repetitious words and phrases. Moreover one table is specialized strings to save the words and phrases only used in a specific page. It has advantages that the standard maintenance is simple to store the public text and the specific text separately. The tables use both the field string name and the filed language code as the key filed. The field string name and the filed language code are united to create the main index. The field display string is used to preserve the word, the phrase or the sentence. Only one index is created for all records because all the repetitious input of a word, phrase or sentence must be avoided.

Regarding specialized string table, it needs an extra field for the connection with the common string table. It must be considered that not all data can be stored in the dictionary object, in fact most of them are retrieved from database when needed. So a special string table is needed to save these data. Only the data in common string table is loaded to the dictionary object because these are not necessary to change frequently. The fields of the tables are showed as below.

Regarding the picture files, the table can be created with the same step described above to save the file path. Only replace the field display string in the common image table and specialized image table using the filed of file name.

Read Data from Database to Dictionary Object

The Dictionary object in ASP is a data structure that can contain sets of pairs, where each pair consists of an item, which can be any data type, and a key, which is a unique String value that identifies the item. The values can be extracted from a Dictionary object only simply placing the object.key identifier on the right side of the assignment statement. Such an assignment returns the value of the referenced key. The dictionary object can be set as global action for the entire application scope. Bu it is no need to worry the loss performance.

After the connection to a database is created, the data in database will be received and loaded to the dictionary object. The language code and string name are united together as a dictionary key and the value of field displaystring is set as the key's value. The result is to put the value of the field display string to the corresponding dictionary data area. Therefore good performance can be obtained, because the lasting database connection is avoided that will influence the performance. In fact, database is only connected one time when application start, after that the ASP page will read the necessary data from the dictionary object.

Quotation of Text and File Path in ASP Page

After the data including text and file path are stored to the dictionary object, they can be quoted in the ASP pages. But at first it is needed to know the language of the current user' browser. It can be obtained the variables of the request object. The text or picture file path saved in the dictionary object may be obtained through the corresponding key value, the key value is composed of the name and the language prefix. According to experience, there is no disadvantage caused by quoting data from the dictionary object instead of the input data directly. This is because the text or the picture file path which is stored in the dictionary object is buffered by the server.

Example/Discussion

The proposed method is evaluated using a web based Chinese exam system. This system allows the examiners with different mother languages join the test at same time. When an examiner accesses the system, the web server obtains the language information of browser, then retrieves data from the common string table. For the special string table, the language code, common string name and string name are united as key to retrieve data from the special table. For example, if the language code is en and the common string name is section1 and the current string name is point1 then the content(word) stored in the special table will be displayed in the web page. So there is no need to modify any place in the web page, it can be used for different mother language examiners.

Certainly, the realization of multi-languages support has more other factors to be considered. When an education system is designed, it is very important that good design is useful both for the user and the developer. In this paper, how to set the isolation between the content the change and the development is explained. This plan may not only regard Chinese learning system, but may be useful for orther learning systems. The database and the dictionary object as well as the ASP technology provided one extremely good realizations from one language to other languages in web based learning systems.

References

Microsoft Active Server Pages: Frequently Asked Questions, Microsoft Corporation, September 1997
John Meade, Using ASP to Internationalize Your Web Pages on Windows 2000, March 28, 2000
Sjoert Ebben, Gwyneth Marshall, Designing a Globalized and Localizable Web Site, August 27, 1999
Microsoft Corporation White Paper, International Features of SQL Server 2000

Decisions, Decisions, Decisions...how to approach the implementation of a distance learning program.

Description:
The rush to develop online, telecommunicated and hybrid degree and certificate programs has left a trail of failed programs, bankrupted corporations and disillusioned individuals both academically and commercially. Still drawn to the promise of distance education institutions, administrators and faculty alike, are taking a second look and attempting to learn from the successes and failures of others. This panel discussion aims to stimulate thinking in the interest of ensuring that institutions interested in distance education are reminded of what to consider and how to plan for program development and implementation. Three experienced distance learning creators will put it all on the table with lessons learned from the implementation of both online and telecommunicated degree programs.

This panel will present and answer questions covering a broad range of topics from planning within campus wide systems, choosing technology, instructional design and faculty support, intellectual property, marketing and student services. A general outline of what will be covered in each topic area is offered below:

Interactive Video, Synchronous Programs: Tony Klejna	Online, A-synchronous Programs: Melissa Miszkiewicz	Marketing & Student Services: Christine Chelus
▪ Lessons Learned for Instructors & Students ▪ Basics of Presentation Design ▪ Student Involvement ▪ Bringing Unity to the Force – Ownership, Copyright, Faculty Issues ▪ Extending your interactive sessions.	▪ Planning at the Department level ▪ Planning at the Program level ▪ Instructional Design	▪ Marketing & Recruitment ▪ Specialist or Generalist: How do you set up relationships with specialists in your institution to accommodate these needs for students at a distance? ▪ What are the pros and cons of offering full degree programs using DL technology? ▪ How do you choose the right program, certificate or course to offer via DL technology?

Detailed descriptions from each presenter appear on the next page.

Detailed Presentation Information

Interactive Video, Synchronous Programs: Tony Klejna

- Lessons Learned for Instructors & Students
    - Anticipate time/distance/connection issues
    - I'm not technical, where can I get help?
    - Why Should I Change? You Mean I'm Not Already Interactive?
    - Developing Your Knowledge Base of Teaching Techniques
    - New Ways to Package Your Material
    - Practice Makes Permanent, for better or worse
    - Instructor Dynamics, Flexibility, and Style
    - Evaluation and Redesign
    - Why Should We Even Consider Interactive Video?

- Basics of Presentation Design
    - Is Interactive Video Fundamentally Different From What I Do in the Classroom?
    - Less Is More, Keep It Simple
    - Why Fonts, Layouts, and Styles Are Critical in Interactive Video
    - How Long Should I Be On-screen?
    - Graphics and Animations- The Good, the Bad, and the Really Ugly

- Student Involvement
    - "Am I Less Boring By Using Technology?"
    - Why Room Design and Setup Matter
    - Should I Tell Students My Plan of Action?
    - How to Create a "Single" Class
    - "Hello Out There?" - Names and Faces
    - Can I Visit an End Site?
    - Collaboration Across the Network – Opportunities for Students and Instructors
    - Developing Technology Savvy Students

- Bringing Unity to the Force -Ownership, Copyright, Faculty Issues
    - What's Yours Is Mine, and I Might Not Pay You For It!
    - The "Ownership" Committee, the Dean, and the Lawyer
    - Strategies for Equitable Course Ownership and Delivery

- Extending Your Interactive Sessions
    - Generating Live and Archival Sessions
    - Generating Narrated Presentations
    - Hardware/ Software Products and Considerations
    - Hard and Softcopy Distribution

Online, A-synchronous Programs – Lesson Learned: Melissa Miszkiewicz

- Planning at the Department Level – Why create an online program?
  - Find your niche
  - Set realistic goals and desired outcomes
  - Consider geography
  - Consider faculty issues:
    - Time
    - Teaching load and other responsibilities
    - Compensation
    - Intellectural property
    - Sharing the burden: teaching courses designed by others
    - Faculty support at the planning level: instructional design, training
    - Faculty support at the course level: teaching assistants
- Planning at the Program level
  - Choosing your platform
  - Identifying resources
  - Technical support
  - Technical requirements
  - Logistics
  - Supporting Documentation and redundancy
  - Instructional design
    - Faculty values
    - Classroom techniques vs. online techniques
      - Instructor presence
      - Learning styles and proof of mastery
      - Structure and time on task
    - Organization
    - Choosing appropriate technology, or choosing not to choose
    - Identifying teaching resources
    - Creating for the future: reusable learning objects
    - Team work
    - Formative evaluation plans: responding to constructive criticism
    - Documents for student support
    - Rules for student participation

Marketing & Student Services – Lessons Learned: Christine Chelus

- Marketing & Recruitment
  - How do I reach my intended audience? - If my targeted audience is 500 miles away, why would they pick up a publication with my institutions name on it?
  - Moving beyond parochial views of OUTREACH.
  - What are your boundaries, how do you fill the gap for other student services offices and faculty members in the recruitment process?
  - How do I disseminate important information quickly when my students are located so far away?

- Specialist or Generalist
  Transferring a call is not an option with Distance Learning students, now that you have your distance-learning students, how will they:
  - avoid fees imposed by due to policies and procedures originally established for on-campus students;

    - register for courses;
    - access journals and books to complete assignments;
    - buy books for their courses;
    - pay their bill;understand and complete financial aid forms;receive advisement and counseling;
    - turn in assignments and projects;
    - feel like an authentic student of your institution;
    - contact you toll free;

How do you set up relationships with specialists in your institution to accommodate these needs for students at a distance?

- Programs, Certificates and Courses
    - What are the pros and cons of offering full degree programs using distance learning technology for the student and the institution?
    - How do you choose the right program, certificate or course to offer via distance learning technology?

Presenter bios follow on attached pages

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Implementation of distributed learning systems and programs offered through interactive video, on-line Internet based, and residential delivery systems. Guide college utilization of multimedia and emerging technologies, including streaming media and wireless delivery, to provide synchronous and asynchronous learning opportunities. Faculty support and training in distance learning and technology integration into the curriculum.

*Presenter and Trainer – **ED-MEDIA 2002**, Denver, Colorado – **The World Conference on Educational Multimedia, Hypermedia & Telecommunications*** - **STREAMING MEDIA 2002 –MEDIA FOR ALL** *- development of streaming multimedia assets, various methods of creating content, conversion to appropriate format, and broadcasting. Developing media for low-bandwidth handheld computing applications and demonstration of high-performance videoconferencing using Internet 2.*

*Presenter and Trainer – **ED-MEDIA 2001**, Tampere, Finland – **The World Conference on Educational Multimedia, Hypermedia & Telecommunications*** - **STREAMING MEDIA 2001 – A MEDIA ODYSSEY** *–developing and integrating media assets and instructional technologies.*

*Accepted Presenter- CIT2001 – The **10th Annual SUNY Conference on Instructional Technologies**, presentation –* **DEVELOPING STREAMING MEDIA IN EDUCATIONAL APPLICATIONS**

*Presenter and Trainer – **ED-MEDIA 2000**, Montreal, Quebec, Canada – **The World Conference on Educational Multimedia, Hypermedia & Telecommunications** - creating on-line media content, presentations, audio, video, and live broadcasts.*

*Presenter and Trainer **ICCE 99**, Chiba, Japan - **7th International Conference on Computers in Education**, "**NEW HUMAN ABILITIES FOR THE NETWORKED SOCIETY**". Adding dynamic, multimedia content to educational website development and distance learning applications.*

*Presenter and Trainer - **ICCE 98**, Beijing, China - **The Sixth International Conference on Computers in Education**. The conference focus, "**GLOBAL EDUCATION ON THE NET**" served to foster the creation and dissemination of knowledge about the use of information technology in education. Presentations and training sessions on basic and advanced educational website development, electronic curriculum content distribution, and distance education.*

Christine Chelus holds a B.S. in Sociology, a M.S. in Student Personnel Administration and is currently A.B.D. in the Department of Communication at the University at Buffalo. Christine was recently selected as the sole recipient of the The Magness Institute's research grant program for 2002 and will receive funding for her dissertation research regarding educational access to the Internet. Christine also earned her distance learning professional certification from Texas A&M University.

Christine has worked for the State University of New York since 1996 holding numerous positions at Buffalo State College and the University at Buffalo. At Buffalo State, Christine assisted with student recruitment for the Office of Graduate Studies. She also served as program coordinator for the Center for Applied Research in Interactive Technologies. In this role, Christine provided training, marketing, student services and facilitation for over 30 distance learning courses annually.

Upon transferring to the University at Buffalo, Christine served as the primary international education contact for the Center for Applied Technologies in Education and held the positions of Manager of Technology Application Development and Director of New Media Projects. In these roles she served as Project Director for:

> **Buffalo CityNet** - a 20 site interactive video network comprised of educational, government and community agencies. Project coordination included consulting with various community agencies to develop educational programming for the video network.
>
> **Taking Gombe to the World through Technology** – partnership project between UB and the Jane Goodall Institute to connect their global Roots & Shoots teams through videoconferencing (HOPENet) and to extend Dr. Goodall's impact on people, animals, and the environment through an interactive educational web-based curriculum (Lessons For Hope) based on her research.
>
> **Project Loop** – partnership project with CRUSA (Costa Rica – USA Foundation) to use technological resources to provide citizens in geographically isolated areas access to qualified instructors regardless of their socioeconomic status. Provide students in Costa Rica and Western New York the opportunity to interact with people and situations of different cultures.
>
> **New Media Project** – partnership project with the Office of the Provost, the Graduate School of Education and the College of Arts & Sciences to provide educators in the outlying areas of New York State access to University at Buffalo graduate programs.

Christine has presented and worked with groups on educational technology material regionally, nationally and internationally. In addition to working on site in Costa Rica, Panama, England, and Germany, through videoconferencing technology, she has worked with educators around the world including Mexico, Tanzania, South Africa, Columbia, Guatemala, Argentina, France, and Japan.

Currently, Christine serves on the following committees: New York State Evaluating Technology in Education Team, New York State Distance Learning Consortium, Western New York Distance Learning Consortium, Western New York Higher Education Distance Learning Consortium, and the Blackboard Advisory Committee.

Melissa J. Miszkiewicz holds a B.S. in English Literature from the University at Buffalo and an M.S. in Curriculum Development and Instructional Technology from the University at Albany. She is a member of several educational associations including the Association for the Advancement of Computing in Education (AACE), the Association for Educational Communications and Technology (AECT) and the American Dental Educators Association where she participates in special interest groups in Academic Affairs and Informatics.

Melissa has worked for the State University of New York since 1991 in various roles, beginning her career in higher education at Empire State College where she successfully started up operations for the college's Workforce Development wing in the Western region of New York State. There she facilitated all aspects of new program development and delivery including conceptualization, proposal development, contract negotiation, staffing, and maintenance.

Melissa moved to the University at Buffalo to start up the online MBA program in the University's School of Management. As director of the online MBA program Melissa collaborated with all areas of the university to uncover and develop faculty resources, rework University systems and policies to accommodate the new program, develop inter-department partnerships, and to develop a policy on intellectual property and course ownership. In this position Melissa successfully selected technologies, developed strategies for instructional design, and a five-stage plan for formative evaluation culminating in the development of six complete online courses. Formative evaluation and testing took place overseas with the school's international programs in Singapore, and on campus with traditional MBA students. Two courses were delivered to students in the fall of 2001 with great success.

Melissa has recently accepted a position with the School of Dental Medicine as Director of Academic Services. In this position she has been asked to develop the school's electronic curriculum by integrating appropriate tools and technologies, applying appropriate methods of evaluation, and working directly with faculty on pedagogical issues. The University at Buffalo School of Dental Medicine is one of five Dental School's across the nation to have adopted an electronic curriculum and one of two to first implement the curriculum.

In addition to her formal duties in the School of Dental Medicine, Melissa is currently a consultant to the University at Buffalo School of Nursing for the development of an Acute Care Nurse Practitioner program that will be delivered online. She has also presented and worked with groups on educational technology and, while with the School of Management, routinely met and provided guidance to academic and technical officials from China, Russia, Brazil, the World Trade Centers Association and the Singapore Institute of Management.

The impact of "communicative effectiveness" of computers in use of computers for communication

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Abstract: This paper uses the data from a longitudinal study to demonstrate that the perceptions of the communicative effectiveness of a computer system has a significant impact on the desire to use computer for communication. The results suggest that it is important to attend to the perceptions when introducing the use f computers for pedagogic communication.

Introduction

One of the key questions that have been raised about the increasing use of computers and digital technology in the educational setting is the way in which students tend to use the computer when they are provided with ubiquitous computing opportunities (see, e.g., Mitra and Hullett, 1997). Studies in the past have demonstrated that usage does vary with different demographic categories just as the very definition of usage remains a contested construct. Indeed, over the time that computers have entered the pedagogic arena, the idea of usage has become increasingly complex as the term "computer use" has become multi-dimensional. Past research has demonstrated that the computer usage can be considered from various perspectives such as those of use for specific pedagogic tasks to those of communication (Oblinger and Rush, 1997).

There is a growing body of literature that would suggest that the computer has taken on a very critical role as a tool for communication as the digital technologies of electronic mail, instant messaging and the Internet in general have opened up opportunities of enhanced communication options between students, teachers and institutions (Mitra and Hazen, 1999). There has also been a body of literature that has suggested that computer use could be determined, in part, by specific attributes of users and user groups who share certain attitudinal and demographic similarities. This relationship is particularly important to explore because, as a corollary, it suggests that knowing certain characteristics of the user, it might be possible to predict the usage patterns of an individual or group (Woodrow, 1994).

Such studies on profiling of users have typically used two different metrices. On one hand, users have been classified on the basis of demographic characteristics, such as those of age and gender. Past studies have sometimes indicated that men and women have different patterns of computer use (Mitra, et. al., 2000a). Similarly, studies on age categories within a general population of computer users have demonstrated that usage trends could be determined by the age of the user (Honey, et. al., 2000). A second relational criteria that has been mobilized to understand and predict usage deals with attitudes of the users. Personal opinions towards computers and computing have known to have an influence on the way in computers are used. In many studies it has been demonstrated that those with a positive attitude towards computing can have a more positive use valence as well (Mitra and Stefensmeier, 2000; Mitra et. al., 1999).

As suggested earlier, there are several different ways to measure attitudes towards computers. It has recently been suggested that there are several different ways in which different attributes of attitudes can be measured and one of those attributes could be the perceptions of the communicative effectiveness of computers (Mitra, 2001). Given the relationship between attitudes towards computers and the use of computers, it can be speculated that those with a positive attitude towards the communicative effectiveness of computers would possibly use the computers for communication purposes as well. In this paper the communicative effectiveness factor is used as the independent variable to test whether differences in the attitude level actually reflect statistically significant differences in the communicative use of computers as well.

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Methodology and Data

This paper utilizes the data from a longitudinal study to assess the impact of technology introduction in liberal arts education at a non-technical small private university in the United States. The data was collected over four academic years and this *post hoc* analysis uses the data collected in the spring of 1999 from a sample of students who responded to a questionnaire mailed to them. The questionnaire was developed by conducting a series of focus group meetings that explored the various technology-related issues that the students were facing with the universal and standardized introduction of technology in teaching. The questionnaire included nearly fifty attitude items measured on a five-point Lickert-type scale. Of these fifty, there were several items that were specific to the local conditions of the university. The relevant items from the questionnaire have been selected to measure attitude and usage.

Instrumentation

The items used to measure communicative effectiveness is based upon four questions that have been found to be reliable measurements of this particular attitude. The measurement of use level is based upon self-reported frequency of use of the computer for specific tasks. Using the work of Mitra (2001), the attitude item is measured on a five-point Lickert-type scale while the use level is measured on a four-point interval scale as well. The items used to measure attitude and usage have all been tested previously to demonstrate that they are reliable measures of the constructs.

The specific items used to measure communicative effectiveness included:

- ☐ Computers are effective for communicating with other students about class related work
- ☐ Computers are effective for communicating with faculty about class related work
- ☐ Computers are effective for communicating with other students about non-course related subjects
- ☐ Computers are effective for communicating with faculty about non-course related topics

Thus communicative effectiveness includes attributes that focus primarily on the role of the computer in the pragmatic act of communicating. It can be argued that a change in the perception of the effectiveness of the computer in facilitating communication could have an impact on the use of computers for communication and eventual learning outcomes.

The specific items used to measure the use of computers for communication included questions about the frequency of use of:

- Use the Internet to get information
- Electronic mail with teachers
- Electronic mail with friends
- Electronic mail with family
- Electronic mail with classmates
- Electronic mail with students organizations

All of these items test the way in which the computer can become an effective tool for communicating with a variety of groups that a student can be involved with in the academic setting.

Analysis and Results

As a first step the attitude items were summed to create an overall communicative effectiveness measure. The item was then dichotomized into a high and low level creating to nearly similar sized groups. Tests of difference in mean level of use was then conducted between the groups using an independent sample t-test at a level of $p<0.05$ to identify if there were significant differences in mean usage for the low and high attitude groups. The results are presented in Table 1.

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Table 1: Computer use level based on High and Low scores for Communicative Effectiveness Scale

Computer Use	Hi (n=162)	Low (n=157)
Use the Internet to get information	3.7	3.8
Electronic mail with teachers	3.1	3.5
Electronic mail with friends	3.7	3.9
Electronic mail with family	3.3	3.7
Electronic mail with classmates	3.3	3.6
Electronic mail with students organizations	2.8	3.0

The next part of the analysis explored the way in which the respondents self-reported their perception of the effectiveness of computer-mediated communication (CMC) for task and non-task related contexts. The results for the two groups are presented in Table 2.

Table 2: Perceptions of CMC based on High and Low scores for Communicative Effectiveness Scale

Effectiveness of CMC	Hi (n=162)	Low (n=157)
Task Context	3.6	3.9
Non-task Context	3.7	4.0

Discussion

First, the data suggests that those who feel that computers do play a role in enhancing their communicative effectiveness tend to use the computer more for communication as well. Furthermore, the analysis also suggested that the primary contributor to the higher communicative use was the perception and other possible determinants such as demographic attributes did not produce statistically significant differences. Consequently, it is safe to suggest that it is important to be able to reliably measure the attitudes of the users towards the communicative effectiveness of the computer. Indeed, knowing the range of the perceptions can help to determine the way in which the computer could be used by a group of students and predicting that use can have a significant impact in policy decisions about the way in which computer networks are designed and maintained on college campuses. This becomes particularly true in view of the way in which band width availability has become an issue on college campuses as students are using the computer more for non-task related CMC (see, e.g., Carlson, 2001). As the data suggests here, a positive predisposition towards the communicative effectiveness can result in a statistically significant higher level of use of the computer.

Secondly, the findings from this study also underscore the importance of measuring the perceptions of the communicative effectiveness of the computer. Although there are different perceptions factors that can be measured with respect to the computer, none of the other factor identified by Mitra (2001) were significant in distinguishing between the different levels of computer use. While the data suggests that there are significant differences, it is really the communicative effectiveness factor that emerges as the critical one. Thus, when considering the measurement of attitudes of students towards computers, it is necessary and essential to evaluate the differences in this factor since those differences can have far reaching usage and effectiveness consequences both for task and non-task activities.

Finally, the importance of the communicative effectiveness should come as no surprise as computers are increasingly being introduced in the pedagogic space. It has been the case that the introduction of the computer in the teaching environment has transformed the process of teaching and learning in so far as that the pedagogic process has become a more dialogic process where the different participants in the teaching and learning process are engaging in the acts of communication. In a way the different players in the pedagogic space have now found their own voices and the traditional relations of power and authority, often predicated upon who was able to communicate with whom, are being dismantled. Those students who are quicker to realize that a shift is occurring in the way teaching and learning is being played out with the help of computers are perhaps also the ones who have a positive attitude towards the communicative effectiveness of the computer. Eventually these students with the more

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positive attitude would be more likely to use the computer more for communicating with the various groups they have to interact with in the learning process.

To some degree the positive attitude could also be related to the issues of communication apprehension that have been researched with respect to the use of CMC (Sproull and Kiesler, 1992; Walther 1992, 1994, 1996). Work on interpersonal communication, communication apprehension and the opportunities provided by the use of CMC in teaching has demonstrated that, first, more voices can be heard during the teaching and learning process. The increasing number of voices in the pedagogic space, as the positively predisposed students increasingly use the communicative functions of the computer can have implications on the process of teaching and the organization of the teaching institution. For instance, using a tool such as electronic mail to communicate with the instructor is often accompanied by an increasing burden on the teacher to attend to and respond to all the electronic letters that arrive with missives and from the students who are often the quiet ones in the classroom (Mitra, et. al., 2000b). As the findings from this data suggest, there can be an anticipation that there will be increasing use of electronic mail to communicate with teachers and it is in the interest of the teachers and the educational institution to be able to reliably measure the various attitudes of the students with respect to the use of computers in teaching.

In summary, this data and finding from earlier studies all suggest that there is a need to measure attitudes towards computers. Such measurements can offer insights into the way in which computers can eventually be used in teaching. Furthermore, the findings from such measurements can offer ways to predict and anticipate what the usage patterns could be. Finally, the usage patterns can have an impact on the learning outcomes related to the use of computers in teaching. The data here suggests that among all the different attitude factors that can be measured, one of the most important ones is the attitude towards the communicative effectiveness of computers in teaching. To be sure, the value of this measurement is not only empirically evident but can be ontologically supported given the fact that good pedagogy ultimately remains a dialogic and discursive process.

References

Carlson, S. (September 28, 2001). Napster was nothing compared to this year's bandwidth problems. Chronicle of Higher Education, A44.

Honey, M., Culp, K. M., and Carrigg, F. (2000). Perspectives on Technology and Educational Research: Lessons from the Past and Present. Journal of Educational Computing Research, 23, 1, 5-14.

Mitra, A. (2001). Developing a questionnaire to measure the effectiveness of computers in teaching. Educational Multimedia and Hypermedia Annual.

Mitra, A. and Hazen, M. (1999). Longitudinal assessment of computerization at Wake Forest University. In (Ed., D. Brown), Electronically enhanced education. Winston-Salem, NC: Wake Forest University Press.

Mitra, A. and Hullett, C. (1997). Toward evaluating computer aided instruction: Attitudes, demographics, context. Evaluation and Program Planning, 20(4), 379-391.

Mitra, A. and Stefensmeier, T. (2000). Changes in student attitudes and student computer use in a computer enriched environment. Journal of Research on Computing in Education, 32(3), 417-433.

Mitra, A., Steffensmeier, T., Lenzmeier, S., Avon, R., Qu, N. and Hazen, M. (2000a). Gender and Computer Use in an Academic Institution: Report from a Longitudinal Study. Journal of Educational Computing Research, v 23 (1), 67-84.

Mitra, A., Chesner, C., Burg, J., Ferebee, M. (2000b). Computer-mediated communication and face-to-face instruction: An integrative perspective fir a changing society using a case study approach. In D. G. Brown (Ed.) Teaching with Technology, (pp. 220-224). Bolton, MA: Anker Publishing Company.

Mitra, A., Stefensmeier, T, Lenzmeier, S. and Massoni, A. (1999). Institutional implications of changes in attitudes towards computers and use of computers by faculty. Journal of Research on Computing in Education, 32(1), 189-202.

Sproull, L. and Kiesler, S. (1992). Connections: New ways of working in the networked organization. Cambridge, MA: MIT Press.

Walther, J. B. (1992). Interpersonal effects in computer-mediated interaction: a relational perspective. Communication Research, 19, 52-90.

Walther, J. B. (1994). Anticipated ongoing interaction versus channel effects on relational communication in computer-mediated interaction. Human Communication Research, 20, 473-501.

Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal and hyperpersonal interaction. Communication Research, 23, 3-43.

Woodrow, J. E. J. (1994). The Development of Computer-Related Attitudes of Secondary Students. Journal of Educational Computing Research, 11,4,307-38.

Adaptive Web-based Learning System with Free-Hyperlink Environment

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Abstract: A typical learning method using the Internet is exploratory learning, where learners frequently reach a learning impasse caused by insufficient hyperlinks. In this paper, we propose an environment that supports open-ended web-based exploratory learning. This environment avoids the impasse by enabling learners to create hyperlinks in the open web and share the hyperlinks. Furthermore, the hyperlinks have been adapted with collaborative filtering.

Introduction

Rapid spread of the Internet enables us to learn with informative web pages that exist all over the world. A typical learning method using the Internet is exploratory learning, where learners construct knowledge through exploring the web autonomously. However, the learners frequently reach a learning impasse caused by insufficient hyperlinks. If a page is not complete with sufficient hyperlinks to fulfill their goal or interest, the learners cannot visit the next page smoothly. Thus insufficient hyperlinks lead the learners to the impasse.

Search engines, which can supply suitable hyperlinks (pages), help escape from the impasse but occasionally return meaningless hyperlinks. Adaptive web-based learning systems, which alter the hypertext contents/structure to learners' characteristics, can avoid the impasse. The existent adaptive web-based learning systems do not present sufficient hyperlinks to fulfill learners' expectation. Almost all such systems limit the adaptation to the closed web (i.e. web pages inside one server), since teachers can hardly describe information indexes and adaptation rules to the open web (i.e. arbitrary web pages). Recently, this limitation has become a major focus in the domain of adaptive hypermedia (Brusilovsky, 2001).

In this paper, we propose an environment that supports open-ended web-based exploratory learning. This environment avoids the impasse by enabling learners to create hyperlinks in the open web and share the hyperlinks. Furthermore the hyperlinks are adapted with collaborative filtering. The prototype system with this environment, which is MITS (Multi-hyperlink Tailoring System), is currently under construction.

Free-Hyperlink Environment

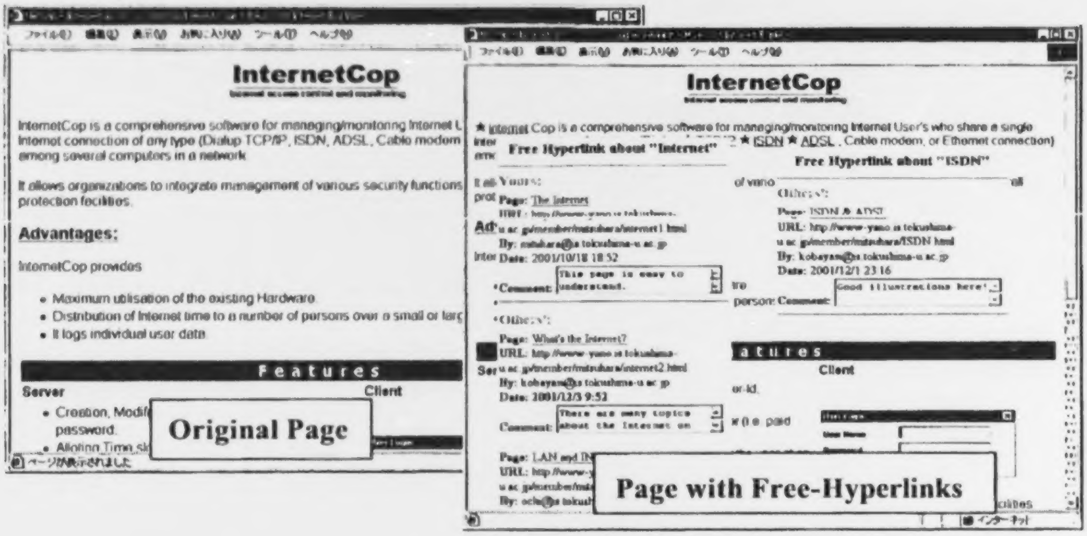
The key idea for avoiding the impasse is a free-hyperlink environment, where learners can create hyperlinks (i.e. free-hyperlinks) in the open web and share the hyperlinks. The free-hyperlink environment will organize scattered pages and consequently form large-scale teaching material with many sufficient hyperlinks, which avoids the impasse. In other words, numerous learners substitute for the teachers who have to complete sufficient hyperlinks.

When reaching the impasse, learners usually try to find suitable pages by using search engines. Taking this process into account, a search engine has been integrated into the process of the free-hyperlink creation. Although this integration is time-consuming, the time will be minimized eventually since the free-hyperlinks can be shared. The free-hyperlinks are created in the following process.

(1) Search Query Input: Learners pick a word(s) as the query and send the word to an existing search engine.

(2) Search Output Receipt: They receive the search output modified by MITS.

(3) Visit and Free-Hyperlink Creation: By their selecting a page, the page and a comment window are displayed. If considering the page to be informative, they input comments on the page (e.g. "This page has useful diagrams"). Immediately after inputting the comments, the free-hyperlink between the word and the page is created.



InternetCop is a comprehensive software for managing/monitoring Internet U
Internet connection of any type (Dialup TCP/IP, ISDN, ADSL, Cable modem
among several computers in a network

It allows organizations to integrate management of various security functions
protection facilities.

Advantages:

InternetCop provides

- Maximum utilisation of the existing Hardware
- Distribution of Internet time to a number of persons over a small or larg
- It logs individual user data

★ Internet Cop is a comprehensive software for managing/monitoring Internet User's who share a single
★ ISDN ★ ADSL , Cable modem, or Ethernet connection)

Free Hyperlink about "Internet"

Yours:

Page: The Internet
URL: http://www-yano.is.tokushima-u.ac.jp/member/matsuhara/internet1.html
By: matuhara@is.tokushima-u.ac.jp
Date: 2001/10/18 18:52
Comment: This page is easy to understand.

Others':

Page: What's the Internet?
URL: http://www-yano.is.tokushima-u.ac.jp/member/matsuhara/internet2.html
By: kobayan@is.tokushima-u.ac.jp
Date: 2001/12/3 9:53
Comment: There are many topics about the Internet on

Page: LAN and IN
URL: http://www-y
By: ochi@is.tokus

Free Hyperlink about "ISDN"

Others':

Page: ISDN & ADSL
URL: http://www-yano.is.tokushima-u.ac.jp/member/matsuhara/ISDN.html
By: kobayan@is.tokushima-u.ac.jp
Date: 2001/12/1 23:16
Comment: Good illustrations here!

Figure 1. Free-hyperlinks

Figure 1 shows a snapshot of the free-hyperlinks. The free-hyperlinks are highlighted with a star-shaped icon in order that learners can distinguish the free-hyperlinks from original hyperlinks. By clicking on a free-hyperlink, a pop-up box containing the information about the free-hyperlink is immediately displayed. The information consists of page title, URL, free-hyperlink creator's e-mail address, creation date, and comments. The learners select the next suitable page, referring to the information.

Collaborative Filtering in MITS

It is apparent that the increase of the free-hyperlinks causes option overflow. To improve this problem, collaborative filtering is used, which is a technique for recommending items estimated to be suitable by similar learners (Resnick et al, 1994). To calculate the similarity between learners, we assume that the learners who made the free-hyperlink of the same word have similar interest. MITS counts the number of free-hyperlink of the same word. It calculates the similarity by means of Pearson's correlation coefficient (r), and shows the free-hyperlinks of five learners with high similarity ($r>0$). This is the adaptation in MITS, which strikes a proper balance between enriching information and eliminating redundancy.

Conclusion

A free-hyperlink environment avoids the learning impasse caused by insufficient hyperlinks. Specifically, it enables learners to create hyperlinks in the open web and share the hyperlinks, which are adapted on the basis of the learners' interest using collaborative filtering. However there are some problems with the MITS prototype. One is a failure to modify original web pages. For example, JavaScript embedded by MITS contends with JavaScript in the original web page. Currently, this study is trying to improve the problem and prepare an experiment for evaluation.

References

Brusilovsky, P. (2001). Adaptive Hypermedia, *User Models and User-Adapted Interaction 11*, pp87-110.

Resnick, P., Iacovou, N., Suchak, M., Bergstom, P., & Riedl, J. (1994). GroupLens: An Open Architecture for Collaborative Filtering of Netnews, *Proc. of CSCW94*, pp.175-186.

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Supporting Arts and Science Communities On-Line

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Abstract: This paper examines the use of the Web to support continuing professional development (CPD). It outlines the factors driving the adoption of CPD and highlights areas where the Web can aid in the development of successful professional communities. A survey examining the use of the Internet to support professionals working in the domains of the Arts and Science is presented. The study reviews twenty four sites for the presence and degree of adoption of several key features including: - community building, range and value of content, user friendliness and guidance, sophistication of employed Web technology.

1. Introduction

The use of the Internet and the World Wide Web is growing, and the number of applications where it is employed to support, or even to replace, many traditional activities associated with work and recreation continues to expand. Such new technology means that the nature of the jobs we do has changed, as has the professions in which we work and the skills required. Life-long learning has never assumed greater importance than it does today, allowing us to remain competent and achieve personal satisfaction and job fulfilment, throughout our careers. From an employer's viewpoint, lifelong learning contributes to competitive advantage through excellence of employees. At a national level, it allows us to remain competitive in a world participating in free trade and experiencing rapid changes through technology.

In this setting it is not surprising that many professional communities have turned to the Internet to augment or replace continuing professional development (CPD) support. Traditional approaches to professional development rely on a mixture of activities including conferences, meetings, scholarly reading, newsletters and short courses. However, no matter how excellent any of these activities prove to be, they are of little value if they are not accessible to those who need them most, when they need them. While many will argue that the Web cannot provide all the things that come with more 'traditional' approaches, Web technology can provide flexible support to professional communities, especially under circumstances where the community members are geographically dispersed and are subject to time constraints.

The level of support will vary between communities, depending on the subject requirements, the technical sophistication of providers and audience, as well as resources available for the upkeep of the support mechanism itself. Resources available on websites supporting professional communities can range from links to other informative sites, to provision of original content, to full-blown community facilities including online discussion forums. In the latter case, the professional community can support itself via a 'Web community'.

Significantly, the use of new technology does not guarantee success in encouraging and supporting CPD. Any successful Web community must be built upon solid foundations. "Web communities need 'social scaffolding' to grow and thrive. Social scaffolding refers to those aspects of a site - roles, rituals, features, events, and leadership - that facilitate community development. Much like a trellis enables a plant to grow, social scaffolding enables members to become progressively more involved in the community" (Kim, 1998). Simply launching a website with a bulletin board and chat facilities does not automatically generate a community (Mager and Karlenzig, 2001). There are numerous examples of quickly launched message boards with many topics but no responses. Creating gathering places alone is not enough - they need to be organised and integrated into the community. The central issues surrounding communities are people issues - Web technology merely acts as a facilitator, providing the tools for helping people come together (Cothrel and Williams, 1999).

This paper begins by outlining the factors driving and inhibiting the formation of Web communities to support professional development. It then goes on to survey two disparate professional groups, in the Arts and in Science/Technology, and attempts to gauge their level of adoption of Web technology in their professional development activities. Twenty four sites are examined, twelve in each group, and a number of measures, ranging from 'level of adoption of community interaction' to 'technical sophistication', are considered.

2. Continuing Professional Development and the Web

Getting people to 'buy into' continuing professional development can often prove difficult. Individuals often need to be reminded that they have a career - not just a job (Arnold and Smith, 1998). In order to be truly effective, individuals need to take ownership of their approach to personal development and life long learning. The Web enhances this process by allowing individuals to extend their professional interaction, seeking out and exchanging new ideas and opinions, beyond the boundaries of the organisation in which they work. Web technology can be used to complement existing forms of learning and development, delivering CPD to a widely diverse and dispersed audience. Individuals may get less benefit from face-to-face conferences as conference size increases. The Web can mitigate these effects by enabling users to take a more 'personal' approach to professional development, so that individuals can tailor a developmental programme to their own requirements. "Every learner can, at his or her own choice of time and place, access a world of multimedia material... immediately the learner is unlocked from the shackles of fixed and rigid schedules, from physical limitations... and is released into an information world which reacts to his or her own pace of learning" (Benjamin, 1994, p49). While the use of Web technology does mean that individuals can work at their own pace, there still needs to be a forum for obtaining feedback on their progress. Further, there are some subjects, requiring more nuance or hands-on involvement, which may prove more difficult to translate to an online environment (Stuart, 1999).

Professional development can be substantially enhanced by opportunities to collaborate with others within Web communities (Hixson and Tinzmann, 1990). The opportunity to take advantage of the expertise of others can provide community members with important reinforcement and incentive for continuing growth and development, along with enhanced personal status and respect that comes from membership in a learning community with their professional colleagues. The asynchronous nature of much of the communication that takes place online lends itself to CPD and supports synthesis of knowledge (Salmon, 2000). Individuals have 24-hour access to the system and can log on whenever they wish and for however long they wish. Users are able to reflect on issues raised online, and their own ideas and thoughts can germinate through composing replies.

CPD is an ongoing process and as such, the use of Web technology to aid this process is not a one-shot event. Traditionally, individuals within an organisation would take one or two weeks off from their daily grind to go on a training course. The use of Web technology enables professional development to be a constant continuing process. However, technology is no panacea for professional development. In order to be truly effective, the use of technology must be linked to the objectives and goals of any professional development programme, and must deliver real value to the community.

3. Web Communities

The use of the Internet to develop Web communities has meant that localised communities can now have a more global outlook. "The Net erases boundaries created by time and distance, and makes it dramatically easier for people to maintain connections, deepen relationships, and meet like-minded souls that they would never have met" (Kim, 2000, p.x). In order to be successful and deliver true value to the users, the aims of the community must be clear and the first step to building a loyal community of members is to understand the purpose of the community (Kim, 1998). Web communities grow and thrive when members are able to fulfil their purpose and accomplish those goals that require other members to participate. The concept of collaborative purpose is one of the Web's premier strengths as a means of building community (Real Communities Inc, 2000). There are a number of features that aid the development of an on-line community (Kim, 2000). These include: -

Backstory: The community's backstory provides a powerful tool in shaping members' expectations about the purpose and personality of the site (Kim, 1998). The term backstory comes from filmmaking and refers to the part of the movie's story that has happened before the first frame of the film. Backstories introduce the community founders, communicate their motivation, and impact a sense of the community's core values.

Site Map: The site map gives an overall picture of the community space and may include links to each section of the community. Site maps should be updated as sites evolve and sections of the community are added.

Feedback: Through implementation and maintenance of feedback loops, communities evolve over time and may react to the requirements of its members. Regular surveys will help gauge the community opinions and re-enforce a sense of shared purpose.

Database: A member database system is crucial for creating and maintaining member profiles that evolve over time. This database can be used to control access to Web pages, mailing lists, chat rooms, conference areas and member profiles. Many communities also allow members to develop their own home pages, thus helping each member develop their sense of belonging to the community (White, 2001).

Frequently Asked Questions: These address the needs and questions of newcomers without alienating established members. FAQs serve a key role in breaking down initial barriers for new users and making them feel more at ease with the technology and the community environment itself.

Communication Technology: Communication is at the heart of online communities. The technologies employed can be public (interactions between several people) or private (one-to-one interactions); synchronous (messages are exchanged in real time) or asynchronous (messages are accumulated and users need not be online simultaneously). All communities need a mixture of public and private meeting places and it can often prove difficult to identify a single space where the Web community 'lives'. This is a result of the range of tools adopted by members (Cothrel and Williams, 1999). The most commonly used tools include: - *Electronic Mail-* The use of e-mail is widespread and as such, it is an extremely powerful communication medium that may be used to hold a community together. E-mail distribution lists may be used for making announcements and for encouraging communication between users. A community newsletter can serve a key role in keeping members up to date with key events or issues that may arise within the community. E-mail can also be used to encourage feedback and suggestion from community members. Poling (1994) found that the use of e-mail enhanced the quality of communication within groups and ultimately aided group cohesion: *Mailing Lists and Bulletin Board* - Community mailing lists can facilitate conference-style interaction between community members. However mailing lists do not create the same sense of gathering in a location with fellow community members that conference-style interaction can provide (Steuer, 1998): *Chat* - Real-time chat is a frequently misused community technology (Steuer, 1998). Nothing discourages users more than an empty chat room, or an interactive event that has very little or zero interaction between users. However when utilised correctly, real-time chat can be a very effective communication medium.

4. A Survey of Arts and Science Websites

Our investigation of Web-based support for professional development focussed on two broad subject areas, viz., Arts/Humanities and Science/Technology. Twenty four websites were chosen at random - twelve from the Arts domain and twelve from the Science domain (see Table A). The aim of this survey was to gauge the degree and nature of support afforded by these subject-oriented sites. To this end, a feature list was formulated (see Table B) to map the characteristics across the sample sites. The features in question span three broad categories: Usability, Resources, and Community Interaction; with each sample site examined for the presence/absence of these features.

Arts and Humanities Sites	Science Sites
History Classics and Archaeology	LTSN Centre for Information and Computer Sciences
Humbul Humanities Hub	Association for Computing Machinery
CORD	Joint Information Systems Committee
Philosophical and Religious Studies	Scottish Teachers Online Resource Modules
Art, Design and Communication	IEEE
Performing Arts (PALATINE)	IEEE Computer Society
Sociology, Anthropology and Politics (C-SAP)	International Federation for Information Processing
English Subject Centre	Computer Science Discipline Network
Hospitality, Leisure, Sport and Tourism	Geography, Earth and Environmental Sciences
LeisureTourism.com	LTSN Engineering
Social Policy and Social Work (SWAP)	LTSN Physical Sciences
European League of Institutes of the Arts	Royal Astronomical Society

Table A: Sample Sites

Presence of Features: The feature survey covers aspects that are commonly employed on websites that actively try to develop a sense of community. Naturally, a professional group may decide not to adopt all such features for their particular community. Every site gained one point for each extant feature (see Table B).

Usability	Backstory, Contact details, Details of last site update, Search engine, Elementary search and navigation instructions, Site map
Resources	Details of conferences/ seminars, Resources – academic, Resources – magazines/ newsletters, Links, FAQ section
Community Interaction	Feedback forms/ surveys, Mailing lists, Chat rooms, Bulletin boards, Registration

	required in order to contribute to site

Table B: Features

Scoring of Features: Having surveyed the presence of various features for supporting communities online, a deeper analysis of each feature sought to gauge the range and depth of material on each site, estimate site reliability, and assess site appearance. The appearance and overall feel of the site is considered significant since this is likely to influence the return of users to a site. Each of the feature categories was examined in detail to afford a further dimension of ranking for our twenty four websites.

As a basis for 'ranking', each site was awarded up to 4 points for features in each category. Points are awarded on a qualitative basis, dependant upon areas where there are discernable differences between the features present on each individual site. In cases where a site had none of the features examined in a particular category, the site was assigned zero points for that category. For example, a site that does not have any of the Community Interaction features would be awarded zero points in that particular category.

Technological Features: This final measure gauges the sophistication of the technology used on the website. The technological features present on a site do not necessarily yield better results in terms of supporting a professional community. Four simple to detect measures were used to estimate the 'sophistication' of each site. Namely, the presence and use of HTML, different Data Types, use of Scripting, and use of Server-Side Scripting. HTML examines the sophistication of the HTML code employed on the site (see Table C).

HTML	Raw HTML code, Image maps, Frames, Cascaded Style Sheets, Tables
Data Types	Adobe Acrobat files, Windows Media files, Word documents, PowerPoint presentations, Zip files, Flash, Rich Text Format files
Scripting	Instances of scripting, Number of functions, Size of functions, Number of times function called
Server-Side Scripting	Use of GET method in forms, Use of POST method in forms, Use of cookies, Site adding information to their database

Table C: Technological Features

The source code for pages from each of the twenty four sites was analysed across each of the four categories to gauge the level of complexity and technical sophistication of the code. In a similar manner to the Scoring of Features section, the categories were assessed in order to arrive at a site ranking that was based on those areas where there are discernible differences between the websites, with 3 points being awarded to the most sophisticated site in each category.

Results and Analysis

Almost predictably, study of the twenty four sample sites has highlighted the fact that Science sites score higher than Arts sites in every respect. This may be explained by the quicker uptake of technology in science-based subject areas, and the greater experience of those maintaining these sites.

Presence of Features

When analyzing the Presence of Features on each of the twenty four sample sites, Science sites consistently score higher across each of the three categories examined. However it is interesting to note that Arts and Science subjects can actually be found to be progressing entirely in parallel. Science sites may be a step ahead all of the time, but nonetheless it holds true throughout that where Science sites score highly in categories such as Resources and Usability, so do Arts sites. Similarly, in the Community Interaction category where Science sites gain lower scores, Arts sites also gain lower scores. It could perhaps be argued that Arts sites are following in the footsteps of Science sites (see Figure A).

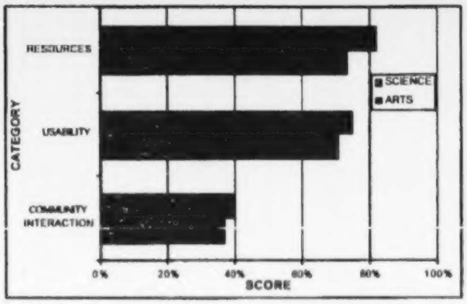

Figure A: Presence of Features

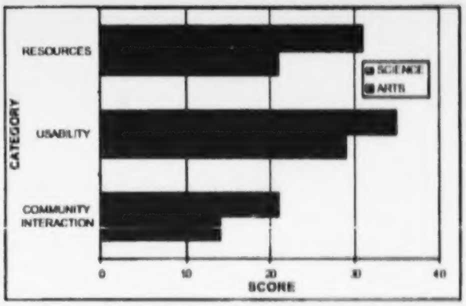

Figure B: Scoring of Features

If there is one thing that the results do *not* seem to imply, it is that Arts websites are good at providing one particular thing and Science websites at providing another. Essentially, the experiences of both communities are very similar. However, Arts sites do appear to cater more to the novice Internet user, with 50% of the Arts sites sampled offering elementary navigation instructions to users. Conversely, Science sites appear to assume a higher level of technological proficiency from those accessing their sites, with only 16% offering any form of help to users in navigating between pages.

Both Arts and Science communities have potential to improve the level of community interaction. Neither area has fully embraced the use of communication technology to enhance the level of interaction between community members. The reasons behind this could be varied. Maybe current implementation of these technologies is still relatively new and fragile. Perhaps many existing tools do not mirror well 'real life interactions'. Maybe the communities see no benefit from these forms of interaction.

Scoring of Features

Science sites appear to score higher across all of the categories examined. Similar to the results in the previous section, both groups of sites appear to be progressing in parallel, with Science sites scoring higher in each category (see Figure B). Both sets of sites scored highly when considering the Usability of the sites. Equally, both Arts and Science sites show less evidence of Community Interaction. This concurs with the findings of the previous section, where the majority of sites in each category are not fully making use of communication technology as a means of building community and developing a level of community interaction.

The difference between the scores of Arts and Science sites is greater in the Resources category. Across the sites surveyed, it is interesting to note that Science sites tend to have a greater range and depth of material, while Arts sites tend to rely more on providing links to material of interest.

Technological Sophistication

Again Science sites scored more strongly across all categories (see Figure C). This perhaps indicates a quicker uptake of technology or greater experience from those maintaining Science sites. Alternatively, Arts sites may have felt that this level of technological sophistication was not necessary.

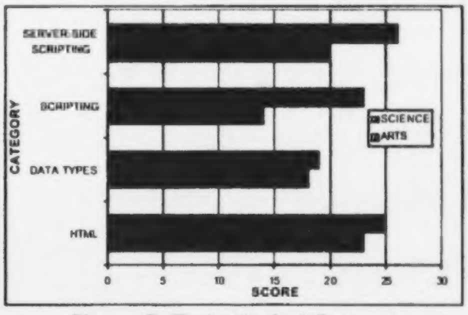

Figure C: Technological Features

Once more, there appears to be a degree of parallel progression between the two sets of sites: Arts sites score highly (though not quite as highly) in the same categories where Science sites achieve high scores. This holds true especially in the HTML and Data Types categories, where Science sites show only marginally greater sophistication than Arts sites. The only anomaly is the category of Scripting, which achieved the third highest ranking in Science, but comes fourth in the Arts. Interestingly, this category also shows the highest divergence between Arts and Science sites, with a difference of almost 10 points.

The main difference between Arts and Science sites appears in the Scripting and Server-Side Scripting categories, where Science sites score substantially higher than their Arts counterparts. There is certainly more complex processing around any areas of interaction on Science sites, and this may be the result of the maintainers of Science sites being more comfortable with using complex technological features.

5. Concluding Comments

The use of Web technology for professional development is perceived as being useful and is currently being employed by a wide spectrum of professional communities. The resources and features available on-line can range from lists of useful links, to the provision of original content, to full-blown community facilities including online discussion forums.

Our survey of websites providing support in the Arts and Science domains has found that overall there is more correspondence than divergence. An analysis of site features shows little difference between the two domains. The most interesting point to come out of this analysis is the relative lack of community interaction facilities on sites in both domains. There may be several reasons for this. Possibilities include a lack of perceived need and/or local administrative or technological constraints. This is an appropriate area for further study.

One of the few elements to show marked differences between sites in the two domains was the presence or absence of elementary navigation instructions. Arts sites are more supportive here, perhaps because their user base is assumed to be less proficient in the use of websites in general. Another marked difference emerges within the technological features, where Scripting is clearly employed more with sites supporting the Science community. This may be the result of the maintainers of Science sites being more comfortable with using complex technological features. Ultimately, however, the examination of the sites shows that, barring the exceptions mentioned above, differences between Arts and Science websites are ones of degree rather than kind.

References

Arnold, G. and Smith S. (1998), Expert Advice: Lessons Learned from People in the Know, *CIO Magazine*, November 1, http://www.cio.com/archive/110198_expert.html

Benjamin, A. (1994), Affordable, Restructured Education: A Solution Through Information Technology, *RSA Journal*, (May), pp45-49.

Cothrel, J. and Williams, R. (1999), Online Communities: Getting the Most out of Online Discussion and Collaboration, *Knowledge Management Review*, Issue 6, pp20-25.

Hixson, J. and Tinzmann, M. B. (1990), What Changes are Generating New Needs for Professional Development?, *North Central Regional Laboratory*, Oak Brook, http://www.ncrel.org/sdrs/areas/rpl_esys/profdev.htm

Kim, A. J. (1998), 9 Timeless Principles for Building Community, *Web Techniques*, http://www.Webtechniques.com/archives/1998/01/kim/

Kim, A. J. (2000), *Community Building on the Web*, Peachpit Press, Berkley.

Mager, D., and Karlenzig, W. (2001), Challenging E-Community Myths, *Knowledge Management Review*, (Feb), pp74-75.

Poling, D. J. (1994), E-mail as an Effective Teaching Supplement, *Educational Technology*, May-June.

Real Communities Inc. (2000), Shared Knowledge and a Common Purpose: Using the 12 Principles of Civilization to Build Web Communities, White Paper, August, http://www.realcommunities.com/products/12principles.htm

Salmon, G. (2000), *E-moderating: The Key to Teaching and Learning Online*, Kogan Page, London.

Schreiber, D. A. and Berge, Z. L. (eds) (1998), *Distance Training: How Innovative Organisations are Using Technology to Maximise Learning and Meet Business Objectives*, Jossey-Bass Inc, California.

Steuer, J. (1998), Tilling the Soil: Tools for Building a Web Community, *Web Techniques*, http://www.Webtechniques.com/archives/1998/01/steuer/

Stuart, A. (1999), Continuing Ed, *CIO Magazine*, Sept. 1, http://www.cio.com/archive/Webbusiness/090199_virtual.html

White, N. (2001), Facilitating and Hosting a Virtual Community, *Fullcirc*, http://www.fullcirc.com/community/communityfacilitation.htm

An alternative system to deliver and manage online courses through the World Wide Web

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Abstract

The paper describes the experience of the Faculty of Economics at the University of Trento, Italy, in delivering online courses through the Web. The faculty chose to design and build its own system from scratch rather than buy one off the shelf. We discuss the considerations informing this decision, and present the main functionalities of the system, which was built with a server-side approach. There are asynchronous functions provided, such as the ability for the teacher to upload educational materials and for the student to download these materials through the Web. Some interesting synchronous functions built into the system include the teacher-student chat forum and the low-cost videoconferencing tool where a single student can interact with the teacher who is available on-line at the same time. Everything is integrated in a unique, browser-based system accessible from everywhere. We also describe some important administrative functions of the system.

1. Introduction

Web-based instruction has become a convenient education medium [Aggarwal 2000]: course offerings using web-based instruction are very common in universities [Teare et al, 1999], even if the opportunities for and means of student-teacher interaction can vary with the programme. This paper describes the development of an interactive online teaching system at the University of Trento, and reports the results of the first experiment with course development and delivery in the Faculty of Economics. The faculty has about 3000 students and more than one hundred teachers, some of whom come from other faculties. At present, few teachers have their educational material available online. Some teachers in the Faculty of Economics took the initiative to produce their educational material in electronic format, and created their own personal Web sites with the syllabus of the course, the slides of the lectures, and the information related to practical aspects of the course (room, timetable etc.). However, each of these Web sites had its own design and logic, resulting in a confusing array of links, material, format of lessons, and overall structures that students had to sift through in order to find the desired information. The plea arose from the students for a more uniform presentation of online educational materials and for a standard procedure to access them.

On this basis, in September 2000 the faculty decided to fulfil this request for uniformity. Firstly, we determined which functionalities should be provided and then looked into whether such a system could be found on the market or should be built from scratch. We will briefly discuss this latter issue. At the evaluation stage it was important to investigate the cost of building a system using internal resources. This was because, although there are valid reasons for purchasing an off-the-shelf Course Management System such as TopClass, Lotus Learning Space or WebCT,there are many instances where universities have successfully developed a system by themselves. It was evident that homegrown systems are often more tailored to a university's specific needs. For an analysis of this, see [A'herran 2001] [McMahon et al, 2000]. Courseware management systems are being promoted as a means of simplifying the creation and management of instructional Web sites. There are many studies that compare specific courseware management tools (e.g.[InfoWorld, 1998],[PC Week, 1997]), but it seems that the efficiency and effectiveness of these tools with respect to customized Web-based systems is less easy to measure.

In summary, we decided to build rather than to buy for the following reasons:

- the cost: the systems that manage, distribute and maintain the online learning materials are high-cost systems that also imply secondary costs for adequate hardware and assistance.
- the skills: the faculty has no personnel specifically qualified to work in these environments. Complex systems such as Lotus Learningspace ™ or Blackboard ™ require personnel specifically dedicated to their management, thus requiring more resources than the faculty can provide.
- the highly specific needs of end-users, in particular the integration with administrative and bureaucratic functions: many of the functionalities that normally relate with the didactic activity of the teacher are closely related with administrative tasks that should be carried out in a specific way and at a specific time, thus constituting a big constraint for packaged systems that have no personalization features or that require a vast amount of adjustments in order to be personalized.
- the time: a prototype was to be ready for the second part of the 2000 academic year (March 2000) with a pilot group of teachers and students, and a beta version of the system was to be available for use by all the teachers and the related students in the first semester of 2001. This schedule was not compatible with our time of implementation of already-built learning environment like the ones cited above.

For all these reasons, we decided to build the system on our own, creating only what we needed. The main objectives of the project were the following:

- to allow the teacher to keep a constant relationship with students, in the different ways that we will explain in the following sections;
- to allow the teacher to distribute educational material to students;
- to keep data for administrative and reporting tasks that must be performed by the teacher and by the secretary of the Faculty.

Some general considerations must be kept in mind to understand the complexity of the relationships among the different entities of the data schema. We have the following constraints:

- A teacher can have multiple courses.
- More than one teacher could teach a course.
- A student can follow multiple courses, and therefore must have access to the different faculty areas of the teachers.
- The educational material must be kept online over a period of some years, in order to let students download the correct material for the year they followed the course, and also to give another possibility to students who have failed to complete their courses within the prescribed time.

A difficult choice, currently under debate in many institutions, regards whether the system should be open to everyone or limited to only registered students, i.e., only regular, fee-paying students. Some teachers believe that the educational material should be freely distributed to everyone in the world, while others prefer that only their students (freely) download the educational material. For the time being the more restrictive vision has been adopted: the students must register with the system by providing their personal data and their faculty registration number. A login and password is released for newly registered students. The same registration procedure is used for the teacher, thus assuring that only the course instructor can load material into the system.

The system is built with several functions, most of which are available to the teacher, a subset is available to the student, and a specific set of functions are devoted to administrative purposes. There are also common functions, though with different privileges: teachers can modify the data while students can only read them. We will now present these functions, distinguishing them by type of user. The main function that the system guarantees is to transfer a file from the teacher's computer to the system, and from the system to the students' computer. By inserting the correct login and password, the teacher can upload the files, categorize them and assign them to the different lessons. The students can work from their home workstations to connect to the system as long as they have a login and password. They can then check for updated information or materials for a their courses, and download the relevant materials if desired. The didactic material or administrative information is thus transferred to the student, who can then read, print, or store it as desired. At the moment, the graphic layout of the Web site has not been decided. When all the functionalities of the system have been completed, the designers will look more closely at the "cosmetic" aspects of the site.

2. The Teacher tools

The teacher is the user having access to almost all the functions of the system. After having inserted her own login and password, the teacher chooses the course on which she wants to operate. Courses are also identified by year, so the course entitled "Information Systems" taught in 1999 is found in a different section with respect to the same course taught in 2000, even if it uses the same educational material.

After having chosen the course, the teacher has all the tools at her disposal. All the tools provide the principle functions for managing the material or information, i.e., inserting, updating, deleting and listing. These tools are principally:

- Materials (lecture slides, tests, solutions of tests, notes, graphics, charts, tables etc.) are categorized; the list of types of materials is dynamic.
- A dynamic syllabus, where the educational material can be viewed. The teacher can upload and download material at this location.
- The course programme, timetable and bibliography of related material.
- "Live" links related to the course, dynamically updated by the teacher and directly usable by students.
- Frequently Asked Questions related to the topics covered in the course.
- The diary of the lessons (fig. 1), which differs from the syllabus in that it has a more administrative organization, while the syllabus can also be used to upload/download the materials.
- The newsgroup, up to three for each course: the details are discussed in the next section.
- The list of the students that are registered for the course, with their email address. The teacher can use it as a mailing list to send cumulative or multiple messages to the students on the list; such messages can refer to lesson cancellation, announcement for seminars etc.
- A videoconferencing system (fig. 2), made using a personalized version of the Netmeeting ™ software, integrated inside the browser. When the teacher is online with the videoconferencing system

opened, the students that connect to the videoconferencing page will automatically see a green light indicating that the teacher is available for a live session. The system automatically stores the IP address of the teacher, thereby helping the student and teacher to overcome the technical difficulties of managing a conferencing system via Internet.

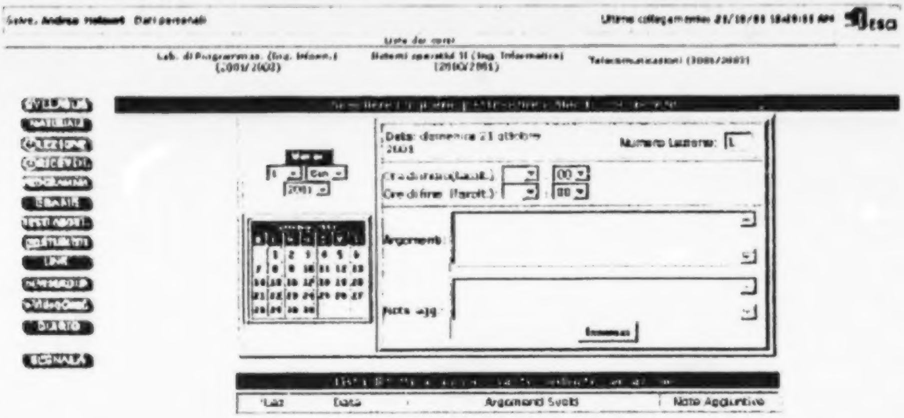

Figure 1: The teacher's diary

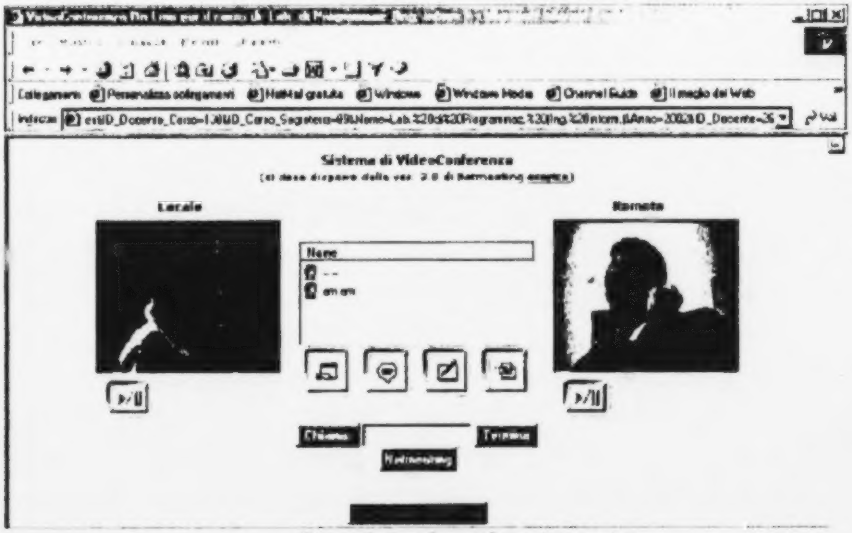

Figure 2: A videoconferencing session

In the "syllabus" and in the "materials" sections the teacher can upload the material by means of a simple form, just choosing the relevant file from her own hard disk. The system will transfer the file to the server and record the information in the underlying database. In this way, the material is securely transferred to a central station, available for the students to be downloaded. The file is also associated to a specific lesson, thus helping to compile the syllabus. An interesting feature of the uploading process is the possibility of excluding the students from seeing that the file is present on the system. This is very useful in cases where there are multiple teachers on the same course. In fact, the system could be used to create a closed group composed only of teachers and tutors, where some documents are shared only among them and are not visible to the students that enrol for the course. This has been done commonly in courses where tutors and teachers exchanged the test answers before the lesson or test was given.

3. The Student tools

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The tools available to the students are the same as those seen by the teacher, although mostly in read-only format. In practice this means that the syllabus can be used only to download material from the server, while the course programme can be viewed but not modified. A specific functionality provided to the student is course enrolment (Fig.3, item 3). As with any enrolment procedure, the student must choose the courses desired. In this area the student, previously registered with the institution, is presented with the list of the courses offered by the faculty that have online materials, and the student simply chooses the courses she wants. However, the most important feature available that is specifically for students is the "news" section. (Fig. 3, item 2)

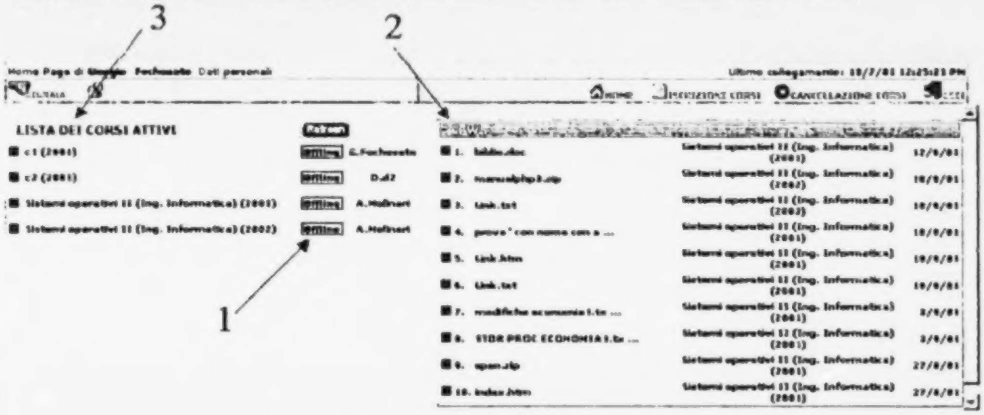

Figure 3: The main window of the student

This function is presented to the student when she connects to the system. On the left is the list of courses in which the student is enrolled, while the right part of the video shows a frame with all the documents uploaded since the last time the student logged in. This feature allows the student to go directly to a document presented in the "news" list without having first to choose a course and search for the most recent material. This is particularly useful to the student who cannot be present in the classroom for one or several lessons but who nevertheless wants to keep up with the course.

Another important feature of the system is the newsgroup. The validity of this tool for didactic purposes has been widely analysed and proved. [Collis et al, 1997] [Eastmond 1995] [Hanna 2000] [Horton 2000] [Palloff et al, 1999]. The newsgroup inside the system is related to the course, thus allowing the teacher to have different discussion forums for every course taught. The teacher moderates the newsgroup by acting on the messages in varying ways: recommending a message, deleting messages, voting on messages etc.. The messages from the teacher are of a different colour (fig. 4), this to confirm the different role of the teacher in managing the newsgroup. Each message, both in the summary and in the detailed view, reports the number of times it has been read by other users (fig. 5, item 1). Students can participate in the forum not only by writing and responding to messages, but also by voting on the messages (fig. 5, item 2).

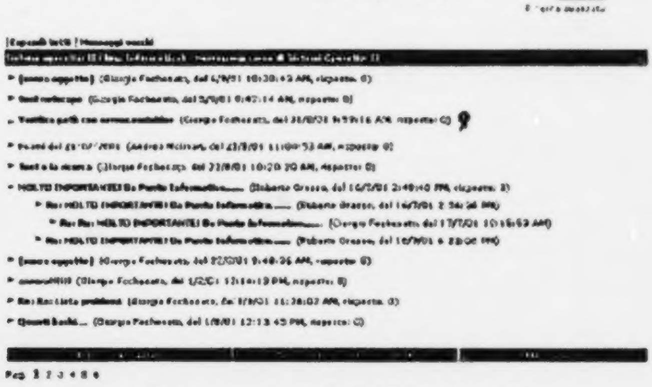

Figure 4: The newsgroup with the different types of messages

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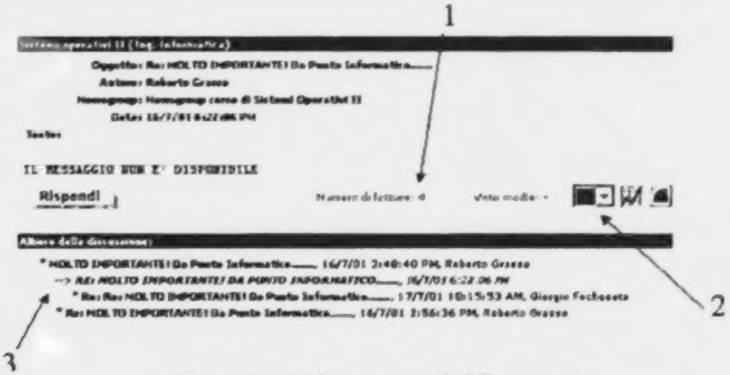
This vote is visible to everyone and serves to evaluate the importance of the message for the current topic. The forum has threads, so every reply is associated with the corresponding message. The thread in which the message is involved is always visible to the reader, also when she writes a response. (fig. 5, item 3). All the messages are stored in and appended to text files, not in the database. The files have a preconfigured maximum dimension, so when this dimension is exceeded a new text file is created. This proved to be the most logical choice when taking into account the following facts:

- the number of newsgroups available: there are more than one hundred teachers and courses
- the variable dimension of the messages: in most cases the messages are short (a few hundred characters), but some messages (FAQs, for example) could be very long, so the database fields should be dimensioned accordingly, with a great waste of space.

On these text files an indexing engine makes it possible to use the traditional search and advanced search mechanisms. As mentioned in the discussion of teacher tools, in the student section it is possible to check if the teacher is on-line at that moment via videocamera, and therefore if the teacher is available for interaction in real-time (fig. 3, item 1)



Sistemi operativi II (Ing. Informatica)

Oggetto: Re: MOLTO IMPORTANTE! Da Punto Informatico......
Autore: Roberto Grasso
Newsgroup: Newsgroup corso di Sistemi Operativi II
Data: 16/7/01 6:22:06 PM
Testo:

IL MESSAGGIO NON E' DISPONIBILE

Rispondi! Numero di letture: 4 Voto medio: -

Albero delle discussioni:

* MOLTO IMPORTANTE! Da Punto Informatico......, 16/7/01 2:48:40 PM, Roberto Grasso
--> RE: MOLTO IMPORTANTE! DA PUNTO INFORMATICO......, 16/7/01 6:22:06 PM
* Re: Re: MOLTO IMPORTANTE! Da Punto Informatico......, 17/7/01 10:15:53 AM, Giorgio Fochesato
* Re: MOLTO IMPORTANTE! Da Punto Informatico......, 16/7/01 2:56:36 PM, Roberto Grasso

Figure 5: a single message with different options

4. The administrative functions

This area includes several functions, not only related to ICT administration. It also includes functions necessary for the faculty secretary. The first important function is the change of academic year. In September of every year, the course can change teacher/s, title, group of discipline, and most of all students. So, every year in this period a specific function that allows the faculty secretary to redefine the association between the courses and the teachers must be provided. Because of the quantity of information associated with a course, this task requires the provision of several functions that could be fully automated, partially automated or completed manually. These functions are listed as follows:

- A function to transfer automatically all the materials from the previous to the current year, this in case the teacher decides to reuse the material of the previous year. Everything is therefore copied with a new identifier, so the old and the new courses have different identities but the same material.
- A function to selectively transfer materials and other information related to the course from one year to the other. The major problem is represented by the newsgroup, where threads could be in progress and therefore an automatic transfer between the two years could confuse the students on one side, and could be inconsistent with a potentially different course programme on the other. The default option is that the newsgroup remains connected only to its original course, so a new course will have a new newsgroup.
- A function to store previous courses with all the related materials so that students can access to them.

Other more traditional administrative functions are related to the ordinary activity that the secretary carries out during the academic year, especially at the beginning of the year. The main function is the management of the teacher database, with all the administrative information necessary to fulfil bureaucratic obligations. In addition, a function that assigns the teacher to courses is provided; this association is fundamental for the rest of the system, as it is used in every area that grants access to the online material. All the materials, newsgroups, links, students etc. depend on this unique association: teacher-course-academic year.

5. Feedback and future developments

The prototype of CMS we developed has been under a stress test since the second semester of academic year 2000/2001 and will be released in its final version at the end of this experimentation period. The system has

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been tested with about 1.600 students and 200 teachers for one year, with a download rate of 1.300 documents per day. We submitted some questionnaires to students, both manually and via e-mail, and collected direct feedback from colleagues. From these responses we can assert that the reaction to the system has been very positive. Our main concern was the teachers with less computer experience, which meant a majority of our faculty. The system has proven very easy and intuitive to use, winning praise from everyone due to its simplicity. We must admit, however, that we made a great effort in this area, in terms of providing direct assistance to teachers, sometimes by using students to help teachers in difficulty. We also received positive comments from the students. In the students' questionnaires we asked for comments on functionality, usefulness, quality of materials and performance of the system.

In short, of the approximately 200 questionnaires returned from students, 79% expressed satisfaction with the system. In particular, the contact with the professor and the availability of new material are the most welcome features. Eighty-six percent were satisfied with the quality of the material, although a few underlined the need for open (not read-only) material. The overall usefulness of the system was largely connected to the news section, where the student is notified at every connection of any new material added since his/her last connection. A second positive aspect was the teacher-student contact and the related improvement in the learning process. In this part we received 91% positive feedback, an embarrassing indication that change was definitely needed. The performance of the system was found to be satisfactory for 78% of students, while the rest were not very satisfied. An important point to note is that teachers often don't look at the amount of megabites their materials represent (they use office connections to the Web site) but students using home connection with analogic modems at 56Kbps suffer in this aspect, which should be considered more by teachers when uploading materials. As regards the frequency of use, more that 50% of students used system daily, and the rest from two to four times a week.

In conclusion, we can be very satisfied by our first experiment, though there are some points where the system must be further integrated. One important point of integration is with the student secretary database. In our university the student secretary is an autonomous entity, with its own procedures, database and technology. On one hand this allows single projects to be started without having to depend on the big infrastructure of the student secretary. On the other hand, however, there is a time where the different autonomous systems should be integrated. The simplest example regards the login and password to access the different facilities that the university offers to students, examples being e-mail, access to laboratories, account of the refectory, etc.. At the moment, the uniformity of login and password in the two systems is not guaranteed, it is up to the student to register herself in both systems with the same login and password.

In conclusion, the system presented in this paper is one alternative to Course Management Systems, built with the main target of distributing educational material to students in a uniform way. Some real-time functions have been added to the system and are currently under testing; however we believe that the basic functionalities provided by the system to distribute dynamic information and educational material are the minimum services that should be provided to students. The positive results of the first experiments seem to confirm this assertion.

Bibliography

[A'herran 2001] A'herran A., Integrating a course delivery platform with information, student management and administrative systems, in Proc. ED_Media 2001, World Conference on Educational Multimedia, Hypermedia and Telecommunication, Tampere, Finland, June 25-30 2001

[Aggarwal 2000]Aggarwal, A. (2000). (Ed.) Web-based learning and teaching technologies: Opportunities and challenges. Hershey, PA: Idea Group Publishing

[Collis et al, 1997] Collis, B. & Knezek G. (1997). Teaching and learning in the digital age-research into practice with telecommunications in educational settings Eugene, OR: International Society for Technology in Education.

[Eastmond 1995] Eastmond D. V. (1995). Alone but together: Adult distance study through computer conferencing. New York: Hampton Press.

[Hanna 2000] Hanna, D. E., Glowacki-Dudka, M. & Conceicao-Runlee, C. (2000). 147 Practical tips for teaching online groups: Essentials of Web-based education. Madison, WI: Atwood Publishing.

[Horton 2000] Horton, S. (2000). Web teaching guide: A practical approach to creating course Web sites. Yale Univ Press.

[Infoworld, 1998] Infoworld Publishing Company (1998). Web-based Training Solutions. http://wwwinfoworld.com/cgibin/displayTC.pl?/981123comp.htm

[Mcmahon et al., 2000] McMahon M., Luca J, Courseware Management Tools and Customised Web Pages: Rationale, Comparisons and Evaluation, in Proc. ED_Media 2001, World Conference on Educational Multimedia, Hypermedia and Telecommunication, Tampere, Finland, June 25-30 2001

[Palloff et al, 1999] Palloff, R. M. & Pratt, K. (1999). Building learning communities in cyberspace: Effective strategies for the online classroom. San Francisco, CA: Jossey-Bass.

[PC Week 1997] PC Week (1997). Computer-based training on the Web. http://www8.zdnet.com/pcweek/reviews/0818/18ibt.html

[Teare et al, 1999] Teare, Richard, Davies, D. & Sandelands, E. (1999) The Virtual University: An Adion Paradigm and Process for Workplace Learning. London: Cassell Academic.

Stories from the Frontline: Lessons Learned in Two Corporate E-Learning Initiatives

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Abstract: This paper will provide overview of the redesign of two corporate training programs, New Supervisor's Basics and Ethics and Compliance. These two courses are part of an enterprise wide e-learning initiative underway at Harris Corporation; a Melbourne, Florida based international communications and electronics company.

Components of successful repurposing training programs and interactive methodologies incorporated in redesign will be shared with participants. The lessons learned, and challenges encountered will also be included in the presentation. Attendees will have an opportunity to discuss the components of successful programs and uses of interactive methodologies to determine applicability to their own organizations.

Evolution of Corporate Web-Based Training

This paper presents an overview of two separate stand-up (instructor-led) courses that were repurposed into web-based training (WBT). The paper further describes the lessons learned by the Harris Knowledge Network (HKN) team during this ongoing effort. These lessons learned are not restricted to a stand-up/WBT repurposing effort; they are readily applicable to other projects in which an existing educational/training system is modified into a different delivery system.

Corporate Example

An ongoing goal of the HKN team was to create a site that supports employees' need for training and information while maximizing return on investment with Internet technology and training. Empowering employees with the elements and tools to become independent knowledge workers was also an objective of the Harris team. Preliminary research strongly indicated that although the application of web-based training and other e-learning initiatives would play significantly in the overall organizational learning strategy, they would have to be carefully integrated into the curriculum. Adapting the blending learning methodology for two of the first courses rolled out worked well within this strategy. The initial blended model included a Bulletin Board System (BBS) and collaborative tools. These features will be added incrementally as HKN solidifies its curriculum.

Requirements

An analysis of business requirements and technical environment was performed in order to determine the best overall methodology and design strategy for these courses. The methodology had to account for multiple training and information needs within a large geographically dispersed corporation in an economic manner. A needs analysis was also conducted to determine the skills and skill levels of the end users. This data identified what were the gaps or "holes" of knowledge. It also gave strong design clues as to which materials should be presented online and which material would be optimally delivered via live instructor.

Business requirements identified were diverse training and information needs, and personnel distributed across several states and countries. Fiscal drivers included the desire to reduce travel and training costs while improving the skills and knowledge of employees. The technological factors taken under consideration included accelerated desktop computer processing speed, improved browser technology, and such features as Java enabled client server interactivity, improved backend database technologies, the ubiquitous availability of commercial internet service providers, and improved access to the bandwidth needed for large file transmission (Wagner, 1999).

After performing a comparative analysis of business and technical requirements, as well as needs analysis of end users, the chosen methodology for both Harris' New Supervisor Training and Ethics and Compliance Courses was a blended design consisting of synchronous and asynchronous learning.

Glossary of Terms

E-learning: Covers a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio- and videotape, satellite broadcast, interactive TV, and CD-ROM.

Blended learning: Learning events that combine aspects of online and face-to-face instruction

Asynchronous learning: Learning in which interaction between teachers and students occurs intermittently with a time delay. Examples are self-paced courses taken via the Internet or CD-ROM, Q&A mentoring, online discussion groups, and email.

BBS (bulletin board system): An online community run on a host computer that users can dial or log into. BBS users can post messages on public discussion boards, send and receive email, chat with other users, and upload and download files. BBSs are text-based and often related to the specific hobbies or interests of their creators

Business requirements: Conditions an e-learning solution should meet to align with needs of such stakeholders as content developer, subject matter expert, learner, manager, and training administrator.

Collaborative tools: Allow learners to work with others via email, threaded discussions, or chats

Customer-focused e-learning: Web-based learning programs targeted at current and prospective customers. By training customers online, companies attract new business and make people more comfortable with e-transactions.

End user: The person for whom a technology is designed; the individual who uses a technology for its designated purpose. In e learning, the end user is usually the student

Enterprise-wide e-learning: E-learning that is intended for all or most employees within a company. Often part of a strategic change of direction with a very short timeline. Also used to support a core process such as sales.

Synchronous learning: A real-time, instructor-led online learning event in which all participants are logged on at the same time and communicate directly with each other. In this virtual classroom setting, the instructor maintains control of the class, with the ability to "call on" participants. In most platforms, students and teachers can use a whiteboard to see work in progress and share knowledge. Interaction may also occur via audio- or videoconferencing, Internet telephony, or two-way live broadcasts

Ongoing Endeavor

The New Supervisor's Basics Course initially piloted in November 2001 and is scheduled for its second session in January 2002. Ethics and Compliance Course is scheduled for initial pilot in February 2002. Also Environmental

Health and Safety WBT is scheduled for its first course pilot in January 2002 and customer focused e-learning courses are currently under development. This corporate training and information site will continue to expand as the portal to various knowledge portals for specific audiences throughout the international company. It follows the strategic plan for continually increasing the breadth and depth of information and training offered via the corporate training portals and knowledge hubs.

Harris Knowledge Network has continued to successfully integrate itself as a corporate tool as technology advances and business factors address employee needs as specialized knowledge workers. Successful deployment and maintenance of a knowledge network depends upon accurately defining organizational business goals, creating a viable learning strategy and on having a clear understanding of requirements and terminology.

References

ASTD's Learning Circuits E-Learning Glossary Compiled by Eva Kaplan-Leiserson (2001).

Wagner, E. (1999). Beyond Distance Education: Distributed Learning Systems. *Handbook of Human Performance Technology*, 626-648.

Effective Collaboration in a videoconference-based CSCL Environment

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Abstract: Previous research on video instruction shows that the learning is enhanced when small groups of users watch and discuss lectures and videos together. Using specialized, high-end videoconference systems, these improved results have been shown to apply even when the users are in different locations. In this paper, we explore two issues in making Digital Library scenarios widely supported at low cost. First, we explore designing of a model system that allows distributed individuals to collectively watch a Digital Library video using shared controls such as play, pause and stop. Second, we explore the impact of four alternative discussion channels on users leaning and interaction behavior.

1 Introduction

This paper contains the research plan from the original project proposal. More recent ideas and progress will be periodically made available from the Yano Lab. home page[1]. With rapid changes in technology, what we learn today become obsolete or irrelevant within a short time span. We need to continuously update our skills, and cost-effective support for such lifelong learning is a key challenge facing our education systems. To address this problem, one solution adopted by many universities has been to broadcast classes via TV networks in a Digital Libraries, and strategy Stanford has pursued successfully for over 25 years. However, much work is needed to enable a more advanced utilization of the available information and communications resources. This research focuses on the exploration of issues in develop of digital library environments that facilitate CSCL, CSCW (Computer Supported Collaborative Work) to their specific individuals needs and preferences. The strategy that Stanford has pursed as synchronous model of learning has drawbacks: it often conflicts with users' work commitments, and the model is not scalable. Even if the class cold be broadcast to a million people concurrently, there are few chances that interesting interaction would happen between specialized users and end users in such environment.

The flexibility and scalability can be solved by using Digital Library video, videoconference streaming technologies and the Internet to create an on-demand, anytime, anywhere learning model. However, research shows that learning can suffer when users watch videos individually. This concern is identified and addressed in a classic study reported in Science by Gibbons et al. (1997). As a solution, they propose the tutored video instruction model, wherein remote users watch videos in small groups with a discussion facilitator. As they watch the video, they periodically pause and discuss it. The study shows that the tutored video instruction users outperform users who attend the live class in the classroom, as well as users who watched classes live from remote locations and users who watched classes video individually. The advantage of tutored video instruction over classroom attendance was replicated at the University of Massachusetts where some users groups met without tutors (Stone, 1990). The advantage of tutored video instruction was also found by Smith, Sipusic, and colleagues (Sipusic, 1999, Smith 1999). In addition, they tested and extension of tutored video

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[1] http://www-yano.is.tokushima-u.ac.jp

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instruction called distributed tutored video instruction, which does not require users to meet in the same room. The researchers had groups of up to seven users watch and discuss pre-recorded lectures from multiple locations. In addition to the lecture video, users were connected with a high-quality, low-latency audio and video connection. In experiments involving six university courses and several hundred users, course grades of distributed tutored video instruction and tutored video instruction users were better that those of users who attended the live lecturers and were indistinguishable from one another. The success of distributed tutored video instruction and tutored video instruction is attributed to the collaboration and discussion that occurs among the users watching the video.

Distributed tutored video instruction is clearly a desirable model in many ways. It allows users to participate from anywhere, thus eliminating location constrains. It allows users to participate almost anytime, subject to finding a few partner users willing to participate at the same time. It is scalable, as hundreds or thousands of such small groups can exist and make progress independently. Best of all, it provides all these features while statically showing better learning outcomes than being in the classroom.

Given the desirability of distributed tutored video instruction, this paper extends earlier work in two principal directions, allowing for wide-scale deployment of distributed tutored video instruction in a Digital Library. First, a key component of distributed tutored video instruction is the ability to collaboratively view pre-recorded lecture video. For example, when one user presses the pause button, the video should pause for all remote users. The "what you see is what I see" principle needs to be preserved for all group members.

Second, distributed tutored video instruction results presented and Sipusic at al. (1999) were based on the remote participants having a specialized, high-quality videoconference system, e.g., the system presented four remote videos currently on a monitor, each at 30 frames per second, while also encoding the video of the local participant. Such infrastructure is unlikely to be available to most DL-users (digital library users), and past literature shows little benefit from including talking-head video in somewhat similar contexts (Boyle, 1994) Consequently, in this paper we propose a new model of communication for effective collaboration in a videoconferencing-based CSCL environment with videoconferencing, audio-conferencing, text chat and face-to-face communication. And also the question of how this model is affected if the communication channel is less rich. Does is affect learning and interaction behavior?

2 Distributed collaborative video

Enabling the distributed collaborative video instruction in Digital Library scenarios requires two components:

a) A distributed lecture video viewing system with shared controls like play, stop and pause.

b) A communication system for discussion around the library holds materials including video content.

Although the distributed tutored video instruction requirements are quite basic in many ways, today's streaming media products and applications sharing products do not support it.

Streaming media players (e.g., Microsoft Windows Media Player) allow multiple people to watch the same stored video from a shared video server. However, users do not shared the VCR controls. Users could say "pausing video" on the conference call when pausing the player, but remote users will end up pausing their video players at slightly different times. In addition to being a cumbersome process, over multiple stop-starts, they can easily get out of synchronization.

Unfortunately, this almost works, but not adequately. The remote Digital Library users can see and control the navigator or video, but the video is jittery and of low quality. Instead of the video data stream going from the Digital Library video server to all participants and being independently decoded and rendered on their workstations or PCs (shown in Figure 1), the video stream goes only to the Digital Library user who starts the media player (DL-user1) (see Figure 2). It is decoded and rendered on DL-user1's machine, and the pixel-level screen changes are detected by the application sharing system (e.g., NetMeeting), re-encoded using a separated algorithm, and sent to others' desktops. Because none of the application sharing products is optimized for this scenario (they are targeted towards transmitting infrequent changes to the screen as may occur during web browsing) the performance is dismal compared to highly optimized video codecs, and the network bandwidth consumed is large. Although application sharing allows DL-users to share documents, presentations and DL web pages, current systems do not work for dynamic media like video.

To solve the above problem, what we need is a partial sharing navigation browser and media player application. We want the Digital Library content to stream independently to each users' navigation browser and media player and be decoded and rendered there (as in Figure 1), but we want to have a Navigation with VCR control UI of the browser and media player to work via our model application system. To implement this solution, we need to combine the functionality of JMF (Java Media Framework), NetMeeting SDK and JDK 1.3.

3 Video-communication model

In this section, we propose an interaction model that would solve the problems of distributed materials and video-communication viewing that commonly exists in others implementations, while also providing opportunities for instant communication for unintended interactions with unexpected DL-users by introducing the sense of distance among DL-users in the Digital Library environment.

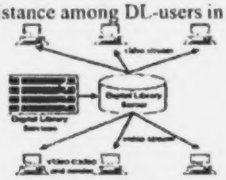

Figure 1: Conventional video flow when each Media Player independently connects to the digital video server

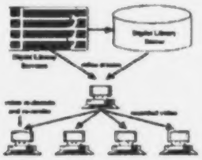

Figure 2: video flow when players are shared under NetMeeting.

In the first implementation we tried to introduce the sense of distance in a hybrid space by providing public and private places, as well as by varying the amount of digital information exchange between users (see Figure 3). Public places are used by end DL-users, while private places are used by specific DL-users. A place for DL communication consist of a public place that is shared by users as a hallway, and private places, that are used by these users as their classrooms. The hallway is provided in a virtual space on the network, while the private classroom space is located in a Digital Library. DL-users can be defined independently from their private places locations. The virtual hallway and the private classrooms are interconnected by virtual links that are provided by the messenger GUI located in their networks terminals.

When one DL-user wishes to initiate a video-conversation with other DL-users, the first user send a instant message through the Digital Library messaging service showing his or her picture and information to the DL-users group. The user caller can wait till the DL-users group is available without interrupting the activities of the group when the group looks busy. After the user decides to contact the DL-users group, the user approaches the private place of the DL-users group, then our implementation combines the Windows Media Player and NetMeeting in a manner that can be displayed the DL-video image along with the basic CVR controls start, stop and pause (see Figure 4) . All events generated by the VCR controls are captured by the UI shell surrounding the media player and transmitted to remote DL-user group's media players using the T.120 data channel provided by NetMeeting, JMF and JDK.

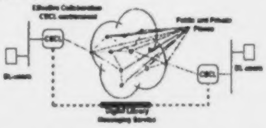

Figure 3: Proposed interaction model.

These race conditions are inherent in distributed systems, and many classes of solutions are possible. It is necessary to give an apparent order to all tasks being issued, but without first passing them through a

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central messaging service to avoid video-communication the user felt uncomfortable and the Digital Library does not know where the users are. In our first software implementation, we introduced a notion of ordering of the transmitted messages using the time stamps of the DL-user sender's video stream in each of the messages. Since the media player records the video stamps relative to the start of the video stream. these timestamps are obsolete and not influenced by the system clock. Any player that receives a message with a timestamp earlier than the one on it had record on its last sent message ignores the received message. This ensures that all the players record the message that has the latest timestamp relative to the start of the video stream.

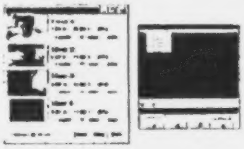

Figure 4: User interface. The modified media player used by the participants on the left.

As mentioned in Section I, we wish to explore the impact of three digital communication channels in a Digital Library. The first, videoconferencing (transmission of life video of all DL-users) required extra work. A separate, special-purpose application was built to allow participants to see each other. This application only transmitted video; the second, audio-conference was provided by other channel. This window displayed medium quality video (full color, 15 frames/second) of all DL-users group. Each group member's image was approximately 5 centimeters wide and 4 centimeters tall. Video was captured using a camera on top of each participant's monitor. The third, text chat was supported using the standard chat, with these tools all DL-users were communicated in a network-based system.

4 Study focus

A major goal of this ongoing research is to develop a new model for effective collaboration in a videoconference-based CSCL environment examining how various communication channels affect this new model in a Digital Library environment. Specifically, we are interest in determining whether videoconferencing (audio and video) is the best option relative to text chat.

We are examining three major sets of variables to determine the utility of these communication channels. First, because this model is been designing for the educational context, we measured participant learning and comprehension. Second, because of the tight relationship between learning and discussion in our model, we measured various aspects of the users' interaction and discussion. Finally, we want to know if our new CSCL model experience is the best way for effective collaboration in a Digital Library environment. Figure 5 shows an example screen for the collaborative video viewing condition. For this first implementation, each participant was seated alone in a room with PC. All participants used microphone to communicate, but when the shared DL-video played, the sound from the computer speakers was relayed through each microphone, causing an unacceptable distraction (public place). For the second test, participants were seated together at the same room. One computer class was played using our first implementation model (private place), except the computer's screen was displayed on a projector screen at the end of the room. The professor who was teaching used a computer and mouse to pause and play the DL-video during discussions. Group members would ask the professor to pause the video if they had something to say; often they would just being talking and the professor would automatically pause the video.

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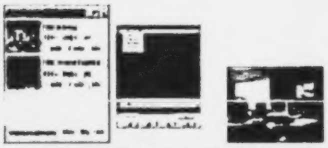

Figure 5: Shows an example screen for the collaborative video viewing condition.

Although the groups of our first implementation paused the DL-video more often, the difference was not significant. In addition, both test groups felt that the number of pauses was about right, and both test groups were equally comfortable with pausing video. Both groups were also equivalent in terms of time spend discussing the DL-video and comfort with asking questions and making comments. However, the first test users felt that there was too much discussion, while second test users felt that the amount of discussion was about right.

5 Discussion

First we should note shortcomings of this ongoing study. First, the video we used for these studies was didactic material property of Digital Library. However, if the distance education takes hold, it is likely that more resources will be invested in producing materials of higher quality than a recorded lecture. Second, this ongoing research has the generalizability issues common to our lab studies. The majority of our participants were students, and although our tests settings were not very similar to a college classroom environment, it was similar to watch is found in distance leaning training settings. As a result, this ongoing research could benefit from future field study replication.

The first goal of this ongoing research is to build and effective collaboration model in a videoconference-based CSCL Digital Library environment on top of existing, commercial technology. Ideally, we hope to build a model that would recreate the collaboration video viewing experience for students and DL-users who could not meet in the same room. Our ongoing studies found no significant differences between the first and second test groups on most major measures, including our measures of leaning.

However, our study did find one area in which the model could benefit from additional design. Distributed tutored video instruction test groups were not as comfortable with pausing and discussing the DL-video, reflected by both the survey data and the reduced time spend discussing the video when it was paused. This result is worrisome given the tight assumed connection between discussion and learning in the tutored video instruction literature. The second goal of this ongoing research was to examine the effects of using different communication channels to link DL-users together. Aside from this issue, our data suggest that providing videoconference is a helpful addition. If this is consistently replicated, it is good news for Digital Libraries implementations that wish to implement distributed tutored video instruction providing the video channel.

6 Concluding Remarks

The effective collaboration in a videoconference-CSCL environment model in a Digital Library provides significant benefits: scalability, good learning outcomes, and location and time flexibility for DL-users. In this paper we have addressed two issues that together allow our model to become more widespread. First, we have shown how a collaborative video viewing solution can be built on existing technologies by any third party. Seconds, we have provided results on DL-users learning, interaction, and satisfaction as a function of communication channels used for interaction. Both of these solutions illustrate that existing barriers to distributed tutored video interaction can be overcome without tremendous expense.

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References

Boyle, E., Andreson, A., and Nwlands, A. (1994). The Effects of Visibility on Dialogue Performance in a Cooperative Problem Solving Task, *Language and Speech*, 37, 1, 1-20.

Christel, M.G. (1995). Addressing the contents of video in a Digital Library. *Electronic Proceedings of the ACM Workshop on Effective Abstractions in Multimedia.* (San Francisco California).

Edigo, C. (1990). Teleconferencing as a Technology to Support Co-operative Work: Its Possibilities and Limitations. In J. Galleguer, R. E. Kraut, and C. Egido (eds.) *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work* (p. 351-371). Lawrence Erlbaum Associates.Finn, K., Sellen, A., and Wilbur, S. (1997). *Video-mediated Communication*. Lawrence Erlbaum Associates.

Fox, E.A., Marchionini, G. 1998. Toward a World Wide Web Digital Library. *Communications of the ACM*, 41,4 (April), 28-32.

Gibbons, J. F., Kincheloe, W. R., and Down, K. S. (1997). Tutored Videotape Instruction: A New Use of Electronics Media in Education. *Science*. 195: 1139-1146.

Green and Williges, R. C. (1975). Evaluation of Alternative Media Used with a Groupware Editor in a Simulated Telecommunication Environment. *Human Factors*, 37 (3), 283-289.

Omoigui, N., He, L., Gupta, A., Grudin, J., and Sanocki, E. (1999). Time-Compression: System Concerns, Usage, and Benefits. *Proceedings of the ACM Conference on Human Factors in Computing* (CHI 99).

Schanase, J. L., Kama, D. L., Tomlinson, K. L., Sanchez, J.A., Cunnius, E. L., and Morin, N. R. (1997). The Flora of North America Digital Library: A case study in biodiversity database publishing. *Journal of Networks and Computer Applications* 21, 1, 87-103.

Sipusic, M., Pannoni, R., Smith, R., Dutra, J., Gibbons, J., and Sutherland, W. 1999. Virtual Collaborative Learning: A Comparison between Face-to-Face Tutored Video Instruction and Distributed Totored Video Instruction. Sun Microsystems Laboratories, Inc. TR-99-72. Available at http://www.sun.com/research/techrep/1999

SUN. 2000. Java Media APIs Home Page. (http://java.sun.com/products/java-media).

Stone, H.R. (1990). Economic Development and Technology Transfer: Implications for Video-based Distance Education. In M. G. Moore (Ed.), Contemporary issues in American Distance Education (pp. 231-242). Oxford, England: Pergamon

Wactlar, H. D., Christel, M.G., Gong, Y., Hauptmann, A.G. (1999). Lessons Learned from Building a Terabyte Digital Video Library. IEEE Computer, 32,2, (February), 66-73.

CardioCaseDiscussion: a Cooperative Learning Environment for Patients' Cases Discussion in Cardiology

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Abstract: Problem Based Learning is of great use in Medical Schools. This method is based on patients' cases discussions and its success lies in the fact that it stimulates student's investigation and critical thinking. This strategy complements the conceptual learning and allows the students to deal with real situations. This paper describes a web-based cooperative learning environment, CardioCaseDiscussion, to support the discussion of patients' cases among medical students and professors of cardiology. This environment is part of CardioEducar, an educational meta-environment which purpose is to integrate several educational environments.

1 Introduction

Problem Based Learning (PBL) has become the outstanding method of teaching in pre-clinical undergraduate medical education (Elsner, C. et. al., 2000). PBL makes students more active during the learning process because they feel empowered to have impact on the outcome of the investigation. The web can be used to support on-line discussion in PBL approach in order to enhance the student communication. Online discussion can assist learners to interact and collaborate with peers or experts for knowledge construction purpose.

2 Cooperative Learning

Cooperative learning allows students to help each other in the learning process by working together and/or with an instructor. According to Comeaux, P. & Nixon, M. A. (2000), collaborative technologies allow the construction of common ways of seeing, act and understand. These technologies allow people to develop shared knowledge and/or new group activities. The communication technology used in the learning environment depends on the educational goals of the learning theory adopted. The web support to medical cases discussion provides a virtual environment where users can interact from different remote locations, in different or synchronized moments, and share knowledge information (Osuna, C. A. & Dimitriadis, Y. A., 1999).

CardioCaseDiscussion is designed to incorporate problem-based learning into a multi-user computer-assisted information exchange in an asynchronous communication way.

3 CardioCaseDiscussion Environment

CardioCaseDiscussion is one of the learning environments of CardioEducar, a meta-environment for cardiology education that offer computer-based support for the teaching conferences and meetings held in the Medical School and the University Hospital of the Federal University of Bahia, Brazil.

CardioCaseDiscussion supports meetings for discussion of patients' cases. It was developed to teach medical students to analyze patient's data (history, physical examination and tests) and to formulate a diagnosis. The environment supports cardiology cases discussion in three different situations: (i) a group of students oriented by a professor; (ii) a single student oriented by a professor, and, (iii) a group of students without the professor guidance. It can also be used by a single student with individual learning objective. In this scenario there will be no opportunity for discussion.

CardioCaseDiscussion is composed by four environments:

- *Authoring Environment*, which supports a professor when preparing the discussion of a patient's case. It offers facilities to insert the patient's data (history, physical examination and tests results).
- *Discussion Environment*, which presents the cases and monitors the discussion among students and the professor.
- *Meeting Environment*, which supports the case's data presentation in a live classroom meeting.
- *Tutorial Environment*, which provides medical students with detailed information about cardiology diseases and cardiology tests.

The communication among participants takes place by means of text messages interchange. CardioCaseDiscussion uses categorization and structuring of messages in order to facilitate the argumentation and to guide the participants to reflect about their messages. The users can participate in the discussion in four different ways: (i) asking a question, (ii) answering a question of another participant, (iii) introducing a commentary, or, (iv) disagreeing of an answer or a commentary. CardioCaseDiscussion supply representative pieces of information about the message contents to help user to identify the message relevance and context. This argumentation model is used to facilitate the dynamic of the discussion, orienting the participants on how to express their opinions and ideas (Gerosa, M. A. et.al., 2000). Awareness is implemented in CardioCaseDiscussion through the author identification of each contribution for the discussion. The discussions are asynchronous, which provide more flexibility to the students allowing them to use the environment according to their possibilities or preferences.

4 Conclusions

The cardiology cases discussion can be held easily with the CardioCaseDiscussion support. The benefits of this environment lie on its support to problem based learning and its ability to facilitate user's access and cooperative work through the web. The use of an Internet browser provides platform-independent access and allows its users to participate in the discussions at different time and locations. The environment can be used in Medical Schools or as a support for distance learning and continuing medical education.

References

Comeaux, P., Nixon, M. A. (2000). Colaborative Learning in a Internet Graduate Course: A Case Study Analysis. *WebNet Journal*, 34-43.

Elsner, C et. al. (2000). Sharing Cardiology Cases with Students and Doctors over the WWW: The Kasus-Platform at the Heart Center Leipzig. *Computers in Cardiology*, 27, 185-188.

Gerosa, M. A., Fucks, H., Lucena, C. J. P. (2001). Use of Categorization and Structuring of Messages in order to Organize the discussion and Reduce Information Overload in Asynchronous Textual Communication Tools. 7th *International Workshop on Groupware – CRIWG'01*, Darmstad, Alemanha, 136-141.

Osuna, C. A., Dimitriadis, Y. A. (1999). A Framework for the Development of Educational-collaborative Applications Based on social Constructivism. 5th *International Workshop on Groupware – CRIWG'99*, Cancun, México.

Pedagogical Agents in Virtual Reality Environments:

Do Multimedia Principles Still Apply?

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Abstract: In this paper, I review a set of studies that examined what students learn in various virtual reality environments (VREs) designed to promote an understanding of environmental science. The goal of the reported studies was to provide an update to the classic distinction between the role of media versus method in promoting learning (Clark, 1999). Media was varied by comparing how students learn from an instructional game delivered via a desktop display (D), head mounted display without walking (H), and head mounted display with walking (W). The instructional method was varied by comparing how students learn when words are presented as on-screen text (T), narration (N), or both (NT).

The Role of Media in Virtual Reality Environments

The first goal of this research was to examine the role of media in VREs. Thus, an important research issue concerns whether more immersive VREs (e.g., via head mounted displays) result in qualitatively different learning outcomes than less immersive VREs (e.g., via desktop computer displays). Immersion is defined as the extent to which computer displays are capable of delivering an inclusive, extensive, surrounding, and vivid illusion of reality to the senses of a human participant (Slater & Wilbur, 1997). How does immersion affect learning?

First, higher levels of immersion may promote a higher sense of presence which in turn, may promote more engagement and deeper learning. Presence is a subjective state, the psychological sense of being in a VRE (Slater & Wilbur, 1997). Past research in VREs, found that higher levels of immersion in the learning environment induce a higher sense of presence during the learning experience as measured by participants' ratings on a presence questionnaire (Welch et al., 1996). The fundamental idea is that a higher sense of being in the environment may encourage the deep processing of the learning task by engaging students in an active search for meaning (Moreno & Mayer, 2000).

Second, more immersive VREs may improve transfer of learning to the real world because the more similar a learning environment is to a real environment, the better the transfer of learning (Durlach & Mavor, 1995). Preliminary evidence supports the idea that the richer the perceptual cues and multimodal feedback (e.g., visual, auditory, haptic, etc.) the more likely the transfer of VR training to real-world skill (Regian, Shebilske, & Monk, 1992). This idea is also consistent with one of the grand aims of VREs for learning: to provide interface transparency by making the interaction with technology more "natural". The cognitive advantage of a transparent interface, which is generally concomitant with a more immersive environment, is that it drives students' limited attentional resources to learning the content material rather than to the interface.

The Role of Method in Virtual Reality Environments

The second goal of this research was to examine the role of method in VREs. Method refers to the instructional method implemented in the design. For the case of the reported studies, the role of the modality of the verbal information was examined. More specifically, the instructional method was varied by presenting the words printed as on-screen text (T), spoken as narration (N), or both (NT). How does the modality of the verbal information affect learning? To answer this question, I start with a dual-processing theory of multimedia learning.

According to dual-processing theory, students who can hold corresponding pictorial and verbal representations in working memory at the same time (such as the dynamic graphics of the VREs held in visual working memory and the corresponding narrated explanations held in auditory working memory) are better able to build referential connections between them (Paivio, 1986). On the other hand, given the limited resources students have for visual working memory, using a visual modality to present both pictorial and verbal information can create an overload situation for the learner (Baddeley, 1992; Chandler & Sweller, 1991; Sweller, 1989). Previous research in a desktop environment has shown that students learn better--as measured by tests of retention and transfer--when the instructional method involves spoken rather than printed explanations (Mayer & Moreno, 1998; Moreno & Mayer, 1999; Moreno & Mayer, 2002; Moreno, Mayer, Spires, & Lester, 2001). Similar results were obtained in an immersive VR training environment (O'Neil et al., 2000). This effect of instructional method has been called the modality effect (Moreno & Mayer, 1999; Moreno et al., 2001).

Does redundant verbal information (identical narration and on-screen text presented simultaneously) facilitate students' understanding of an interactive VR program further? Recent findings on learning with short multimedia explanations have shown that when instructional materials contain simultaneous pictorial information such as animations, adding identical on-screen text to a spoken explanation hurts rather than helps students' learning (Mayer, Heiser, & Lonn, 2001; Moreno & Mayer, 2002). The negative effects of redundant verbal messages have been interpreted as due to learners' need to split their limited visual attention between simultaneous text and graphics. This effect of instructional method has been called the redundancy effect.

Media Versus Method

The decision to use different delivery media (D, H, or W) or methods (N, T, or NT) in instructional design may depend on one's conception of learning. In this section, I consider the following two views: media-affects learning and method-affects-learning.

Media-Affects-Learning

On one hand, a media-affects-learning view is that the delivery medium can affect what is learned. Media refers to the delivery device; in this case I varied the degree of immersion by presenting the instructional program via a desktop computer screen (D), via a head mounted display while the learner is seated (H), or via a head mounted display while the learner can walk (W). For example, Seidel and Chatelier (1997, p. 2) call for research comparing how people learn from desktop workstations versus from head mounted displays (HMDs) by asking, "What is the value added by HMD, and what purposes or what types of tasks does it serve best for learning purposes?"

According to the media-affects-learning view, immersive VREs (such as in conditions W and H) have the potential of making computer-based learning feel more real by promoting a sense of presence, which in turn, could promote deeper learning. The effect of media would be reflected in superior performance on tests of retention and transfer for students who experience more immersive environments. If media affects learning, then a media effect would be expected, that is, performance on tests of retention and transfer depends on whether the instructional program was presented by desktop display, head mounted display, or head mounted display with walking. This pattern would be reflected in a main effect for media and no interaction between method and media.

Method-Affects-Learning

On the other hand, the method-affects-learning view is that instructional methods influence learning. Instructional methods can guide cognitive processing in the learner, which influences the knowledge that the learner is able to construct. According to the method-affects-learning view, it is not technology per se that promotes learning but rather how the technology is used. As long as instructional methods promote appropriate cognitive processing during learning, then media does not seem to matter (Clark, 1999). Although VR offers a compelling technological breakthrough, the medium itself does not promote learning but rather the instructional methods that it affords promote learning.

In the present review, the modality of the verbal information was used as instructional method. Therefore, the effect of method would be reflected in two ways. First, by demonstrating a modality effect, that is, superior performance on tests of retention and transfer for students who receive verbal explanations as narration (N) rather than as on-screen text (T). Second, by demonstrating a redundancy effect. Students who receive verbal explanations as narration (N) will outperform those who receive redundant explanations (NT) on tests of retention and transfer.

The main interest of the reported studies is the general issue of whether method affects learning across media--that is, whether instructional methods have the same effects within different media environments. If method affects learning, then a modality or redundancy effect can be expected within each of the VREs examined--desktop display, head-mounted display, and head mounted display with walking. This pattern would be reflected in a main effect for method and a lack of interaction between method and media.

A Virtual Reality Agent-Based Micorworld

The learning environment used in the reported studies is a computer game called "Design-A-Plant", developed by the Multimedia Laboratory at the Department of Computer Science of North Carolina State University (Lester & Stone 1997). In this program, the student travels to an alien planet that has certain environmental conditions (e.g., low rainfall, light sunlight) and must design a plant that would flourish there (e.g., including designing the characteristics of the leaves, stem, and roots). It includes a pedagogic agent who offers individualized advice concerning the relation between plant features and environmental features, encouragement when students encounter difficulties, and feedback on the choices that students make in the process of designing plants. The program starts with the agent introducing the student to the first set of environmental conditions. Then, he asks the student to choose the appropriate root from the library of roots' names and graphics shown on the computer screen. After the student had chosen a root, the agent gives a narrated explanation for the correct root. The same procedure applies to the stem and leaves, with the agent first asking the student to make a choice, and giving the student feedback afterwards. Once the student is given the last explanation on the leaves for each environment, he is taken to the next environment. The same procedure follows for the rest of the environments.

Experiment 1: Media Versus Modality Effects

Method and Results

The participants were 89 college students. Each participant served in one cell of a 2 x 3 between-subjects factorial design, with the first factor being modality of the verbal information (narration or text) and the second factor being the level of immersion during the computer interaction (desktop, head mounted display, or head mounted display plus walking). There were 17 participants in the narration and desktop group (ND Group), 17 participants in the text and desktop group (TD Group), 13 participants in the narration and head mounted display group (NH Group), 13 participants in the text and head mounted display group (TH Group), 13 participants in the narration and head mounted display plus walking group (NW Group), and 14 participants in the text and head mounted display plus walking group (TW Group).

After interacting with the respective program, participants were tested on three important measures of learning: retention--in which memory for the basic factual information was assessed; problem-solving transfer--in which students were asked to solve new problems based on the principles learned in the program; and program ratings--in which students were asked to rate their level of motivation, interest, understanding, and the perceived difficulty and friendliness of the lesson. Participants also completed a presence questionnaire. We determined whether the groups differed on measures of retention, transfer, and program-ratings by conducting two-factor analyses of variance for each dependent measure with modality (T or N) and level of immersion (D, H, or W) as between-subject factors, and retention, transfer, and program ratings as the respective dependent measure.

Do students experience a stronger sense of presence in more immersive VREs?

Consistent with past research in VREs, higher levels of immersion in the learning environment induced a higher sense of presence during the learning experience (Welch et al., 1996). Using presence as a dependent measure, a one-factor ANOVA revealed that students in D groups rated their sense of presence significantly lower than students in H and W groups which did not differ from each other, Ms = -2.59, 7.31, and 8.22; SDs = 12.49, 10.03, and 12.33, for D, H, and W groups, respectively, p = .0006.

Do more immersive VREs promote deeper learning than less immersive VREs?

The media-affects-learning view holds that more immersive VREs are more likely to promote students' learning of the science lesson, by virtue of inducing higher levels of presence. Using retention as a dependent measure, a two-factor ANOVA failed to reveal a main effect for immersion. Groups presented with higher levels of immersion did not differ in the mean number of recalled items about the plant library from those presented with lower levels of immersion (Ms = 6.01, 6.50, and 5.82; SDs = 1.85, 1.85, and 2.04, for D, H, and W groups, respectively). There was no significant interaction between immersion and modality.

Using transfer as a dependent measure, a two-factor ANOVA failed to reveal a main effect for immersion. Groups presented with higher levels of immersion did not differ in the mean number of answers from those presented with lower levels of immersion (Ms = 31.06, 30.69, and 30.52; SDs = 9.54, 9.20, and 11.68, for the D, H, and W groups, respectively). A significant interaction was found between immersion and modality ($p < 0.05$). Post hoc analysis of simple effects for modality and immersion indicated that both for D and H conditions, receiving information via on-screen text rather than via narration, proved to significantly hinder students' learning as measured by transfer scores (,p = .006 and .0001, respectively). Similar to the case for retention, there was no immersion effect for students' program ratings and no interaction. The respective ratings for the D, H, and W groups were: Ms = 28.67, 31.83, and 31.52, SD = 6.61, 7.02, and 6.88.

Do students who learn with narration learn more deeply than students who learn by reading on-screen text?

The method-affects-learning view holds that presenting verbal material as speech is more likely to promote students' understanding of a multimedia lesson than presenting the same material as on-screen text, regardless of delivery medium. Using retention as a dependent measure, a two-factor ANOVA revealed a main effect for modality (p = .0003), with a mean number of ideas recalled of 6.84 and 5.43 respectively for the narration and text groups (SDs = 1.51 and 2.01, respectively).

Using transfer as a dependent measure, a two-factor ANOVA revealed a main effect for modality (p = .0001), with a mean number of correct answers of 36.12 and 25.57 respectively for the narration and text groups (SDs = 8.34 and 8.80, respectively). Groups presented with the verbal information in the form of speech gave significantly more correct answers than those presented with the verbal information in the form of text. Groups also differed in the overall ratings for the program. A two-way ANOVA using program ratings as the dependent measure revealed that the narration groups rated the program more favorably than the text groups ($p < .05$), with a mean rating of 32.33 and 28.72 respectively for the narration and text groups (SDs = 5.85 and 7.42, respectively).

The results from Experiment 1 supported the method-affects-learning hypothesis by demonstrating a modality effect on retention, problem-solving transfer, and program ratings. No evidence was found in favor of the media-affects-learning hypothesis. The purpose of Experiment 2 was to test the alternative hypothesis using a different type of instructional method. The effects of presenting redundant verbal information by means of a VR desktop display (D) or by means of a head mounted display without walking (H) was examined. Students received explanations from an agent via narration alone (N), via on-screen text alone (T), or via simultaneous narration and on-screen text explanations (NT).

Experiment 2: Media Versus Redundancy Effects

Method and Results

The participants were 75 college students. Each participant served in one cell of a 3 x 2 between-subjects factorial design, with the first factor being modality of the verbal information (narration, text, or narration and text) and the second factor being the level of immersion during the computer interaction (desktop or head mounted display). There were 14 participants in the narration and desktop group (ND Group), 14 participants in the text and desktop group (TD Group), 14 participants in the redundant desktop group (NTD Group), 11 participants in the text and head mounted display group (TH Group), 10 participants in the narration and head mounted display group (NH Group), and 12 participants in the redundant head mounted display group (NTH Group). The procedure was identical to that of the first experiment. To determine whether treatment groups differed on measures of retention, transfer, and program ratings, separate two-factor analyses of variance were conducted for each dependent measure with modality (N, T or NT) and level of immersion (D or H) as between-subject factors, and retention, transfer, and program ratings as the respective dependent measure.

Do students experience a stronger sense of presence in more immersive VREs?

Similar to Experiment 1, the results showed that programs delivered via head-mounted displays rather than desktop displays induce higher levels of presence (p = .03). Students in the D groups rated their sense of presence significantly lower than students in the H groups. (Ms = .81 and 8.73; SDs = 12.95 and 17.93, for D and H groups, respectively.

Do more immersive VREs promote deeper learning than less immersive VREs?

Using retention as a dependent measure, a two-factor ANOVA failed to reveal a main effect for immersion or an interaction between immersion and modality. Groups who learned in the desktop conditions did not differ in the mean number of recalled items about the plant library from groups who learned with higher levels of immersion (Ms = 6.81, and 6.55; SDs = 1.55 and 1.68, for D and H groups, respectively).

Using transfer as a dependent measure, a two-factor ANOVA failed to reveal a main effect for immersion or an interaction between immersion and modality. Groups presented with higher levels of immersion did not differ in the mean number of answers from groups presented with lower levels of immersion (Ms = 28.17, and 30.55; SDs = 7.47 and 7.36, for the D and H groups, respectively). Similarly, a two-way ANOVA using the overall program rating as the dependent measure failed to reveal an immersion effect. The respective ratings for the D and H groups were: Ms = 30.14 and 28.49, SD = 6.95 and 7.02. There was no significant interaction between immersion and modality.

Do students who learn with redundant explanations learn more deeply than students who learn with explanations in only one modality?

The method-affects-learning view holds that presenting verbal material as narration alone is more likely to promote students' understanding of a multimedia lesson than presenting the same verbal material as narration and on-screen text, regardless of delivery medium. Using retention as a dependent measure, a two-factor ANOVA revealed a main effect for modality (p = .006), with a mean number of ideas recalled of 7.25, 6.96, and 5.88 respectively for the N, NT, and T groups (SDs = 1.57, 1.46, and 1.51, respectively). Supplemental Tukey tests (with alpha at .05) revealed that groups presented with on-screen text alone recalled significantly fewer items from the plant library than groups presented with narration alone or with narration plus on-screen text, which did not differ from each other.

Using transfer as a dependent measure, a two-factor ANOVA revealed a main effect for modality (p = .0004), with a mean number of correct answers of 32.08, 30.77, and 24.84, respectively for the N, NT, and T groups (SDs = 6.16, 8.15, and 5.96, respectively). Similar to the case of retention, supplemental Tukey tests (with alpha at .05) revealed that groups presented with on-screen text alone gave significantly less correct answers to problem-solving transfer tests than groups presented with narration alone or with narration plus on-screen text, which did not differ from each other. Groups also differed in the overall ratings for the program (p = .01), with a mean rating of 32.54, 29.31, and 26.52 respectively for the N, NT, and T groups (SDs = 5.36, 6.87, and 7.43, respectively). Supplemental Tukey tests (with alpha at .05) revealed that groups presented with on-screen text alone gave significantly lower program ratings than students presented with narration alone.

Overall, modality effects were obtained on the retention, transfer, and program ratings replicating the pattern found in Experiment 1 and thus supporting the method-affects-learning hypothesis. However, redundant verbal information did not hurt or help students' understanding as compared to spoken explanations alone. A possible interpretation for NT groups performing comparably to N groups is that students in NT groups may have been inclined to attend to the narration alone due to the experiential mode of VREs. When students are exploring a VRE (either by moving the computer mouse or by moving their head), it is less likely that they will read a box containing text if they can obtain the same information by listening to a narration.

General Discussion

The present review yields evidence--based on questionnaires--that students feel a stronger sense of presence in more immersive VREs. In addition, the reported studies provide new evidence--from retention and transfer tests--that students who experience more immersive VREs do not necessarily learn a computer-based lesson more deeply than students who experience a lower sense of presence. This is consistent with past research in VREs where no relationship between presence and performance was found (Slater & Wilbur, 1997) and fails to support a media-affects-learning hypothesis.

Theoretically, this research provides one of the first methodologically rigorous studies of conditions that foster productive learning in a virtual environment. The replication of the modality effect across different media shows that effective learning depends on which instructional techniques help guide the learner's cognitive processing of the presented material rather than on the medium per se. Importantly, this review has shown that the same factors that improve student understanding in one medium (such as modality effects in a desktop environment) improve student understanding in another medium (such as the present findings concerning immersive VREs). In both cases, ineffective instructional messages can be converted into effective ones by applying the same instructional design principles.

Finally, the conclusions drawn are limited by the nature of the learning materials. The learning materials consisted of an environmental science VRE with short agent and student interventions. It is possible that in VREs where students' physical interventions are essential to the learning process, such as if the goal of the instructional material is to train a procedure, the use of more immersive environments might play an important role in adding psychomotor feedback to the learning experience (Seidel & Chatelier, 1997; Thurman & Russo, 2000). Because some media may enable instructional methods that are not possible with other media, it might be useful to explore instructional methods that are possible in immersive environments but not in others.

References

Baddeley, A. (1992). Working memory. *Science, 255*, 556-559.

Chandler, P. & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction, 8*, 293-332.

Clark, R. C. (1999). Developing technical training (2nd ed). Washington, DC: International Society for Performance Improvement.

Durlach, N. I., & Mavor, A. S. (Eds.) (1995). *Virtual reality: Scientific and technological challenges.* National Academy Press, Washington D.C.

Lester, J. C. and Stone, B. A., (1997). Increasing believability in animated pedagogical agents. In *Proceedings of The First International Conference on Autonomous Agents* (pp. 16-21). New York, NY: ACM Press.

Mayer, R. E. (2001). *Multimedia learning.* New York: Cambridge University Press.

Mayer, R. E. & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. *Journal of Educational Psychology, 90*, 312-320.

Mayer, R. E., Heiser, J, & Lonn, S. (2001). Cognitive constraints on multimedia learning: When presenting more material results in less understanding. *Journal of Educational Psychology, 93*, 187-198.

Moreno, R. & Mayer, R. E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity effects. *Journal of Educational Psychology, 91*, 1-11.

Moreno, R. & Mayer, R. E. (2000). A Coherence Effect in Multimedia Learning: The Case for Minimizing Irrelevant Sounds in the Design of Multimedia Instructional Messages. *Journal of Educational Psychology, 97*, 117-125.

Moreno, R., Mayer, R. E., Spires, H. & Lester, J. (2001). The case for social agency in computer-based teaching: Do students learn more deeply when they interact with animated pedagogical agents? *Cognition and Instruction, 19*, 177-213.

Moreno, R. & Mayer, R. E. (2002). Verbal redundancy in multimedia learning: When reading helps listening. *Journal of Educational Psychology, 94*, XXX-XXX.

O'Neil, H. F., Mayer, R. E., Herl, H. E., Niemi, C., Olin, K., & Thurman, A. (2000). Instructional strategies for virtual aviation training environments. In H. F. O'Neil & D. H. Andrews (Eds.), *Aircrew training and assessment* (pp. 105-130). Mahwah, NJ: Erlbaum.

Paivio, A. (1986). *Mental representation: A dual coding approach.* Oxford, England: Oxford University Press.

Regian, J. W., Shebilske, W., & Monk, J. (1992). A preliminary empirical evaluation of virtual reality as an instructional medium for visual-spatial tasks. *Journal of Communication, 42, 136-149*

Seidel, R. J. & Chatelier, P. R. (Eds.). (1997). *Virtual reality, training's future? Perspectives on virtual reality and related emerging technologies.* New York: Plenum.

Slater, M. & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence: Teleoperators and Virtual Environments, 6*, 603-616.

Sweller, J. (1989). Cognitive technology: Some procedures for facilitating learning and problem solving in mathematics and science. *Journal of Educational Psychology, 81*, 457-466.

Thurman, R. A. & Russo, T. (2000). Using virtual reality for training. In H. F. O'Neil & D. H. Andrews (Eds.), Aircrew training and assessment (pp. 85-103). Mahwah, NJ: Erlbaum.

Welch, R. B., Blackman, T. T., Liu, A., Mellers, B. A., & Stark, L. W. (1996). The effects of pictorial realism, delay of visual feedback and observer interactivity on the subjective sense of presence. *Presence: Teleoperators and Virtual Environments, 5*, 263-273.

Who Learns Best with Multiple Representations?

Cognitive Theory Implications for Individual Differences in Multimedia Learning

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Abstract: Who learns best with multiple representations? In this paper, I present a cognitive theory of multimedia learning from which predictions on individual differences in learning are derived and tested. Elementary students learned how to add and subtract integers with an interactive multimedia game that included visual and symbolic representations of the arithmetic procedure. They learned either with or without verbal guidance in their first language. Verbal guidance was expected to help minimize cognitive load, especially for students with low prior knowledge, low computer experience, and a less reflective cognitive style. The theoretical and practical implications of the results are discussed.

Multiple Representations for Meaning Making in Math

Multimedia environments allow learners to integrate information from different representation formats and sensory modalities into one meaningful experience (Moreno & Mayer, 2000). Therefore, when an arithmetic procedure is to be taught with a multimedia program or game, the instructional designer is faced with the need to choose between several combinations of modes and modalities to promote meaningful learning. In the present review of studies, students learned to add and subtract integers by interacting with a multimedia game consisting of symbolic representations in the traditional number sentence format. In addition, based on recent advances in multimedia learning, the computer game depicts the execution of the computational procedures as visual representations of movements along a number line (Moreno & Mayer, 1999). According to the arithmetic-is-motion metaphor, "numbers are locations on a path", "the mathematical agent is a traveler along that path", "arithmetic operations are acts of moving along the path", and "the result of an arithmetic operation is a location on the path" (Lakoff & Nunez, 1997, p. 37).

For example, students select one of eight problems to solve from the problem menu. Then, students see the problem presented in symbolic form (as 4 - -5 =__) and a number line showing integers from -9 to 9 with a bunny standing at the 0 point. A simulated joystick consisting of the following four alternative moves for the bunny appears in the lower right corner: face to the left, face to the right, jump forward one step, or jump backwards one step. Students may click on any combination of the four joystick options and instantly see the resulting change in the bunny on the number line. The program instructs learners to try to figure out the problem by moving the bunny along the number line using the joystick. When students are ready to answer, they type in a numeral (and negative sign, if needed).

If the student's answer is not correct, the student may try again or see the solution to the problem. If students type in the correct answer, they hear the word "Yes" followed by an animated sequence which consists of four major steps in solving the problem. First, the symbol "4" is highlighted and the bunny moves to position 4 on the number line. Second, the minus sign is highlighted and the bunny turns to the face the left side of the screen. Third, the symbol "-5" is highlighted and the bunny makes five jumps to the right. Finally, the number "9" is highlighted and the bunny faces forward on the 9th position of the number line. Thus, the learner sees how each step in the procedure can be represented in symbols and movements. At this point, students may click on the "Back to Menu" button which takes them back to the main menu.

Would the addition of a verbal representation in the form of spoken words explaining the relationship between the visual metaphor and the symbolic sentence help students' learning? Moreover, do all students benefit from learning with more rather than fewer representations? To help answer these questions, I conducted two studies where the learning outcomes of students who learned to add and subtract integers with symbolic and visual representations (Group SV) was compared to those of students who learned the same lesson with symbolic, visual, and verbal representations (Group SVV). In particular, I concentrated on three learning measures: learning rate, pretest-to-posttest gain, and using what they have learned to solve word problems. The overarching goal of the reported studies was to explore the cognitive implications of training students with multiple representations in a high cognitive load situation and infer some preliminary principles of instructional design for individual differences in multimedia learning. In the next sections, I provide a cognitive theory of how people learn with multiple representations, introduce three possible sources of individual differences in learning from multimedia environments, and derive predictions based on the theory.

A Cognitive Theory of Multimedia Learning

The cognitive theory of multimedia learning used in the present studies draws on two main assumptions: multiple representations help learning and cognitive load hurts learning. One one hand, according to a multiple representation hypothesis, teaching with more representations facilitates and strengthens the learning process by providing several mutually referring sources of information (Kozma, Russell, Jones & Marx, 1996; Grouws, 1992; National Council of Teachers of Mathematics, 1989). For example, past studies in multimedia learning have shown that students learn math better when information is presented in verbal, visual, and symbolic formats rather than in symbolic formats alone (Moreno & Mayer, 1999), and that students learn science better from animations that include words rather than from animations or words alone (Mayer, 2001).

On the other hand, according to the thesis that cognitive load hurts learning, students' working memories are limited in capacity (Baddeley, 1986; Chandler & Sweller, 1992; Sweller, 1994). Therefore, presenting multiple representations of the same arithmetic procedure may overload the learner by creating the need to integrate the multiple sources of mutually referring information. Students with larger capacity are better able to maintain and coordinate multiple representations in working memory than are students with lower capacities (Just & Carpenter, 1992). Thus, although cognitive theory of multimedia learning supports learning with multiple representations in general, individual differences cannot be discarded (Moreno & Mayer, 1999). What are some possible sources of cognitive load differences between students?

Cognitive Tempo

Cognitive tempo (or Impulsivity/Reflectivity) refers to a person's tendency to reflect or not reflect, before responding on a problem-solving task with response uncertainty (Kagan, 1966). According to this individual difference, reflective students make fewer errors and have a longer response time than impulsive students on inductive reasoning, recognition memory, visual discrimination tasks, and serial recall (Borkowski, Peck, Reid, & Kurtz, 1983). From a theoretical perspective, it can be hypothesized that a persistent impulsive style limits students' time to reflect on the accuracy of an answer. Reflective students take more time to develop a solution hypothesis before making a choice (clicking on the computer mouse). A consequence is that deep learning becomes less likely for impulsive than for reflective students, especially where tasks carry high uncertainty and little guidance (Jonassen & Grabowski, 1993).

Prior Knowledge

Based on a cognitive theory of multimedia learning, students with high prior knowledge in arithmetic have already built their own mental model for the presented material (at least partially, for the addition and subtraction of natural numbers). Therefore, multiple representations are easier to integrate with prior knowledge and less likely to overload their working memory (Mayer, 2001; Moreno & Mayer, 1999). In addition, computer knowledge or experience (mastery of the task-specific skills that derive from interacting with a multimedia program such as clicking on buttons, typing in numbers, etc.) may affect multimedia learning. Low computer experience may impose an extra cognitive load if students are not very familiar with computers and the tasks involved in the interaction have not become automatic yet (Chandler & Sweller, 1991). This is particularly relevant for the present study because many participants are children who come from low-income, immigrant, non-English backgrounds with very few having access to computers at home.

Language Background

What are the cognitive consequences of learning verbal materials in a more versus less familiar language? An additional goal of the present study was to examine if students would choose to learn the arithmetic procedure in their first or second language given the option to do so. Knowledge of a less familiar language constrains problem solving in that language (Duran, 1985). As the computer game used for the present studies presented verbal explanations in English with the option to listen to Spanish translations, it was expected that limited English proficient students (LEP) would make significant use of the translations during training sessions. The rationale is based on the assumptions that attentional resources are limited and that in learning situations of high cognitive load such as the present one, students will be likely to lower the attentional demands by choosing to use a more familiar language.

Predictions

Based on a cognitive theory of multimedia learning, students trained with example problems presented in three different forms encode the material more deeply than those trained with problems presented in two forms (Clark & Paivio, 1991; Paivio, 1986). Moreover, cognitive load for the SVV group is minimized respect to the SV group because the extra verbal representation guides students' discovery of the relationship between the visual metaphor and the number sentence (Chandler & Sweller, 1991; Solter & Mayer, 1978; Tarmizi & Sweller, 1988). Consequently, it was predicted that compared to the SV group, the SVV group would show a larger pretest-to-posttest gain, faster rate of learning, and better transfer to solve word problems.

However, individual differences in cognitive load based on students' cognitive tempo, prior knowledge, and language background were expected. Therefore, the positive effects of multiple-representation learning should be stronger for high prior knowledge or high computer experience rather than for low prior knowledge or low computer experience students. Second, the positive effects of multiple-representation learning should be stronger for reflective rather than impulsive students. Finally, as students in Group SVV were given the option to look up the explanations in Spanish, it was predicted that limited English proficient (LEP) learners would show a greater use of Spanish explanations over sessions compared to first English proficient (FEP) learners. The rationale is based on the idea that students who are still in the transition to becoming proficient English speakers will be likely to choose their first language to lower the cognitive load required to understand the explanation of the arithmetic procedures in English.

Experiment 1: A Low Computer Experience Scenario

The first study was conducted at the beginning of the school year in a southern California elementary school where many children come from emigrant, low-income, Spanish-speaking homes. A significant proportion of students is limited English proficient and has almost no computer experience. Training with multimedia games in this scenario is very interesting as it can be argued that the visual presentation of a mathematical procedure such as the one used in the present studies can minimize the importance of language and therefore has great potential for enhancing the learning of non-native speakers of English. Second, visual instruction can build on the existing intuitive knowledge of the learner and can be particularly appropriate for less skilled students who lack formal academic training in the subject domain (Mayer, 1997). Third, visual forms of presentation can help learners build mental models of complex systems that enable problem solving rather than being subjected to rote methods of instruction that emphasize solely the acquisition of isolated facts and procedures (Grouws, 1992).

Method and Results

The participants were 61 students from three fifth and sixth-grade classrooms of an elementary school in southern California who lacked substantial prior knowledge about addition and subtraction of signed numbers. Thirty students participated in the SV group and 31 students participated in the SVV condition. Based on the school records for their English language proficiency level, students were classified as FEP or LEP. Fourteen FEP and 16 LEP students served in Group SV and 15 FEP and 16 LEP students served in Group SVV. First, each student was given the computer experience questionnaire, the paper-and-pencil pretest, and the Matching Familiar Figures test (MFFT) to determine children's cognitive tempo (Kagan, Rosman, Day, Albert, & Phillips, 1964). Second, they were randomly assigned to learn with either a SV or SVV version of the computer game and participated in each of four training sessions held on different days over a two-week period during regular class time. Finally, they were given the paper-and-pencil posttest and computerized word problem test.

For each student, the number of correct answers on the pretest was subtracted from the number of correct answers on the posttest to yield a pretest-to-posttest gain score and the number of correct answers on the word problem test, the number of correct answers on each of the training sessions, and the number of times students asked for a Spanish translation was recorded from a computer-generated log during training sessions.

Do students who learn interactively with symbolic, visual, and verbal representations show deeper understanding from a multimedia math lesson than students who learn with symbolic and visual representations alone?

Students in Group SVV had a larger mean pretest-to-posttest gain score than students in Group SV (p = .02), a marginally larger transfer to word-problem score (p = .075), and no significant difference in the learning rate. These findings suggest that instructional programs that use multiple representations (such as symbolic representations and visual interactive metaphors) are more effective when verbal explanations are explicit. However, the benefit of the verbal representation only affects students' pretest-to-posttest gain of the arithmetic procedure itself. Providing verbal representations does not affect students' learning rate and only marginally helps students transfer the procedure to solve word problems.

On the other hand, the results on individual differences showed that although prior knowledge did not affect the pretest-to posttest gain, computer experience showed a significant interaction with the type of treatment: Students who had low computer experience did not benefit from the verbal representations but students with high computer experience benefited considerably (p = .05). In addition, reflective students scored marginally higher on pretest-to-posttest gain (p = .06). Moreover, high prior knowledge students, high computer experience students, and reflective students learned faster and scored significantly higher than their counterparts in transferring the arithmetic procedure to solve word problems (p = .0001, p = .003, and p = .01 respectively for learning rates and p = .0001, p = .05, and p = .01 respectively for transfer scores). These results show that prior knowledge (both in content and computer skills) and a reflective cognitive style help students' learning by minimizing cognitive load in complex learning environments.

Do students who are in the transition to becoming English proficient use verbal explanations in their first language?

An additional issue was if LEP students in Group SVV would make significantly more use of the Spanish translations than FEP students in Group SVV. To answer this question, for each session and student, the number of times students listened to Spanish translations was recorded. Consistent with the prediction, an ANOVA with language background as a between-subjects factor and number of translations as a within-subject factor revealed a significant effect for language background, number of translations, and a significant interaction (p = 0.02, p = 0.0001, and p = 0.001, respectively). LEP students used significantly more the Spanish translations than FEP students and the number of translations decreased significantly over time for LEP students. This result is consistent with the idea that students prefer to use a more familiar to reduce the high cognitive load that results from learning with multiple representation interactive environments.

Experiment 2: A High Computer Experience Scenario

Experiment 2 was conducted at the end of the school year in a fifth and sixth grade classroom of the same elementary school that participated in Experiment 1. Contrary to the case of the first experiment, all participating students had been intensively trained in computer use for almost an entire school year. Therefore, the first goal of the second study was to test the prediction that due to students' training with computers, computer experience would lose its impact as a determinant factor in learning from the interactive program.

An additional goal of Experiment 2 was to investigate if transfer to word problems could be improved by providing explicit word problem training. The results of Experiment 1 showed an advantage of SVV instruction over SV instruction for only one of three dependent measures: pretest-to-posttest gain. Providing verbal explanations did not help students' learning rate or transfer to solve word problems. In Experiment 2, the learning of a group of students trained with symbolic, verbal, and visual representations (Group SVV) was compared to that of an identical group presented with an additional word problem for each problem type (Group SVVW). Based on past research on problem-solving transfer (Cox, 1997; Mayer & Wittrock, 1996), it was predicted that explicit training in solving word problems would result in better performance on this measure. However, as the treatments did not differ in any other aspect, differences in pretest-to-posttest gain or learning rate were not expected.

Method and Results

The participants were twenty-four students from a fifth and sixth-grade classroom of an elementary school in southern California who lacked substantial prior knowledge about addition and subtraction of signed numbers. Twelve students participated in the SVV group and 12 students participated in the SVVW condition. The procedure was identical to that used in Experiment 1 except that after students were given the computer experience questionnaire and the paper-and-pencil pretest, they were not given the MFFT because individual differences on cognitive tempo were not the focus of the study.

Do students who learn how to add and subtract integers with word problem examples show better transfer to solve word problems than students who are not presented with word problems?

Consistent with the predictions, students in Group SVVW and SVV did not differ in their mean pretest-to-posttest gain or in their learning rate. However, the main prediction was that providing word problem examples to Group SVVW would make a significant difference in the transfer to a word problem test respect to Group SVV. Consistent with this prediction, using transfer to word problems as a dependent measure, a one-factor ANOVA revealed a treatment effect ($p = .05$). Students in Group SVVW were significantly better able to transfer the arithmetic procedure to solve word problems as compared to students in Group SVV.

What is the role of computer experience for students who learn with multiple representations in a computer-trained classroom?

Due to students' overall high experience with computers, it was expected that computer knowledge would not affect overall performance because they had automated the computer skills necessary to interact with the program. Consistent with the predictions, the statistical analyses revealed no computer experience effect on pretest-to-posttest gains, learning rate, or transfer to word problems. High experience students scored comparably to low experience students on all dependent measures. As argued in the predictions, the different pattern of results between both studies can be interpreted as due to the computer training program that the teacher had implemented in the participating class. Experiment 1 was conducted at the beginning of the school year and many students reported having very low or even no basic computer experience. On the other hand, Experiment 2 was conducted in a classroom where the teacher placed priority on students' practice of technologically based instructional materials. For example, one of the goals of the participating class consisted of having each student develop their own web page by the end of the year.

General Discussion

Multimedia programs allow students to work easily with multiple representations of complex systems. The reported studies demonstrate that presenting a symbolic and visual representation of how an arithmetic procedure works does not insure that all students will understand the explanation unless cognitive theory is applied to the design.

The reported studies have important implications. Theoretically, this research supports a cognitive theory of multimedia learning in two ways. First, by demonstrating that teaching with symbolic, visual, and verbal representations facilitates and strengthens the learning process by providing several mutually referring sources of information. Second, by suggesting that the additional cognitive load imposed on the SV group (i.e., the need for students to use their limited cognitive resources to discover the meaning of a procedure and generate their own verbal representation) is detrimental to learning by exhausting working memory capacity. Third, the results from Experiments 1 and 2 show that even when instructional methods are grounded on visual metaphors, transfer skills require explicit training. Although interactive visual metaphors may help students build connections between arbitrary sets of procedures that use symbols and their informal conceptual knowledge, this method only seems to help students understand the arithmetic procedure itself. Finally, congruent with cognitive load theory, when learners are required to mentally integrate disparate sources of mutually referring information, such split-source information may create a heavy cognitive load that disrupts learning, especially for learners who have fewer cognitive resources (Moreno & Mayer, 1999; Sweller, 1991). The present results on individual differences are consistent with the interpretation that students learn deeper in multimedia interactive environments when the advantages of multiple representations are not outweighed by individual differences in cognitive load (Chandler & Sweller, 1991; Sweller, 1994).

On the practical side, the overall results indicate that visual metaphors need verbal guidance and word problem examples if they are to be used as an instructional tool to foster mathematical understanding and transfer. Multimedia environments have the capability of creating dynamic visual representations of constructs that are frequently missing in the mental models of novices (Kozma, 1991). However, the present findings show that for multimedia learning to be effective it is important to design the materials in a manner that minimizes cognitive load. One way to reduce cognitive load is by providing guidance in the form of verbal explanations in students' first language. A contribution of the reported studies is to identify computer experience, prior knowledge, and cognitive tempo as important factors that help students learn from multimedia by minimizing cognitive load.

References

Baddeley, A. D. (1986). *Working memory.* Oxford, England: Oxford University Press.

Borkowski, J. G., Peck, V. A., Reid, M. K., & Kurtz, B. E. (1983). Impulsivity and strategy transfer: Metamemory as mediator. *Child Development, 54*, 459-473.

Chandler, P. & Sweller, J. (1992). The split-attention effect as a factor in the design of instruction. *British Journal of Educational Psychology, 62*, 233-246.

Chandler, P. & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction, 8*, 293-332.

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review, 3*, 149-210.

Cox, B. D. (1997). The rediscovery of the active learner in adaptive contexts: A developmental-historical analysis of transfer of training. *Educational Psychologist, 32*, 41-45.

Duran, R. P. (1985). Influences on language skills on bilinguals' problem solving. In S. Chipman, J. Segal, & R. Glaser. (Eds.) *Thinking and learning skills: Research and open questions* (pp. 187-207). Hillsdale, NJ: Erlbaum

Grouws, D. A. (Ed.). (1992). *Handbook of Research on Mathematics Teaching and Learning* (pp. 243-275). New York: Macmillan.

Jonassen, D. H. & Grabowski, B. L. (1993). *Handbook of individual differences.* Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc.

Just, M. A. & Carpenter, P. A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review, 99*, 122-149.

Kagan, J. (1966). Developmental studies in reflection and analysis. In A. H. Kidd & J. L. Rivoire (Eds.). *Perceptual development in children* (pp. 487-522). New York: International University Press.

Kagan, J., Rosman, B. L., Day, K., Albert, J., & Phillips, W. (1964). Information processing in the child: Significance of analytic and reflective attitudes. *Psychological Monographs, 78* (1, Whole No. 578).

Kozma, R. B., Russell, J., Jones, T., & Marx, N. (1996). The use of multiple, linked representations to facilitate science understanding. In S. Vosniadou, E. DeCorte, R. Glaser, & H. Mandl (Eds.), *International perspectives on the design of technology-supported learning environments* (pp. 41-60). Mahwah, NJ: Erlbaum.

Kozma, R. B. (1991). Learning with media. *Review of Educational Research, 61*, 179-211.

Lakoff, G. & Nunez, R. E. (1997). The metaphorical structure of mathematics: Sketching out cognitive foundations for a mind-based mathematics. In L. D. English (Ed.), *Mathematical reasoning: Analogies metaphors, and images* (pp. 21-89). Mahwah, NJ: Erlbaum.

Mayer, R. E. (2001). *Multimedia learning.* New York: Cambridge University Press.

Mayer, R. E. & Wittrock, M. C. (1996). Problem-solving transfer. In R. Calfee and R. Berliner (Eds.), *Handbook of educational psychology* (pp. 47-62). New York: Macmillan.

Moreno, R. & Mayer, R. E. (1999). Multimedia-supported metaphors for meaning making in mathematics. *Cognition and Instruction, 17, 215-248.*

Moreno, R. & Mayer, R. E. (2000). A coherence effect in multimedia learning: The case for minimizing irrelevant sounds in the design of multimedia instructional messages. *Journal of Educational Psychology.*

National Council of Teachers of Mathematics (1989). *Curriculum standards for teaching mathematics.* Reston, VA: Author.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction, 4*, 295-312.

Paivio, A. (1986). *Mental representation: A dual coding approach.* Oxford, England: Oxford University Press.

Solter, A. & Mayer, R. E. (1978). Broader transfer due to guided discovery of number concepts in preschool children. *Journal of Educational Psychology, 70*, 363-371.

Tarmizi, R. A. & Sweller, J. (1988). Guidance during mathematical problem solving. *Journal of Educational Psychology, 80*, 424-436.

Lights and Wires: Effective eLearning

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Abstract: There exist two commonly held views regarding the use of multimedia and Internet technology within learning environments. Many educators believe that the presence of content material on CD-ROM or the Internet will help students reach their learning goals, and students 'like' multimedia and /or Internet based delivery. This paper explores these views through analysis of the design and development of an eLearning solution.

Introduction

"Television can teach. It can illuminate. Yes, it can even inspire. But it can do so only to the extent that humans are determined to use it to those ends. Otherwise, it is merely lights and wires in a box" Edward R. Murrow

While this statement is obviously discussing the use of television as a learning resource, the same sentiment can be directed toward eLearning solutions. However, the thought of an expensive eLearning solution as merely 'lights and wires in a box' is probably enough to strike fear into the hearts of most eLearning providers. Given the general view that the use of educational multimedia applications and online learning solutions enhance learning effectiveness, such a stance is akin to heresy. Instructional designers developing eLearning solutions claim 'improved learner outcomes' (Colorito, 2001) and 'more effective learning experiences' (Maki et al, 2000). These are nice ideas. Happy learners and even happier teachers skipping down the yellow brick path toward successful learning outcomes. However, not a lot unlike the young woman in the sparkling red shoes, it does not take long to discover that fantasy and reality are somewhat distanced from one another.

There exist two commonly held views regarding the use of multimedia and Internet technology within learning environments. Many educators believe that the presence of content material on CD-ROM or the Internet will help students reach their learning goals, and students 'like' multimedia and /or Internet based delivery. Many factors play a part in shaping an individual's learning experience, not least of all the assumptions of the instructional designer. For example, using Brookfield's paradigmatic assumption, learners within the university context will be predominantly proactive, highly motivated consumers of knowledge. Associated with this assumption is the prescriptive assumption that as the students are proactive, self-directed learners then the best teaching will be that which encourages students to take control over designing, conducting and evaluating their own learning (Brookfield, 1995). Therefore, if the paradigmatic and prescriptive assumptions are correct, it follows that if an environment is created to support self directed learning such learning will (naturally) take place (causal assumption). This is largely the reasoning applied to the integration of multimedia and Internet technology within learning environments. Students 'like' multimedia and/or Internet based content therefore if learning facilitators provide such environments students will (naturally) have successful learning outcomes.

While many learners may prefer, or perhaps expect, to access content material via the Internet recent research does not support the view that students prefer this mode of delivery (McInnis, James & Hanley, 2000). New technology is seductive, this danger is especially apparent when multimedia and Internet technology are viewed as a providing improved learning experiences. However, it is important to not allow technology to overwhelm the foundations of an effective learning experience. Whether delivered via CD-ROM, the Internet, cassette or print, we should seek to provide a learning experience that is meaningful to all users. Jonassen (2001) discusses eight qualities inherent in meaningful learning environments. These are:

- Active: Learners are engaged by the learning process in mindful processing of information where they are responsible for the result.

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- Constructive: Learners integrate new ideas with prior knowledge in order to make sense or make meaning or reconcile a discrepancy, curiosity, or puzzlement.
- Collaborative: Learners naturally work in learning and knowledge building communities, exploiting each others skills while providing social support and modeling and observing the contributions of each member.
- Intentional: All human behavior is goal directed.
- Complex: Unless learners are required to engage in higher order thinking, they will develop oversimplified views of the world.
- Contextual: A great deal of recent research has shown that learning tasks that are situated in some meaningful real world task or simulated in some case-based or problem based learning environment are not only better understood, but also are more consistently transferred to new situations.
- Conversational: Learning is inherently a social, dialogical process. ... Technologies can support this conversational process by connecting learners across town or across the world.
- Reflective: Learners should be required by technology-based learning to articulation what they are doing, the decisions they make, the strategies the use, and the answers that they found.

(Jonassen, 2001)

In view of these effective practice guidelines and qualities as articulated Jonassen (2001) the challenge for educators and eLearning providers is to build in to the distributed educational context dynamic, collaborative, and conversational environments. However, integrating collaboration and conversation within a distributed learning environment is easier said than done. The following case study explores the way in which these guidelines informed the development of an eLearning environment for a core subject for second year university computing students.

Case Study - 'Issues in the Design and Delivery of Multimedia' eLearning resource

History: The subject content and Internet site were partially developed in 1999 and both were extensively revised in 2000. The structure, sequence and content of the subject and the Internet site have been used as teaching and learning resources for two years (2000 and 2001).

Subject: 'Issues in the Design and Delivery of Multimedia' focuses on examining and analysing ethical, legal, social and professional issues in the development and delivery of multimedia. In this subject issues such as software piracy, computer crime, online pornography, professional ethics and the impact and implications of the use of technology are critically analysed.

Learners and Mode: Typically the student cohort comprises (generally) motivated adult learners from a variety of experiential and cultural backgrounds. Approximately 15% of learners are international students and between 20% and 40% are aged over 25 years. The subject is delivered in on campus mode. An extensive Internet site was developed to support lectures and workshops.

Methodology: The creation of educational environments, both in class and online, that fostered collaboration, conversation and activity (Jonassen, 2001) underpinned the philosophical orientation of the instructional design process. In many respects, the process of designing and developing online instructional materials closely resembles a software development life cycle model in that the instructional design process is an iterative one. Progression relies on analysis and evaluation of the objectives and outcomes of the preceding phase. The instructional design process used in the development of the eLearning environment relied on four primary phases that guided and shaped the development process. The phases are illustrated in Figure. 1.

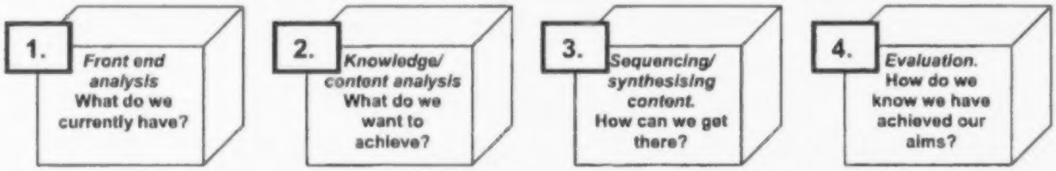
1.
Front end analysis
What do we currently have?
2.
Knowledge/ content analysis
What do we want to achieve?
3.
Sequencing/ synthesising content.
How can we get there?
4.
Evaluation.
How do we know we have achieved our aims?

Figure 1. Four stage instructional design process.

Phase 1: Front end analysis. What do we currently have? (What are the global aims and specific objectives? What resources can be utilised to achieve those goals?) In this phase, existing subject content was reviewed to update specific content areas. This phase examined the current teaching and learning process and specifically analysed the assessment instruments in relation to the stated subject aims and objectives. Feedback regarding content and teaching strategy was sought from learners and colleagues. The major focus of the review concentrated on addressing three primary areas identified in the initial problem analysis:

- Explicitly stating global aims and specific objectives and strengthening the relationships between aims, objectives and content.
- Identifying learner entry and exit points (including assessment) and the relationships between them.
- Addressing inconsistencies in delivery media and identifying opportunities for implementation of innovative delivery strategies.

Global aims: The solution sought to incorporate the following global educational aims in order to strengthen the relationship between aim, objective and content. At the completion of the subject learners should:

- have developed an awareness and understanding of the concepts, practices and ethical codes and conventions regarding the design and delivery of multimedia applications and technology generally
- have developed an understanding of the issues and implications regarding management of knowledge
- exhibit high level critical thinking and problem solving skills
- have developed high level verbal and written communication skills and be encouraged to think critically about the uses (and abuses) of multimedia and information technology generally
- exhibit responsible and discerning use of technology in general

Specific objectives: Further to strengthening the relationships between aim, objective and content in relation to global educational aims, the following areas were identified as desired specific objectives of the subject. Accordingly, at the conclusion of the course, learners should:

- have detailed understanding of the composition and application of their personal ethical framework
- have detailed knowledge of the concepts and principles regarding the ethical, legal, social and professional issues relevant to the development and delivery of multimedia and an ability to apply these concepts and principles in practice.
- be competent in making informed judgments about the impact of multimedia and information technology on the individual, organisation and society
- understand the 'current state of play' of the information economy in Australia and understand the strategic direction of state and federal governments with regard to the information economy and understand the role of Australia in the global information economy
- understand and engage in the discourse surrounding: Ethical codes for computing and information technology professionals; International domain name control and registration; Domain name registrar accreditation; Disability discrimination in online environments; Digital image manipulation; Content control; Online pornography/erotica; Privacy, security and encryption; Hacking and cybercrime/terrorism; Copyright and intellectual property law
- effectively incorporate ethical practice in the design, development and evaluation of multimedia solutions
- apply knowledge of the ethical, social and legal impact of the use of multimedia applications and technology to a business situation in the form of specific analysis and recommendation.

Resources: The resources developed exist primarily in an online format. Resources for in class workshops were developed in hard copy. Workshops in weeks 2,3 and 4 concentrated on exploration of personal ethical frameworks and utilised scenario analysis as a delivery strategy. Student seminar and discussion sessions were scheduled to take place in weeks 5 – 14.

Phase 2: Knowledge/content analysis. What do we want to achieve? (What is the terminal objective? What type/s of knowledge does the learner need to develop?) In this phase, subject content was analysed and evaluated in relation to the stated aims and objectives of the subject, and to ensure that a variety of learning approaches were appreciated. The teaching strategy adopted included lectures, workshops and online fora, integrating scenario analysis, and facilitating formal and informal discussion. As part of this process major learning goals and objectives were defined -"(i)...the terminal objective of instruction" (Taylor, 1994) and subject content was assembled from multiple sources and evaluated –"(ii)...analyse the underlying declarative knowledge base of an expert (or experts)" (Taylor, 1994), and arranged into relatively broad topic areas. The broad topic areas comprise four main modules, providing multiple entry points for learners.

Entry points: Four primary organising factors were identified and implemented to provide overall structure to the subject content. These were: Module 1: Ethical considerations; Module 2: Social factors; Module 3: Legal framework; Module 4: Professional issues. Students are required to undertake all four modules of study. Initial modules are presented linearly to enable learners to progressively develop understanding of primary concepts and principles (Figure 2 — Detail 'Gov.au').

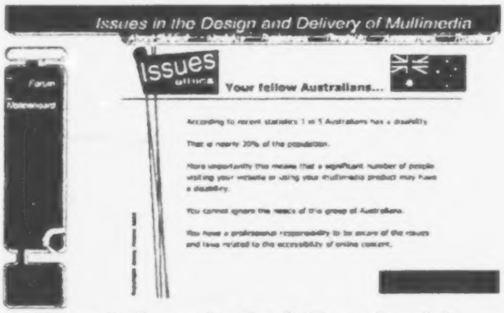
Issues in the Design and Delivery of Multimedia
Forum
Issues
ethics
Your fellow Australians...

Figure 2. Screenshot detail 'Gov.au' module.

Exit points: Four assessment items were specified. They are: Participation in online fora; 20 minute seminar with oral defence; Academic paper - Article reflection; Consultancy report for 'real world' client.

As the subject is taught as part of an undergraduate program exit points are prescribed in that learners must undertake all assessment items. However, learners have control over a number of aspects of assessment. For example, at the commencement of the semester students submit suggested fora topics. Students then 'vote' for four preferred fora topics. When selecting seminar topics learners can select from a provided list or negotiate a topic of choice. Articles for reflection are supplied, however learners are also able to analyse (approved) articles of choice. Further, students are encouraged to self select a client partner for the consultancy report.

Knowledge: In order to achieve desired learning outcomes learners needed to develop (at least) two types of knowledge -- explicit and implicit (Sternberg, 1998, p 13). For example, as primarily novice learners, the students require explicit knowledge " ... knowledge of the facts, formulas, principles, and major ideas of a domain of inquiry." (Sternberg, 1998, p 13), in this case knowledge of ethical, social, legal and professional issues required to function as multimedia designers, they also required high levels of implicit knowledge –tacit knowledge of the domain (multimedia) and the social organisation (their classroom and the University) (Sternberg, 1998, p 13). According to Gagne et al, the locus of control in learning rests with the learner, in that the learner brings to the process of learning inherent cognitive strategies that facilitate understanding (Gagne, 1987, p66). This view is shared by Simonson and Thompson when they discuss cognitive theory and computer based instruction "CBI needs to be organised and delivered in a way that compliments the cognitive structure and level of sophistication of the learner "(1994, p36). Further, Gagne states that learner's process information according to the cognitive strategies used by the learner, and when new strategies are acquired metacognition takes place. That is the process of "learning to learn" is analysed and edited by the learner, increasing the level of understanding (Gagne, 1987, p66). Similarly, Bruner discusses the concepts central to cognitive theory as being: how knowledge is organised and structured; readiness for learning; intuition; motivation (in Simonson & Thompson, 1994, p37). Hypermedia is used as an example of a "powerful tool" in computer based instruction "that is non-linear and non-sequential ... [and] used by cognitive scientists to examine how students interact with instruction during the process of learning" (Simonson and Thompson, 1994, p37).

Phase 3: Sequencing/synthesising content. How can we get there? (What are the major instructional strategies? What are the learning activities that will be used?) In early iterations of the subject, any opportunity for peer to peer discussion in any formal or semi formal educational environment was non-existent. The opportunity to provide students with content in a way that integrated their areas of professional interest

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(computer mediated communication, multimedia and the Internet), and directly related to content issues they were discussing (legal, social, professional and ethical issues in a networked multimedia environment) was identified. Students were encouraged to learn through understanding by articulating and defending their views through delivery of a student seminar with oral defence and to become proactive learners by setting their own research direction within the criteria for the major assessment item. In addition, tailoring delivery of resources in this way also provided opportunities to help learners identify and expand bridging points between subjects being studied simultaneously. For example, students are required to complete the subject 'Computer Mediated Communication' in the same semester as 'Issues in the Design and Delivery of Multimedia'. ' Computer Mediated Communication' requires students to examine and apply concepts and principles related to communication in 'virtual' environments while 'Issues in the Design and Delivery of Multimedia' provides such an environment through the online fora.

Instructional strategies: Instructional strategies were identified "strategy and role-playing games, intentional learning environment, case studies, coaching and scaffolding, learning by design, group, cooperative, collaborative learning" (Wilson, 1997). In practice teaching strategies focusing on the needs, preferences and expectations of the learner were implemented. These instructional strategies were modelled on the effective practice guidelines and qualities as articulated by Collins (1998) and Jonassen (2001) and comprised:

- striving to create a classroom atmosphere (both on campus and online) that is conducive to collaborative learning and is supportive and inclusive of all learners
- encouraging learners to form learning alliances with their peers in order to share information and knowledge within a peer supported learning framework
- promoting strategies that foster a sophisticated level of understanding of subject content and related concepts by encouraging learners to relate content to personal schema.

Early modules utilised short video segments to coach and support novice learners, and to 'personalise' the eLearning environment (Figure 3.). Students were given simple instructions and study direction for the module.

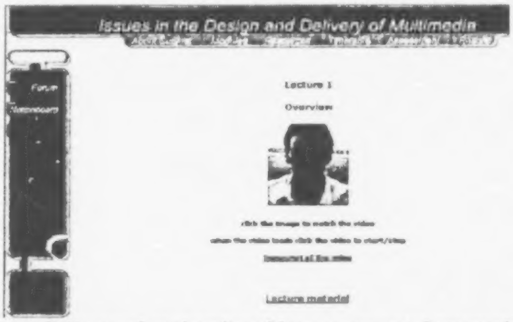

Figure 3. Screenshot showing video segment and transcript.

The rationale for using the online fora was based on two concepts. Firstly, high level understanding of the subject content and specifically complex ethical issues, comes not through transmissive teaching but from engagement with the discourse surrounding specific issues. Secondly, based on anecdotal evidence suggesting a high rate of usage of computer mediated communication technology among multimedia students it seemed that multimedia students would adapt quickly to the medium and engage readily with the concept of an online discussion environment. This view has been supported by the subsequent rapid development of the fora into a dynamic 'virtual' discussion environment where students feel comfortable in forming and expressing their opinions on issues related to the subject content. Evaluation feedback showed that 69% of respondents stated that they would have contributed to the fora even if it were not assessed.

A further area of innovation in this subject involved the use of a 20 minute seminar with oral defence to assess student understanding of specific concepts. As multimedia students are, in general, high achieving students the seminar was implemented as an assessment item to provide a high level of cognitive challenge and stimulation for second year students. This aspect reflected one of Jonassen's (eight) qualities of meaningful learning environments - namely the provision of a complexity (2001). Additional challenge was provided in the form of

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weekly reflection questions. The questions were designed to provide extension to in class discussion and activity.

Phase 4: Evaluation. How do we know we have achieved our aims? (What are the results of formative and summative evaluation?) Students were surveyed (informally) at the start of the semester "[to]… measure the extant knowledge bases of the relative novices…" (Taylor, 1994). The purpose of the survey was twofold. Firstly, it was important to discover existing levels of knowledge and expectation, and for students to begin to examine the validity of their assumptions and expectations. Students were asked to examine: what they knew now, what they hoped to know and what they thought the subject would help them learn.

Based on the outcome of the survey, the subject design focussed on taking the learners from where they were situated at the start of the subject (self identified novices) to where they expected to be (more or less) at the conclusion of the subject (multimedia producers cognisant of ethical and professional issues related to the field). This progression reflected Taylors "… gradual elaboration of a series of organisers…" (Taylor, 1994).

Conclusion

The use of a supported eLearning environment for the subject 'Issues in the Design and Delivery of Multimedia' provided students with a valuable learning resource. While students enjoyed ease of access, intellectual challenge and willingly contributed to the online fora, the majority of high level discussion and complex reasoning still took place within the on campus classroom.

Within distributed learning environments, multimedia and Internet technology provide a vehicle for the transmission of content material, in the same way print materials, and audio/video cassettes have traditionally done. Technical capabilities aside, it matters little whether content is delivered via CD-ROM, the Internet, audio or video cassette, or even print based materials, as these technologies merely provide the substrate to the learning resource. Unless the subject structure and content is based on sound pedagogical theory, and sits within a coherent, supported learning framework, it will make no difference whether cutting edge multimedia and Internet technology have been used. The content will make little sense to the learner.

References

Brookfield, S. 1995 The Getting of Wisdom: What Critically Reflective Teaching is and Why It's Important [Online], Available: http://nlu04.nl.edu/ace/Resources/Documents/Wisdom.html [11 July 2001].

Bruner, R. 1994 In Simonson & Thompson, ***Educational computing Foundations*** Merrill: New York

Collins, M. 1998 I Know My Instructional Technologies: It's These Learners That Perplex Me! [Online], Available: http://www.ties.k12.mn.us/stmarys/Collins.html [06 March 2001]

Colorito, R 2001 *Learning Online* Indiana Alumni Magazine Vol. 64, No. 1 -September/October

Gagne, R. 1987 ***Instructional Technology Foundations*** Lawrence Erlbaum Assoc: New Jersey

Jonassen, D. 2001 Design of Constructivist Learning Environments [Online], Available: http://www.coe.missouri.edu/~jonassen/courses/CLE/index.html [10 July 2001]

Maki, R., Maki, W., Patterson, M., & Whittaker, P. 2000 *Evaluation of a Web-based Introductory Psychology Course: I. Learning and Satisfaction in on-line versus Lecture Courses.* Behavior Research Methods, Instruments, & Computers pp. 32, 230-39

McInnis, C., James, R., Hanley, R. 2000 *Trends in the first Year Experience. In Australian Universities* Department of Education, Training and Youth Affairs. Commonwealth of Australia

Simonson, M.R. Thompson, A. 1994 ***Educational Computing Foundations*** Merrill: New York

Sternberg, R.J. 1998 *"Abilities Are Forms of Developing Expertise"*, Educational Researcher, vol. 27, no. 3, April, pp. 11-20.

Taylor, J.C. 1994 *"Novex Analysis: A Cognitive Science Approach to Instructional Design"*, Educational Technology, vol.xxxiv, no.5, May-June, pp. 5-13.

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Information and Communication Technologies in the Teaching and Learning Process: Does Online Professional Development Make a Difference?

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Abstract

This study is an ongoing examination of the effectiveness of an online professional development course designed to examine the connection between learning theory and technology used to support learning in the classroom. The course was taught by three methodologies: a traditional face-to-face class that used the online materials as a resource; an online class that received all instruction via the Internet; and a hybrid class that used the online resources in addition to meeting weekly for teleconferencing with the instructor. At the completion of the course, data was collected from the participants relating to course design and implementation resulting in positive feedback from most students. To ascertain changes in attitude and classroom practice, further data was requested from the students six months after completion of the course. This study focuses on the second round of data collection and examines the changes in attitude and practice reported by the teachers.

Introduction

Information Technology in the Teaching and Learning Process is a core course in a seven course Diploma of Information and Communication Technology at the Christchurch College of Education in Christchurch, New Zealand. The diploma attracts practicing teachers who want to upgrade qualifications and gain skills in using information and communication technologies (ICT). The course is designed to examine the connection between learning theory and technology used to enhance learning in the classroom, and was formerly taught as a face-to-face course with provision for the occasional distance student made available through teleconferencing. At the beginning of 2001, an increased demand from students around the country wishing to enrol in the course as distance learners led to the decision to develop the course for online delivery. Due to the configuration of students requesting enrolment in the course, three different methodologies were identified: a traditional face-to-face group that would meet bi-weekly with the instructor on campus and use the online materials as a resource; an online group that would receive all instruction via the Internet; and a hybrid group involving a group of teachers in a remote location who would use the online resources in addition to an initial two-day, face-to-face start to the class with the instructor. A weekly phone conference between the instructor and the assembled group was also a dimension of this hybrid class. The existence of the three methodologies presented a unique opportunity to explore how the use of telecommunications impacted each of the groups as they interacted with the course materials, the instructor, other class members and with the technological interface used to deliver the course. Also of interest was the impact that this class had on the teachers' attitude and practice in their individual classrooms.

Literature Review

Online professional development is a new methodology that is increasing rapidly. New demands are being placed on teachers and school as an outgrowth of the demands of the knowledge age society, new understandings of the teaching and learning process, and an upsurge in the design and availability of new technologies. These new demands are forcing changes in professional development (Moon, 2000; Trewern, 1999) and have contributed to the growth of professional development offered through telecommunications (Bates, 1995; Blanton, Moorman, & Trathen, 1998). One such change is the availability of professional development presented to practicing educators online, allowing them to take advantage of new interactive technologies that offer study at a time and place convenient to them (Leonard, 1999; McIsaac & Gunawardena, 1996).

Berge (1998) describes two major frameworks from which to view instruction. The first is a *transmission* framework, examples being lectures, textbooks and videotape and is based on theories of positivism and behaviourism. The second, a *transformation* framework, in which the learner transforms information by generating hypotheses, making decisions and constructing knowledge either individually or through a social interaction with others, is based on the theory of constructivism. Contrasting these methods as

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teacher centred versus learner centred, Berge states that instructors have implicit or explicit personal theories about good instruction and will choose teaching methodologies and technologies according to theses preferences. Bates (1995) cautions that the transmission model no longer meets the changing needs of the knowledge economy workers, where communicating effectively, working in teams, analysing information and generating new knowledge are creating complex new educational needs.

The design of online instruction needs to shift from prescriptive, directed learning situations to environments that allow learners to solve real-world problems and engage in dialogues with a community of practitioners (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Describing constructivist environments as those that "engage learners in knowledge construction through collaborative activities that embed learning in a meaningful context and through reflection on what has been learned through conversation with others learners," (p. 13) Jonassen et.al suggests a framework of context, construction, collaboration and conversation to facilitate the making of meaning for learners. Within the online learning environment, this framework can be mediated by a variety of technologies. Computer-mediated communication is available through electronic mail, computer based discussion and conferencing. Collaboration is available online through the ability of the technology to support groups across a distributed environment where learners can actively work toward a negotiated meaning. Using situated, case-based learning to give authentic contexts in which students can work, is supported by both video and hypermedia environments and gives learners an opportunity to reflect, communicate and negotiate a shared meaning within the group (Jonassen et al., 1995). Wiggins (1993) defines the characteristics of good learning environments, both distance and local, as being centred on worthy problems or important questions, including tasks that are replicas of real-world problems faced by professionals in the field, providing access to resources commonly available to those professionals, and presenting problems that require a repertoire of knowledge, judgement and skills. In defining the constructivist online environment Jonassen et.al (1995) states: "Constructivism can provide theoretical bases for unique and exciting distance learning environments. These environments should emerge from authentic tasks, engage the learners in meaningful, problem-based thinking and require negotiation of meaning and reflection on what has been learned" (p. 21).

Design and Implementation of the Course

The outcomes of this course required that students examine a variety of learning theories and teaching strategies, look at current research in the field and apply practical skills. To accomplish these goals the instructor used a combination of directed, transmission oriented learning such as lectures or explanatory content, practical activities and readings; and more transformational, constructivist approaches such as reflection, evaluation and discussion. To give the students a chance to work through these concepts and make personal meaning from the idea presented, students were asked to reflect on what they had read, apply the learning to their own situation and/or evaluate materials within the context of their own teaching situation. Questions were posed through the discussion forum where students could offer opinions, solutions and share experiences based on their personal reflections and interactions with the course materials.

Methodology

This study was begun in February 2001 during the first semester of the academic year in the southern hemisphere. Twenty-nine students enrolled in the course with 14 in the hybrid group, 8 in the online group and 7 in the on-campus group. To evaluate the effectiveness of the course design and understand the students' perceptions and satisfaction with the course, the following data from the hybrid, online and campus groups was available: initial survey of online students, statistics from the courseware used to present the course materials, e-mail between lecturer and students, discussion board archives and end of course survey.

Since the data collected during and immediately after the course reflect only participants perception of the design and implementation of the course, further data was needed to examine any change of attitude or practice in the teachers' classroom practice. Six months after the end of the course, students were asked to reflect and comment on changes in attitude or classroom practice that they could attribute to their participation in the course.

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Results

Results of the end of course survey showed that students reacted positively to the structure and design of assignments, with only one campus student marking 'disagree' to the question "Assignments were of definite instructional value," and all others marking either 'strongly agree' (33%) or 'agree' (62%). When asked to comment on the effectiveness of the instructional methods used in the class, 62% of students marked 'strongly agree' and 38% of students marked 'agree.' Students were equally positive about the student-student interaction and student-instructor interactivity, and 100% of the students felt that the course helped them to see the relationship between learning theory and information and communication technologies, with 57% marking 'strongly agree' and 43% marking 'agree.' Students felt that the course would help them integrate ICT into their classroom activities with 62% marking 'strongly agree' and 24% marking "agree." Overall, differences in satisfaction between the participants in the three course methodologies, although they did exist, were minor and not statistically significant due to the small sample. The majority of the students were positive about their participation in the course, their interactions with the instructor and the other students, their success with the technological interface and the knowledge gained about teaching and learning with information and communication technologies.

While these results showed that students responded well to the combination of both directed and constructivist instructional methods, and were pleased with the content of the course, these findings did not indicate whether the course would have significant impact on the attitudes and classroom practice of the teachers involved. To determine the impact of the course content six months later, answers to an e-mail questionnaire were examined. Ten teachers returned the questionnaire, which represented a third of the participants.

The first question asked the teachers to comment on any change in attitude or perception about either technology, learning theory or teaching in general that they attributed to the content or interactions in the course. The answers to this question fell into three categories: confidence, leadership and teaching/learning.

Confidence

All the teachers reported feeling more confident. Four teachers mentioned specifically that they felt more confident about their own use of information and communication technologies. Four teachers reported that they were more assured about their own academic abilities or more confident about taking part in discussions about learning theory and/or research relating to the use of technology in the classroom.

> "I also feel that the research we had to do, as part of the course, was good for me personally, as it made me feel more confident in myself. Doing the readings, the bibliography and the presentation were all hard work, but I felt extremely pleased with my efforts and finished products."
>
> "I've certainly gained more direction and confidence to mix it with those whom I perceive to be more technologically literate ..."
>
> " . . . and being able to wax eloquent with such terminology as constructivism and scaffolding while discussing lesson plans proves that my IT self-confidence has gone up the scale tremendously."

Several teachers noted that they found themselves more confident as they planned instruction.

> "This has helped me to have greater confidence in using ICT with my classes and to be less concerned about not knowing how to do everything."
>
> "It has also helped me to become more comfortable in an ICT environment where collaboration and teacher facilitation are often the most effective strategies to use when managing a class."

> But more so, the readings have given me the confidence and knowledge to trial things. The stress seems to have alleviated when setting up items for the class, eg. Hyperstudio stacks at the beginning of the year were effortless. I now think the big stresses came from me, as the children pick it up so quickly."

Leadership
Several teachers commented on leadership roles they had assumed. Some of these roles were formal such as becoming the technology coordinator for the school, running professional development sessions for staff or posting technology rich lesson plans on a website; while others were more informal:

> "This course has also made me think more closely how to regard computer skills – or lack of them – amongst colleagues and how to extend the common pool of knowledge within the school."

> "I read information [in the course] that I have referred to since and passed on to other teachers I work with."

> "Attitude was positive to start with, but knowledge gained has led to informal discussion with peers and increasing their options."

Teaching/Learning
Comments were mentioned by the teachers that pointed out changes in perceptions toward teaching and learning.

> "I have found myself looking at the work that I am preparing and presenting, and reflecting on whether the knowledge fits the constructivist, directed or behaviourist style and in this reflection I guess comes an improved evaluation of the product as well as a question of the value of the work and how it is presented."

> "One of the perceptions that I have become more aware of is sorting out whether the computer is a tutor, tool or tutee. It has made me look closely at what the computer in each situation requires of the learner."

> "Whereas I used to be fascinated by what computers and technology could do I am now (since the course) refocused on the fascinating business of learning and how to set up the optimum conditions for it to take place."

> "I have found it vital that I know what research says."

The second question focused on the practical classroom applications. Teachers were asked to comment on any activities they had implemented or changes they had made resulting from the knowledge gained in the course. Some answers focused on changes in the classroom that involved the use of technologies.

> "I have focussed on information literacy in our library and tried to refine the library use to include the Internet."

> "I taught and used PowerPoint and Internet skills in my IT701 assignment. I have since gone on to teach spreadsheets, databases and HTML in basic ways."

Teachers also reported making changes in the way they approached the teaching task, taking the learners' needs into consideration. The following quotes are examples of this.

> "My focus with ICT now is to get the children asking focus questions that they will be able to answer."

> This course has made me think about direct instruction and how I can present it when teaching computer skills to ensure that the students' learning styles are used and higher order thinking skills are stimulated."
>
> "Probably when I analyse the impact of IT701 on my teaching practice, I believe it has given me ideas on how I can make better use of the computer as a tool and how it fits with learning theories."

Conclusions

From the ten questionnaires returned there is evidence that the course has had an impact on teachers and they way they approach teaching and learning. Many teachers report increases in confidence in computer use, planning for classroom instruction and academic abilities. Some mention increased leadership within their educational communities. All teachers noted changes in their perceptions and attitudes about using information and communication technologies in the teaching and learning process. These included a new appreciation of constructivist versus directed approaches to teaching and learning, fostering higher order thinking, catering to individual learning styles, the teacher in the role of facilitator, an increased appreciation of the benefits of research findings on classroom practice and reflection and evaluation of their own teaching methods. One teacher described the changes in this way:

> "I don't know sometimes I think that I must have been walking around teaching with my eyes closed. Not realising why I am teaching this way, where did these teaching strategies come from and what was I trying to achieve in the class. This course has opened my eyes – even though it is just now that I have realised how much I have changed over the year – it's quite exciting!"

Results from the questionnaire about changes in classroom practice are less clear. Some teachers reported on specific practices they had changed while others reported on changes in focus. In general, the responses from the second question were extensions and variations of the responses to the first question and did not list explicit changes. A limitation of this study is the low number of questionnaires that were returned and the limited scope of the questions asked. Further study would be required to determine the long-term impact of the course content and methodology on the participants' classroom practice.

References

Bates, A. W. (1995). *Technology, Open Learning and Distance Education*. London: Routledge.

Berge, Z. L. (1998). Conceptual Frameworks in Distance Training and Education. In D. A. Schreiber & Z. L. Berge (Eds.), *Distance Training: How Innovative Organizations are Using Technology to Maximize Learning and Meet Business Objectives*. San Francisco: Jossey-Bass Inc.

Blanton, W. E., Moorman, G., & Trathen, W. (1998). *Telecommunications and teacher education: A social constructivist review*. Paper presented at the Review of Research in Education, Washington, DC.

Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B. B. (1995). Constructivism and Computer-Mediatede Communication in Distance Education. *The American Journal of Distance Education, 9*(2), 7-26.

Leonard, D. C. (1999). The Web, the Millennium, and the Digital Evolution of Distance Education. *Technical Communication Quarterly, 8*(1).

McIsaac, M. S., & Gunawardena, C. N. (1996). Distance Education. In D. Jonassen (Ed.), *Handbook of Research for Educational Communication and Technology*. New York: Simon and Shuster Macmillan.

Moon, B. (2000). The Changing Agenda for Professional Development in Education. In B. Moon & J. Butcher & E. Bird (Eds.), *Leading Professional Development in Education* (pp. 1-336). London: RoutledgeFalmer.

Trewern, A. (1999). Online Professional Interactive Networks: Virtual Professional Learning Communities for Teachers. In K.-W. Lai (Ed.), *Net-Working: Teaching, Learning & Professional Development with the Internet*. Dunedin, New Zealand: University of Otago Press.

Wiggins, G. (1993). Assessment: Authenticity, Context and Validity. *Phi Delta Kappan, 75*, 200-214.

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Multimedia Magic: The Design and Development of a Programme in Applied Serology

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Abstract: This multimedia programme consists of colourful animations and video footage, supplemented with commentary, text, slides, and photographs. It is used for training students and laboratory personnel in basic serology. The educational rationale behind the design and development of this programme is discussed. The compilation of the project team and the roles and responsibilities of each member is presented and the programme will be demonstrated.

Introduction

The development of Applied Serology programme was initiated by the Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, University of Pretoria. Multimedia development is a costly procedure, but due to funding from a German institution, it was possible to obtain the necessary resources to develop this programme.

Educational rationale

The aim of the programme is to present students and laboratory personnel with a multimedia tutorial on adapted serological techniques for use in undergraduate as well as post-graduate teaching in Immunology, Applied Veterinary Immunology and Serology.

Practical serological procedures as used in diagnostic and research laboratories, are relatively complicated tests that require dedicated and expensive apparatus and reagents. To demonstrate these procedures is labour-intensive and costly. Therefore it would be prudent to utilize communication and information technologies to provide cost-effective and innovative learning opportunities in applied serology and immunology. The nature of serological techniques requires that students be afforded maximum visual exposure and hands-on training. By developing a programme richly illustrated with diagrams, video clips and structured animations, it will provide opportunities for students to be repeatedly exposed to procedures that would otherwise only have been demonstrated once, in a teaching laboratory.

A self-assessment question databank was included to provide the students the opportunity to assess their own level of competence. A student can do the self-assessment as often as he/she wants to – the questions for each exercise will differ because it is drawn from the database of questions.

Planning phase

The content of the programme is based in part on a book compiled by C. Staak, F. Salchow and N. Denzin – "*Practical Serology – From the Basics to Testing*". The rest of the content was added and it was very well structured before the development of the programme started.

Collaboration between the Department of Veterinary Tropical Diseases of and the GTZ-BgVV Service laboratory in Germany exists and the development of this project was made possible by the generous financial support provided by the German Ministry of Economic Cooperation and Development through the GTZ. Although some services needed to be paid for, the Department of Telematic Learning and Education

Innovation provided the services of the instructional designer and programme developer. A project team consisting of members of the Department of Telematic Learning and Education Innovation, lecturers from the Department of Veterinary Tropical Diseases and the GTZ, was compiled.

The subject matter experts from the GTZ and the University of Pretoria compiled a very extensive storyboard even before the project proposal was submitted to the Department of Telematic Learning and Education Innovation of the University of Pretoria. This department is responsible for the development of different forms of electronic educational media used in the different faculties.

Project team

The project team for this project consisted of a project manager, content specialists, an instructional designer and a programmer, a graphic designer, a sound engineer, a photographer and video photographer. Each team member played a significant role in the success of the final programme.

Design phase

The design phase consisted of the development of an appropriate "look and feel" and the selection of an appropriate development platform. QuestNet+, an authoring tool was used for the development of the programme. The functional utilisation of different media e.g. animations, voice-over, video, graphics etc. was very well researched by the appropriate members of the project team. The design of the processes and procedures demonstrated by the programme, was based on the fact that the principles applied in serological techniques are often very difficult for students to understand and it also takes a lot of time and laboratory equipment to perform the different tests. The programme provides the student with a graphic and animated explanation of each test principle. The test procedures are explained in systematic animations and are supplemented with video footage. The aim is to expose the learner as much as possible to the real-life situation in the laboratory. Photographs, slides and other graphics are used to present results.

Development process

Numerous obstacles had to be overcome during the development process e.g. the distance between one of the subject experts (in Germany) and the developers (in South Africa). Failure of technology at a crucial phase of the project, also hampered the continuity of the project. Emphasis was placed on the effective utilisation of resources and time management. Quality assurance strategies were also implemented to ensure that all the team members were involved with the testing and evaluation of the programme and everybody was satisfied before the next phase commenced. Technical aspects as well as content matter were thoroughly assessed. A lot of time was devoted to these quality assurance strategies.

Demonstration

The programme will be demonstrated to provide examples of:

- The functional use of the different media.
- The content of the programme.
- The self-assessment exercises.

Conclusion

Applied Serology is an excellent example of the power of multimedia. During the design and development phases of this project many valuable lessons were learnt that will be implemented in the process of developing of future multimedia programmes. It was surely a worthwhile experience.

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Virtual University Support for Lifelong Learning in Lebanon

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Abstract: This paper discusses the growing need for a virtual university facility in Lebanon and the creation of a system (VUSIL) to meet this need. Although general public access to the system is possible, the prototype server was designed with two main user-groups in mind: students and professional engineers. The system was designed to provide lifelong learning opportunities based on the potential of the Internet and the World Wide Web to deliver distance education. A needs analysis was conducted and the results were used to inform the design of the VUSIL system. This paper describes the results of the needs analysis and outlines the design of the system.

Introduction

As we enter the 21st century and embark on the Information Age, there is a growing belief that learning is the key to economic success and competitiveness. This belief is developing at many levels – within individuals, organisations and nations. In a fast changing world, knowledge rapidly becomes outdated. Employees therefore need to enhance their employability through ongoing self-development. Furthermore, employers need to continually update the skills of their workforce in order to remain competitive. Bearing this in mind, Keeling et al (1998) suggest that *'learning in the workplace ... is essential to promote a more highly skilled, flexible workforce and economic stability'*.

Over the last few decades a new approach to learning has evolved in order to overcome the problems outlined above. This new approach is often referred to as *'continuing professional development'* (CPD). CPD is just one aspect of the broader field of lifelong learning. The development of lifelong learning has taken place in two basic stages. The first of these was initiated in about 1970, when a number of international organisations such as UNESCO, OECD, the Council of Europe and the Standing Committee of European Ministers introduced the concept of lifelong learning into international discussions and committed themselves to its realisation. In the next decade, interest in lifelong learning waned but it still retained its importance (Peters, 1998).

The second stage in the development of lifelong learning started in the mid-1990s. Interest in the concept is now greater than ever before and is of a completely different nature (Knapper and Cropley, 2000). The economic, technical and social changes and the new challenges set by the Information Society have made this possible.

The lifelong learning approach to educational provision is important because it can facilitate the realisation of the *'education-on-demand'* and *'just-in-time'* training paradigms. These techniques are increasingly being implemented through the use of appropriately designed web-based systems (based on both intranets and the Internet). Web-based training (WBT) is a method for the delivery of training, assessment and reference material via the Internet or an intranet (Steed, 1999). Like computer-based training (CBT), it is self-directed and self-paced. It allows students to access training material on their own personal computers. Unlike CBT, web-based training materials may be rapidly changed and delivered to students, without the cost and 'latency' involved in creating and mailing out a computer diskette or a compact disk (CD-ROM). Another important facet of WBT is that it allows the tracking of course use and the assessment of users' progress – in order to better determine the success of the training course. In addition, WBT provides interactivity through online communication and multimedia techniques such as chat rooms, e-mail, discussion groups and audio/video presentations (via the Internet). Some of the benefits of web-based training include: reduction of training expenses and training time, ease of delivery, ease of updating content, multimedia capabilities, controllable access and accessibility - anytime and anywhere.

A genuine virtual university has no physical place where people go to attend classes. The classrooms are nowhere and everywhere at the same time. Indeed according to Donoghue et al (2001), it is anticipated that *'virtual classrooms will take the place of the solid buildings where students currently attend lectures, at set times in set rooms'*. Within these systems, the lecturers are instructors and facilitators who are trained to use networking facilities to teach and lead interactive discussions (Duggleby, 2000; Barker, 2002a; 2002b). Furthermore, the class materials, books and other products can be ordered via the telephone or on the Internet. These books may be conventional paper-based publications or they may be electronic documents that exist within a digital library facility. These resources can be augmented by the use of email and other means of electronic communication such as video conferencing. The students and facilitators communicate with each other - just as they might if they were meeting in a student lounge, a library or during a lecturer's office hours. Emerging Internet technologies can be used to create online learning communities that are not restricted by geography.

Project scope

The fundamental issue that this research is intended to address is the impact that digital electronic libraries, and hence, virtual university facilities are having on post-compulsory educational provision within the professional sector of the Lebanese community. Particular emphasis has been given to exploring the implications of realising the education on demand and just-in-time training paradigms through the utilisation of a distributed digital library system based on the use of a globally available digital information superhighway. A cyber café was used as one of the access options. Other access possibilities include home PCs, libraries and conventional universities.

The initial work in this research project involved identifying the needs of particular sectors of the Lebanese professional community and designing a prototype virtual university facility to meet those needs. Courseware materials have been designed, and are in the process of being implemented and evaluated. These materials are to be delivered using the prototype VUSIL facility. Subsequently, they will be employed as a basis for an empirical study of lifelong learning in Lebanon. As well as courseware creation, particular emphasis was given to mechanisms for course accreditation, skill assessment and the mechanisms underlying the optional award of 'digital diplomas'. A critical evaluation of the potential advantages and limitations of the system was conducted from two perspectives: those involved in using the system; and those responsible for maintaining it.

Needs Analysis

The needs analysis was undertaken within the Internet café *('the PC club')* in Beirut, Lebanon; most of the participants were students at universities and professional people (mainly engineers). The main aims were: (1) to identify the need for a prototype system, VUSIL; and (2) to explore different topics of interest that would become subjects of study. Because the intended users of the system are both students and professional people, the perspective of both of these groups were studied. For this purpose, an online questionnaire was used; this could be accessed via a URL that was embedded in an electronic message that was sent to members of an electronic mailing list. This contained 337 addresses. In some situations, 'follow up' face-to-face interviews were carried out in order to clarify issues in order to obtain more information about potential study areas.

Seventy-seven responses were received. Sixty-three percent of the respondents were males; thirty-seven percent were students, twenty-eight percent were professionals (mainly engineers). The rest followed a range of careers such as computer-related, management, self-employed and consulting. Amongst those who took part in the survey, nearly 45% held (or were studying for) an undergraduate degree and 32% possessed (or were eligible for) a graduate degree.

The results of the needs analysis survey for VUSIL were encouraging. This is reflected by the fact that more than 75% of those who responded reported a positive interest in online learning. Further interest was shown in obtaining a qualification through the Internet. Four levels of online qualification were distinguished: diploma or certificate, technical degrees, undergraduate and post-graduate degrees. A diploma/certificate represents one or a set of modules relating to a subject of study; at this level, a full degree is not aimed for, only recognition of successfully completing the required modules. A technical degree is based on a highly specific set of modules. Undergraduate (BSc) and post-graduate (MSc/PhD) levels represent normal degrees. The majority of respondents (61%) showed an interest in the post-graduate degree level, while 19% and 12% expressed an interest in studying at diploma/certificate and undergraduate levels, respectively. Only 8% were interested in further study leading to a technical degree. These results demonstrate the need for and the potential importance of an online learning system (such as VUSIL) in Lebanon.

The survey has demonstrated the need for a wide variety of subjects of study. It revealed that information technology topics were amongst the most popular subjects of interest. Computers and the Internet were the most popular topics - accounting for more than 25%. There was also considerable interest in other subjects - such as e-business (11.5%), money and finance (10.7%), science and nature (9.9%) and health and fitness (9.1%). Based on these findings, appropriate topics were chosen for delivery through VUSIL.

An attempt was made to study the reasons behind respondents' choices relating to the selected areas of interest. The reasons were divided into four main categories: 36% for new skills relevant to jobs, 25% for current topics of importance, 25% for personally relevant topics and nearly 6% for particular leisure interests or hobbies. Other minor reasons given amounted to 8%.

The findings from the survey we have conducted fall in line with the results of other research in this area – see, for example, Sinitsa (2000). Our results provide a sound justification for the development of the VUSIL system.

Development of the Prototype

The VUSIL project involved a number of different design and development stages. Following on from the initial design, the first prototype was programmed. Table 1 shows the functions that were included in the first implementation of the VUSIL prototype. The next stage of the development involved producing two short courses and mounting them on the server. At the conference, further progress on the development of the system will be reported.

Table 1. Functions of VUSIL

Functions	Description
Administration Office	performs the tasks of a university's registration office
Lecture Hall	place where users go in order to 'take' lectures
Library	gives access to electronic documents and bookshop facilities
Course Catalogue	provides university information and a list of available modules
Forum	place to post questions, comments and get replies
Manager's Toolbox	Provides facilities for adding and deleting courses

The main aims of our study are to test the first prototype virtual university in Lebanon, to help tutors perform their teaching tasks and activities and to assist students and professionals in their learning activities. As can be seen in Table 1, the system supports six main functions. Each of these is briefly discussed below.

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The Administration Office performs the tasks of a university's registration facility. This includes the ability for users to register for online courses, view and edit their personal profiles, and view their transcripts. The Lecture Hall is the place where users who are registered for a module can go in order to take the corresponding lectures. The Library provides two main facilities: first the provision of access to electronic documents relevant to particular courses of study (for example, course specifications and course notes); and second it provides a bookshop facility. As VUSIL does not handle commercial transactions, there are links to Web sites (such as www.amazon.com) where students can buy books for the courses. Students and online-tutors can enter the Library in order to purchase required books for courses, university merchandise, souvenirs, etc. These can be placed in a shopping cart and purchased from third-party suppliers. The Course Catalogue provides users with general university information along with a list of available modules. Upon choosing a certain module, users are presented with a more detailed description. The Forum gives users the ability to post questions and information related to the modules they are taking. Modules are automatically added to the Forum once they have been entered in the Administration Office. In the Forum, users can select the module to which they wish to post questions and comments. In turn, learners and tutors can reply to these posted items. The Forum also serves as a place for tutors to post information about modules such as test dates, assignments, and so on. The Manager's Toolbox is primarily intended for course instructors and managers. It enables new courses to be added to the system and, if necessary, old ones to be deleted. In addition, particular parts of any given course can be modified and deleted and new parts added. New functions can be added to the toolbox as needs arise.

Future Developments

VUSIL has been designed and built using a basic set of requirements. There is therefore still a number of features and improvements that need to be incorporated into the system. These fall into short-term and long-term development goals. Three of the most important short-term developments that should be included in the system are: (1) the addition of a 'user-friendly' help system that is capable of providing new users with general help, guided walk-throughs and advice related to using the system; (2) the provision of a topic index and a search facility to enable students to search the VUSIL web in order to locate particular items of interest - software to perform each of these latter functions is available commercially; and (3) linking the VUSIL system to external academic support sites. This is discussed below.

For the last eighteen months, the University of Teesside (UK) has been, evaluating the use of a commercial software package - called Blackboard - to create an online learning environment. Blackboard (www.blackboard.com) offers a complete suite of enterprise software products and services that provides online education infrastructure for schools, colleges, universities and other education providers. Using the power of the Internet, it provides software solutions that facilitate the management of the many diverse demands of an academic organisation and helps to bring educational experience online. One of Blackboard's important features is its forum facility. As a further development of the VUSIL system, we plan to provide our users with access to Blackboard's forum - thus giving them the ability to access some of Blackboard's facilities.

From the perspective of long-term developments, there are three important enhancements to be made to the system. First, the addition of a large variety of subjects of study; this would cover most of the topics in which students have expressed potential interest (based on the survey). This variety of subjects would attract more users, thus adding to the overall utility of the whole system.

The second main development would involve the incorporation of XML as the basic mark-up language (Maris, 2000). Use of XML is important because it facilitates the preparation of the catalogues and indexes needed in order to implement efficient and effective searching for material and modules in the system. It also simplifies data exchange with respect to the administrative tasks associated with monitoring and assessment – and subsequent reporting of feedback to both students and staff.

The third enhancement would involve the addition of streaming audio and video facilities (Beckstrand, Barker and van Schaik, 2001). This type of technology does not require files to be downloaded before use. In addition, the use of streaming technology does not require specific class meeting times while still simulating on-campus presentations.

Conclusion

Computers and electronic communications technologies are increasingly being used to provide mechanisms for the support of open and distance learning. These technologies make it possible to provide mechanisms to facilitate an 'education on demand' approach in a variety of different situations. This can occur at home, in the workplace, in libraries and in colleges. Of course, through the use of mobile computing facilities (such as notebook computers and hand-held devices), there is no limit to where electronic learning can take place provided a wireless signal of some sort can be received. This approach to learning using mobile technology is illustrated by the use to which devices like Compaq's iPaq hand-held computer are now being put – see, for example, Schneider (2001).

There is now a significant number of virtual university systems available to support open and distance learning - particularly in the UK and North America. We have designed and developed a prototype virtual university server system to support the needs identified in this paper. Quite naturally, these systems are based on (and embed) 'Western culture'- as they are primarily designed to serve American and British societies. However, within Europe, the use of 'all English' material is problematic because of the many different languages and cultural differences that exist. This too is a problem in many Middle Eastern countries where Arabic is the predominant language. Although the VUSIL project is currently being developed in English, a long-term objective of the project is to create an online system that can be used by both English and Arabic speaking people. Naturally, two important aspects of this work are the development of a bilingual facility both in terms of the end-user interface to the system and its academic content. Such a development is quite challenging and makes it different from many of the other monolingual virtual university systems that currently exist. For Arabic speaking nations, this is an important development because although many students and most professional people in Lebanon can speak and use English, there are many other people in the Middle East who are likely to want to use lifelong learning opportunities but who are unable (or unwilling) to use English as their mode of communication. The VUSIL system could easily cater for this type of audience.

References

Barker, P.G., (2002a). On Being an Online Tutor, *Innovations in Education and Teaching International*, 39(1), 3-13.

Barker, P.G., (2002b). *Skill Sets for Online Teaching*, paper submitted to EDMEDIA 2002, Denver Colorado.

Beckstrand, S., Barker, P. and van Schaik, P., (2001). *Towards More Independent Learning: A Southern Nevada Perspective*. ED-MEDIA 2001 Conference Proceedings (106-110), Tampere, Finland.

Duggleby, J., (2000). *How to be an Online Tutor*, Gower, Aldershot, Hampshire, UK.

Keeling, D., Jones, E. and Botterill, D., (1998). Web-based Learning, Motivation and Employer-Employee Interaction: Implications for Lifelong Learning, *Innovations in Education and Training International*, 35(4), 282-291.

Knapper, C.K. and Cropley, A.J., (2000). *Lifelong Learning in Higher Education*, Third Edition, Kogan Page, London.

Maris Technologies, (2000). *XML and Courseware*. Kingston, Surrey, UK.

O'Donoghue, J., Singh, G. and Dorward, L., (2001). Virtual Education in Universities: a Technological Imperative, *British Journal of Educational Technology*, 32(5), 511-523.

Peters, O., (1998). *Learning and Teaching in Distance Education – Analysis and Interpretations from an International Perspective*, Kogan Page, London.

Schneider, J., (2001). Focus:PDAs, THE Journal, 28(10), 82-86. This paper is available electronically at: http://www.thejournal.com/magazine/vault/A3486.cfm

Sinitsa, K., (2000). Learning Individually: a Life-Long Perspective – Introduction to the Special Issue. Educational *Technology and Society*, 3(1) 2000.

Steed, C., (1999). *Web-based Training*, Gower, Aldershot, Hampshire, UK.

A Neural-Network system for Automatically Assessing Students

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Abstract: This paper is concerned with an automated system for grading students into an ability level in response to their ability to complete tutorials. This is useful in that the student is more likely to improve their knowledge of a subject if they are presented with tutorial material at or just beyond their ability. However, dynamically responding to a student's changing knowledge about a subject usually requires the presence of a human teacher, an altogether expensive resource. The system discussed here can grade both a student and the questions in a tutorial with minimal input from the human teacher. In order to accomplish this a specialist neural network is employed. The design and operation of our system is discussed along with arguments as to why a neural network approach is suitable for this problem.

Introduction

The Tutorial Supervisor (TS) is an automatic system for grading a student into an ability level in response to the student's interaction with tutorial questions. Once the student has been graded then a question or tutorial can be selected which is inline with best pedagogic practice (Bergeron 1989). Our TS is an expansion of the TS designed by Bergeron et al (1989). Our TS improves on Bergeron's original specification by having the additional ability to adapt to both students and questions/tutorials as the system is in use, as opposed to requiring the system to be taken off-line and reprogrammed/trained. The TS's ability to respond in real-time to a student's changing ability and how a population of students perceive a particular tutorial or question is brought about by the use of a specialist neural network device that is able to learn and adapt without human intervention. A thorough description of our TS along with complete details of its design and testing can be found in Mullier (1999).

Operation of the Tutorial Supervisor

The TS is simple in operation. A set of questions to be given to the student is recorded in a database and is graded with a difficulty level by the author of the question. A student can then be given an appropriate question, depending upon the student's ability and the difficulty of the question. However, in order for a student to progress in their learning it is necessary to pitch questions so that they sufficiently tax the student without it being impossibly difficult (Bergeron 1989). Therefore it is necessary to track the student's change in ability as they progress through the learning material. Our system achieves this by recording the student's interactions with questions and mapping this onto an ability level. The system is robust to exceptions in the student's behaviour, since a student may generally perform well but make a mistake with one particular question. Similarly, the system is able to regrade questions in the question database. For example, a question may have been graded by the author as being relatively easy. However, it may transpire that a population of students actually find it difficult. This will be bourn out by most students who should have performed well with the question actually performing poorly. Such a situation negates the pedagogy stated above. Our system is able to statistically determine that a question has been misgraded and is able to remedy the situation. The remainder of this paper will discuss the issues relating to the design and implementation of our TS system.

Rationale for Using a Neural Network

A neural network is an Artificial Intelligence (AI) system that is able to learn rules in response to being presented with many examples. The neural network is said to learn the rules from the examples. In contrast a traditional rule-based system would have rules encoded within it that a designer has previously identified. The advantage of neural network systems is that it is not always possible for a human designer to express and encode rules in a reasonable time frame or even express them at all. A further disadvantage of rule-based systems is that if the rules change for some reason then it is necessary for the designer to reincorporate the new rules within the rule-base (Hagan et al 1996).

A further reason for choosing a neural network for the TS in preference to a rule-based system is that, unlike a rule-based system, a neural network can be domain independent. It is unlikely that, for example, a high level student produces results in the same range for every type of domain. Thus the rule "IF SCORE >70 THEN LEVEL 10" is only likely to apply to the domain that it was initially defined for. This is the reason why Bergeron et al (1989) use a neural network for their Tutorial Supervisor. Their neural network holds the rules that it has learnt from its training data (the first domain). It is then able to change its rules in response to new data (new domains), by retraining off-line. In this manner the neural network can adapt to misconceptions or inaccuracies in the original rules and adapt to new situations. This would be a difficult and time-consuming process for a symbolic rule-based system, since it would require the re-engineering of the rule base by a designer, in that the new rules would have to be identified and then encoded. In essence, the neural network is doing the job of the human rule designer. Designing such rules is not necessarily a simple matter, since it requires the human designer to examine many student interactions with various questions and tasks so that a valid grading of each question can be made (e.g. this question was answered well by novice students, it is therefore easy and can be presented to other novice students). The situation is further complicated by the possibility that different populations of students (students from different classes or tutorial groups) may have different previous knowledge of the domain and therefore the initial question gradings may not apply to them. It would therefore be helpful if an AI system could be employed to accomplish the task of dynamic question grading and therefore remove some burden from the author. However, Bergeron et al's (1989) TS is unable to readapt to different domains without being manually provided with new training data and then retrained off-line. The remainder of this paper describes the neural networks used for our Tutorial Supervisor, which improves upon Bergeron et al's (1989) design by allowing the automatic on-line adaptation to different domains.

Tutorial Supervisor Architecture

The Kohonen self-organising map is a specialist type of neural network with the ability to learn without a designer specifically indicating that the networks results are right or wrong, this is termed unsupervised learning (Callan 1999). This is useful in our system since the distinction between a novice student and an expert student, in terms of marks at tutorial nodes, may be small, or may vary significantly from domain to domain. For example, the majority of students may achieve marks between 50% and 60%, with a few results between 60% and 75% percent and a few between 40% and 50%. There are therefore two large ranges of numbers that occur infrequently (0-40 and 75-100). If a standard type of neural network, such as a back-propagation network which is the most commonly used neural network, were to be used to model the above problem then these mark ranges must be identified beforehand or the neural network's outputs would have to be designed to produce student ability levels between 0 and 100, in order to accommodate a broad range of scores. Identifying scores beforehand is not likely to be practical since it would require the collection of a large amount of data (with no initial benefit for the student). Designing such a generic neural network also introduces the following difficulties. A back-propagation neural network must have enough ability levels (outputs) to clearly demonstrate the distinction between students in these highly clustered areas, necessitating an increase in outputs for all areas to cover for all possibilities, even those that are unlikely. The increase in outputs renders the neural network more complex, resulting in a network that is more difficult to train. Further, and most crucially, once the trained back-propagation neural network is used for different domains, then there is no direct correspondence between an ability level for one domain and an ability level for another. This is because an output of the back-propagation neural network does not correspond directly to a student ability level, since the student ability level may vary between domains. The upshot of this is that the back-propagation neural network would require complete retraining for different domains.

A Kohonen network can solve the above problem by continually adapting to input stimuli whilst it is being used by students. This is because of the way a Kohonen network operates. A Kohonen network is given a number of outputs by the network designer, representing the number of categories that the network designer wishes the network to identify (the number of required student levels in our case). It is then left to the network itself to sort the input data into this number of categories, since it is not made explicit by the training data itself. In the case of the back-propagation neural network it would be required to include an example solution with the training data. If there are ten or more distinct patterns in the data then a correctly trained Kohonen will learn by itself to distinguish them (Kohonen 1989,Callan 1999). Therefore, it is irrelevant to the network if the actual values of the input data change; it will still attempt to separate them into the number of categories represented by the number of

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outputs that it has. The outputs of a Kohonen neural network therefore behave as fuzzy sets, whose boundaries may change over time. The Kohonen neural network is therefore simpler than the standard neural network for the TS in this case, since the number of outputs can be kept small since it is not necessary to design for all unlikely possibilities (the network will adapt to them if they occur).

Training Data

A neural network has a number of inputs, which in our case represent the student's responses to questions and a number of outputs, each one representing a unique ability level. The inputs to the Kohonen neural network must incorporate history data in order to make a more informed evaluation of the student and therefore avoid a restriction of Bergeron at al's (1989) neural network, namely reacting to a one off error (or success) from a student. History data can be used to prevent the TS from making snap judgments of the student. For example, if the student is generally performing well, but gets one question wrong, then if no history data is taken into account the TS is forced to make a decision based only upon the most recent presentation and the student is likely to drop a level. The student ability itself represents a degree of history data, in that if a student is regarded to be an expert student, then they must have performed well in the past. However, the direct incorporation of history data prevents a continual changing of levels based upon one interaction only. The incorporation of history data can be achieved by presenting a number of previous interactions with tutorial nodes to the neural network. Each time a new interaction is presented the previous interactions are shifted along the inputs to accommodate the new input and the oldest interaction is lost. Training data supplied to the neural network are figures that represent a percentage value of a student's interaction with a tutorial. For example, if the student achieved a 50% success level with a tutorial question, then it is this figure that is passed to the TS.

Re-grading Questions Using Fuzzy Logic

Each question level is generally presented to a student of the same level, or just below, a pedagogy used with success by Bergeron et al (1989), in that a level *x* student should be able, overall, to answer a level *x* question. A question may however, be graded incorrectly by the domain author. This can be determined by the system after a number of interactions with different students (a population of students who should be, generally, getting a question right are getting it wrong or vice versa). It is not suitable to immediately re-grade a question with respect to an interaction with one student, however. As has been discussed earlier, a student is a complex entity and it is difficult to formulate rules describing them accurately. In order to resolve this problem each question level is modeled as a fuzzy set. This allows a question's level to be adjusted slightly, within the level, without necessarily affecting the overall level (as presented to the student), thus there is a buffering effect and the question does not rapidly leap back and forth between levels. The use of fuzzy sets also provides a mechanism for allowing a question to belong to more than one question level set, providing a smoother transition between levels. This differs from Bergeron et al's (1989) approach in that they collect data from the students and then periodically use it to update the training of the neural network. There is therefore a delay, which ensures that the question levels do not suddenly change, which could potentially result in the question level continually changing and thus be distracting to the students. However, the drawback is that this is a manual process that requires the direct intervention of the system designer. The process for regrading questions described below is achieved automatically, whilst still maintaining the delay between the question being presented to a student and changing its level.

A question is re-graded by a population of students' interactions with the question being determined as incorrect by the TS, for the reasons described above. Such erroneous interactions cause the question ability to move within the fuzzy set until it crosses into a different fuzzy set. A question's ability level is therefore only changed after a number of erroneous interactions with students, the actual number being dependent upon the size of the fuzzy set, the fuzzy set is therefore acting as a buffer. A simple fuzzy processor accomplishes question re-grading. The fuzzy processor compares the level of the current question and the student level output of the TS neural network. The buffer can be implemented using three fuzzy rules (Kosko 1996):

1 IF S_LEVEL > Q_LEVEL THEN Q_LEVELf = Q_LEVELf + 1
2 IF S_LEVEL < Q_LEVEL THEN Q_LEVELf = Q_LEVELf - 1
3 IF S_LEVEL = Q_LEVEL THEN Q_LEVELf = Q_LEVELf (remain unchanged)

where
S_LEVEL is the level assigned to a student
Q_LEVEL is the level of the question, used to decide whether it is suitable for the student.
Q_LEVELf is the fuzzy membership number of the question.

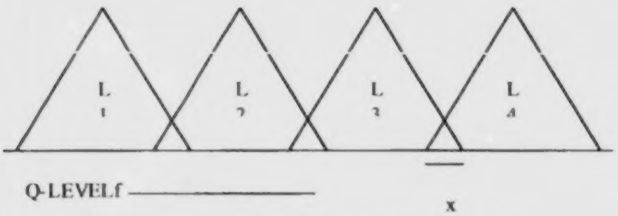

Figure A Membership of the fuzzy sets

Using figure A, a question may belong to one or two of four levels. If the question has a value of Q_LEVELf corresponding to x, then the question is regarded as both level three and level four. If however, as a result of interactions with several students, rule one is repeatedly fired, then the value of Q_LEVELf will increase and the question will become graded as level four only. Conversely, if rule two is repeatedly fired then the value of Q_LEVELf will decrease and the question will be graded as level3 only. Such changes may result in further increases or decreases in the value of Q_LEVELf, which may become any of the levels available. The utilisation of this fuzzy system ensures that the level of a question is not changed (in terms of presenting to students) in response to individual interactions with students. The fuzzy logic is able to distinguish overall trends and is therefore robust in the presence of exception data.

The changing of levels is dependent upon the size of the fuzzy sets, since the size of the fuzzy set directly affects how many interactions are required before a question migrates from one level to another. These start and end points also define whether a question can belong to more than one level or not. It is intuitively sensible to provide a small overlap of neighbouring fuzzy sets. This provides a simple buffer that will help the question to find its true grade. For example, if fuzzy sets were to be defined separately (or as a discrete set) then a question may be presented as a difficult level but become graded as an easier level after several interactions. Once this change has occurred then the question is no longer presented to the original class of students that graded it. This may result in the question becoming stuck at a particular level. If instead the question is presented to both the original class of student and the new class of student, then a smoother progression from one level to another may result and the extra information enables the question level to settle more easily. If the fuzzy sets are defined so that a question may belong to more than two levels, then the question level may not settle at all, as one level of student may push the value of Q_LEVEL one way and another level may push it in the opposite direction.

Experimental Trials

Our TS was designed using a Neural Network package, NeuroShell2 by Ward Systems. Several configurations of neural network were built and tested with both simulated data and real student interactions. The most successful architecture is discussed below. A full description of the experimental trials can be found in Mullier (1999).

The Kohonen neural network proved to be a successful architecture for the problem of grading students into ability levels. Most permutations of parameters produced neural networks that converged upon a solution. A fast and reliable neural network could be produced with between five and twenty inputs or outputs. It is possible to increase this number, but this is unlikely to be required, since it is not desirable to use information from too far in the past, since the network does not have any knowledge of time. It has been experimentally determined that the number of outputs should not rise above twenty. If more levels are required then the outputs may be combined to form fuzzy sets.

Parameters for a generic Kohonen Tutorial Supervisor, i.e. one that will converge on a solution and provide a high degree of student grading for a variety of domains are suggested as the following:

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- 5 Inputs -- this has been found to provide the network with enough information with which to evaluate the student. It is suggested that an input filter, a simple algorithm that combines many history elements into the five required, is employed if more than this number of inputs is required.

- 10 Outputs – corresponding to ten student levels, if more levels are required then it is advised that thirty levels is the upper limit, beyond this the neural network becomes less likely to activate all of its outputs.

- Any form of data extraction may be used to form the training set, however a large number of examples are required to produce a fully trained network. One thousand student interactions provide enough examples. Note therefore, that for a network to be trained with real student data is probably impractical. However, since the Kohonen network is fully adaptable, it is suggested that a network be trained upon generated data and then allowed to adapt to real students. The generated data could be designed to represent realistic but uncomplicated situations. For example, training the network to model simple rules such as "If result in the range 40-50 THEN set student level to 5". The neural network is then able to adapt to any misconceptions present in these rules. Once a neural network has been trained it may be saved and replicated.

Discussion and Conclusion

The Tutorial Supervisor is intended to be an automatic system for gauging a student's abilities with tutorials. This imposes a restriction upon the kind of material that can be offered in a tutorial, since it must be suitable for automatic assessment. Automatic assessment effectively rules out assessments that cannot be graded in a relatively simple fashion. For example, it would not be possible, with current technology, to have an essay automatically assessed, since this would require a complex understanding of the essay on the part of the assessor. Automatic assessment is limited to tasks that can be broken down into elements that can then be individually marked. A tutorial may, for example, take the form of ten questions, each of which could be answered by the student and graded as right or wrong, or graded as containing relevant keywords. However, assessment is not the role of the TS, which is presented with completed assessments (results). Assessment is therefore limited to multiple-choice questions or identifying that the student has visited certain nodes (or a combination of both).

A key issue of concern regarding the TS is the number of student levels that the TS is to recognise and output. Each student level should have tutorial material generated for it; since it is important to target tutorial tasks at the student's ability, this is seen as being of more educational benefit than offering the same tutorials to all students and then assigning a student level based upon the grade that the student achieves (Bergeron 1989), although there is no technical reason why the latter could not be done. The number of student levels therefore may change between domains, since some domains may have a richer set of assessment questions than others (for a number of possible reasons). A possible conflict therefore could arise between the number of student levels that has been designed into the TS by the system designer and the number of student levels that are required by the current domain author. A possible solution to this problem is for the system designer to provide a TS that is capable of outputting a large number of student levels and then each domain author can allow it to adapt to their domains and ignore the inactive outputs from the TS that will naturally arise if there is not sufficient input student levels. The benefit of this approach is that one TS configuration could be used for many domains without the need for reconfiguration. However, the drawback is that some outputs of the TS will always remain inactive, although the experiments carried out as part of the research demonstrated that active outputs tend to cluster together and so are easily identifiable. A problem related to the number of outputs is the number of inputs.

The amount of history data presented to the TS directly affects the grading of the student, in that the more history data presented to the neural network, the greater the effect of previous results with tutorials. This is a similar situation to that of the number of student levels, in that it is possible to design a TS with a large number of inputs and then use only the required amount. However, it is not a simple matter to determine how much history data to present to the neural network in order to aid the student the most. This issue is difficult to reconcile without extensive trials with real students and even if this were done it would still be unlikely that any real conclusions could be drawn since proving the effectiveness of educational systems is notoriously difficult in the educational field (Dillon and Gabbard 1998). The purpose of the TS here is to explore the technical issues relating to the feasibility of providing an automatic student grading system. Whether this facility is useful is open to educational debate. However it is likely to be the case that it will be useful should the correct set-up of the TS be achieved during trials with real students, since Bergeron et al (1989) found their TS to be useful.

Further issues arise concerning the adaptability of the neural network used for the TS. The neural network architecture used by Bergeron et al (1989) requires off-line training and is therefore under the control of the system designer. The drawback with this approach is that it requires the manual intervention of a person who can interpret the student interaction data with tutorials and determine whether it should be represented to the neural network. The advantage of the Kohonen neural network architecture is that it is able to train continually without any intervention from a human. However, there are situations where this adaptation is undesirable, most notably when different skill levels of students use the same domain at different times. For example, if a class of first year students use the system followed by a class of final year students. However, this is not a problem if the questions and tutorials have been adequately assigned a difficulty level, since the first year students will only be offered easier tutorials and so can be graded only as lower level students (although they can still progress if they continue to achieve success with the tutorial). Problems can arise only if both the student abilities and the question difficulties are unknown beforehand. This is because the TS acts as a bi-directional mapping device, in that if either the student abilities or the question difficulties are known beforehand then the TS can produce the unknown parameter. It is not, however, able to produce values when nothing is known beforehand. The TS's ability to re-grade questions automatically is an exploitation of this bi-directional mapping facility, in that the student ability can be changed in response to improving results and the question difficulty can be changed if a significant proportion of students who should get the question right in fact get it wrong.

Research into the TS has demonstrated that a fully adaptable system for automatically grading students is possible and practical. The approach of using an automatic tutorial supervisor has been practically justified by Bergeron et al (1989). However, their system requires manual periodic retraining which renders it unsuitable for a generic tutorial system, or a tutorial system that can be used without the need for reprogramming or otherwise rearranging the program code of the system.

Further research is concerned with incorporating the TS within a hypermedia tutoring system (Mullier et al 2002, Mullier 1999) so that the students' interactions with the TS can be studied. It is anticipated that such a study will prove useful for determining how the TS reacts to different domains, where the rules that describe ability are different, with a view to reengineering the TS so that it is able to learn such a vast set of rules without conflict. A "superTS" such as this would be useful in a more generic tutoring environment such as may become more prevalent on the WWW.

References

Bergeron B, Morse A, Greenes R, (1989). *A Generic Neural Network Based Tutorial Supervisor for C.A.I.;* **14th Annual Symposium on Computer Applications in Medical Care. IEEE Publishing, pp 435-439**

Callan R, (1999)*, The Essence of Neural Networks,* **Prentice Hall: ISBN 0-13-908732-X**

Dillon A, Gabbard R, (1998). *Hypermedia as an Educational Technology.* **Review of Educational Research; Vol. 68, No.3, pp. 322-349.**

Gurney K (1997), *An Introduction to Neural Networks,* **UCL Press; ISBN: 1857286731**

Hagan M T, Bemurth H, Beale M, (1996), *Neural Network Design,* **Pws Publishing Co; ISBN: 0534943322**

Kohonen T, (1989), *Self-Organisation and Associative Memory.* **Springer-Verlag; ISBN: 3540620176.**

Kosko B, (1997), *Fuzzy Engineering,* **Prentice Hall Press; ISBN: 0131249916**

Mullier D J, Hobbs D J, Moore D J, (1999), *A Hybrid Semantic/Connectionist Approach to Adaptivity* in Educational Hypermedia Systems. **In Proceedings of ED -MEDIA'99, Seattle, WA. 1999**

Mullier D J, (1999), *The Application of Neural Network and Fuzzy-Logic Techniques to Educational Hypermedia. PhD thesis.* **Available from www.lmu.ac.uk/ies/comp/staff/dmullier**

Mullier D, Hobbs D, & Moore, D, (2002), *Identifying and Using Hypermedia Browsing Patterns.* Journal of Educational Multimedia and Hypermedia, 11(1), 31-50.

Interactive Websites for New Teachers: Effective Components for Developing Peer Support

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Abstract: A variety of attempts have been made to address the concerns of new teachers as they enter the profession. A meaningful support system has been recommended as a key component to guiding new teachers as they become socialized into the profession. Professors realize the gap between theory and practice is never perceived as wider than perhaps during this period of a novice teacher's career life. Two professors decided to explore if technology could be used to enhance their senior seminar programs for student teachers. The project designers were interested designing a format where student teachers could participate in an interactive telementoring experience. A pilot program was implemented to determine the interest, use, and benefits of an interactive website for new teachers.

Introduction

Numerous studies have identified the most critical issues that cause teachers to leave teaching before they complete three years. Concerns particularly associated with novice teachers include those of classroom management, overwhelming job responsibilities, and finding meaningful methods of support (Nelson & Low, 2000).

A variety of attempts have been made to address these concerns. School districts, regional service centers, and university induction programs have all struggled to develop programs to help support new teachers, particularly in that first critical year of teaching (TEA, 2000). Providing some type of a support system have been recommended by many as a key component to guiding new teachers as they become socialized into the profession (Cole & Knowles, 2000).

Conceptual Framework

Support systems for new teachers take on many forms and designs. Various configurations include individual outside mentors assigned to new teachers, seminars, and other opportunities for professional dialogue and development (Cook-Sather, 2001; Cole & Knowles, 2000).

Emergent issues resulting from related research indicates that perhaps there is a vital need for support in areas other than those traditionally focused on: teaching skills and knowledge. Successful retention of teachers may need to reach beyond the first year and attempt to help teachers develop internal resources necessary to pursue a long and satisfying teaching career (Cook-Sather, 2001).

Designing effective student teacher experiences and induction programs are of primary interest to schools of education. Professors realize the gap between theory and practice is never perceived as wider than perhaps during this period of a novice teacher's career life (Posner, 2000).

Providing structured meetings or seminars are invaluable ways of allowing new teachers a way to schedule and prepare for discussions about teaching. However, with new technologies continually emerging, there may be additional ways in which professionals can connect without the structure of brick and mortar (Harris & Figg, 2000). As new teachers graduate with more skills in technology use and awareness, other avenues could be included in meaningful teacher induction programs.

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The Study

Two professors decided to explore if technology could be used to enhance their programs for student teachers. The project designers were interested designing a format where student teachers could participate in a telementoring experience. A pilot program was implemented to determine the interest, use, and benefits of an interactive website for new teachers.

Each group of student teachers was enrolled in predominately rural serving settings. Students in both of these programs had completed a traditional teacher education program. Regionally, both groups were located in similar, rural areas. Participation in the pilot project was voluntary, with a total of twenty-three student teachers enrolled on the website.

The site includes resources for teaching strategies, such as lesson plans, journals, and classroom management ideas. Additionally, the site has a link to an interactive component where participants have access to a discussion board, email, and a virtual chat room. The purpose of the interactive component is to provide student teachers a way to communicate at times other than during scheduled seminar opportunities. Participants have the capability to share experiences, reflect on their own experiences, and have other students with which to discuss ideas and concerns.

Implications

By incorporating technology into a peer mentoring program, students could have the advantage of a "just in time" format for addressing their needs. If it appears this type of interactive site is beneficial to participants, the benefits may expand to others outside of our two programs. Introducing a telementoring component into the final semester of student teaching may be one way to encourage new professionals in establishing supportive relationships early in their careers. These first year teachers would already have established a network of colleagues to continue sharing concerns, issues, and challenges during this critical point in their careers.

Conclusion

Those entering the teaching profession are benefited by various methods of mentoring and support as they navigate the routines of daily classroom life. Emerging technologies can be integrated into existing mentoring programs as a method of extending support systems. Data collected from student teachers who participated in a pilot project of an interactive website reported benefits in both reflective practices as well as valuable dialogue between others experiencing similar situations. Of the twenty-three eligible participants, eight students were classified as frequent users of the interactive portion of the site.

The authors propose that teacher retention begins even before teachers step into their first classroom. If support programs can be implemented during the final semesters of teacher education programs, it may be possible for novice teachers to build support systems and professional development resources early in their careers. Developing resiliency skills through telementoring may be one avenue to enhance first year experiences.

References

Cole, A.L. & Knowles, J.G. (2000). *Researching teaching: Exploring teaching development through reflective inquiry.* Ally n & Bacon, Needham Heights, MA.

Cook-Sather, A. (2001). Translating themselves: Becoming a teacher through text and talk. In *Talking shop: Authentic conversation and teacher learning* (pp 16-39). Clark, C.M. (ed.), Teachers College Press, New York: NY.

Harris, J.B. & Figg, C (2000). *Participating from the sidelines, online: Facilitating telementoring projects*. ACM Journal of Computer Documentation, 24(40, 227-236.

Nelson, D.B., & Low, G.R. (1998). Learning and improving emotional intelligence skills: Building quality from within. Emotional Learning Systems, Corpus Christi, TX.

Posner, G.J. (2000). *Field experience: A guide to reflective teaching* (5th ed). Addison-Wesley Longman, Inc. New York, NY.

Texas Education Agency. Objective five of the Texas education code. [Online].
http://www.tea.state.tx/A2000/obj5.htm

Showcasing the Experience of Practitioners with Technology Enhanced Teaching and Learning

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Abstract: This paper describes a research project, which seeks to showcase the experience of educators with technology-enhanced teaching and learning. A particular focus of this investigation is on how the use of information and communications technology is influencing teaching practices and students' approaches to learning at the University of Melbourne. As such it comprises a naturalistic inquiry into the experience base of practitioners who have been engaged in technology-enhanced teaching and learning. Our goal is to look beyond objective data and examine closely how information and communications technology is fundamentally influencing the nature of the teaching and learning transactions. As such we are interested in the "untold" stories of practitioners and participants in this work. Data that is collected is archived on a website, and used in a variety of ways for faculty development.

Aims and Outcomes

Educational institutions all around the world are beginning to pay greater attention to the improvement of their teaching and learning practices with the innovative use of information and communications technology (ICT). Although a great deal of work has gone on in the investigation of the effects of computer-based learning, there is a lack of reliable knowledge about *what* works, *why* and in *what ways*? This paper describes a research project that is trying to seek for some answers to the foregoing questions from the perspective of practitioner experiences. The goal of this investigation is to look beyond survey data derived from questionnaires into the experiences of practitioners, to ascertain how ICT is fundamentally influencing the nature of the teaching and learning processes in various subject matter domains. As such the aim is to tell the "untold" stories of practitioners and participants. The stories we are collecting, and the profiles of practice that we are developing will comprise the data for the development of conceptual models of best practice. These models may then form the subject of empirical study in the future.

The outcomes of this research are expected to be a deeper level understanding of how the use of ICT is influencing teaching and learning in fundamental ways. In that regard, this is "exploratory" research as it seeks to compile stories of the experiences of teachers and students with technology-enhanced teaching and learning. As an immediate output, these "stories" or "vignettes" of practitioners will be used to build a "gallery of stories" on technology-enhanced teaching and learning that will be accessible on a website for the benefit of all, but most importantly, for novices. Furthermore, models of behavior and practice derived from this research will provide the context for more empirical studies in the future, such as the study of any correlation between innovative teaching and learning designs and specific learning outcomes, and/or approaches to learning and teaching.

Context and Scope

The application of ICT in teaching and learning has the potential to change educational practices in significant ways (Ben-Jacob, Levin, & Ben-Jacob, 2000; Rogers, 2000). For example, the integration of e-mail and computer conferencing with multimedia databases and electronic libraries has enabled the emergence of a whole new kind of educational activity, namely eLearning. Information and communications technology is also enabling established campus-based providers to rethink and re-engineer the nature of their teaching and learning practices. The University of Melbourne, like many other educational institutions, is currently involved in just such a process as part of a strategy to position the University as a global player in higher education. As a direct result of this and along with the adoption of ICT, innovative approaches to teaching and learning such as problem-based learning and collaborative learning are being encouraged. These initiatives have led to the rise of new roles for teachers such as "facilitators of learning" as opposed to "deliverers of content" (Evensen & Hmelo, 2000; de Verneil & Berge, 2000; Salmon, 2000). They have also exposed students to new models and approaches to learning such as "computer supported collaborative learning" (Dillenbourg, 1999; Koschmann, 1996; O'Malley, 1995), and "computer supported problem based learning" (Bernard, Rojo de Rubalcava, & St-Pierre, 2000; Koschmann, Kelson, Feltovich, & Barrows, 1996).

While interest is growing in the integration of technology in learning and teaching, there is still very little known about how the use of ICT is changing teachers approaches to teaching, and students' approaches to learning (Rumble, 2000). The need to investigate what is happening with technology-enhanced teaching and learning is now imperative. This includes, among other things, understanding how approaches to teaching are being impacted, how teacher-thought about teaching and learning is being modified, how students' approaches to learning are changing, and how student support is changing with the use of ICT?

Methodology

The research described in this paper set out to seek some answers to the foregoing questions from the practitioners' perspective. It comprises a naturalistic inquiry into the *modus operandi* of educators (Lincoln & Guba, 1985). Naturalistic inquiry is particularly suited to questions and settings such as this where the context is heavily implicated on meaning. Such a contextual inquiry *demands* the use of human instruments for gathering data, as humans have the capacity to use their tacit knowledge with qualitative data gathering tools such as *interviews, direct observations, self-reporting and think-aloud*, and *document analysis*. Once in the field, the inquiry takes the form of successive iterations of these elements: *purposive sampling*, *inductive analysis* of the data, *development of grounded theory* based on the inductive analysis, and *projection of next steps* in a constantly emergent design (Lincoln & Guba, 1985; p. 187). Throughout the inquiry, and especially at the end, the data and interpretations are continuously checked with respondents, and differences of opinion are negotiated until the outcomes are agreed upon or differences of opinion are understood and reflected as such. This information is then used to develop a case report or profile, which is tested for "credibility" and "confirmability" (Lincoln & Guba, 1985; p. 189). This testing begins early in the study and continues throughout, culminating in a final representation of what was observed.

Data Gathering

Interviews are being used as the principal instrument for data gathering in the first instance. The initial sample comprises practitioners who are known for spearheading the use of ICT into teaching and learning at The University of Melbourne. This sample will grow to include other practitioners at the University of Melbourne. There is a possibility that this may grow even further to include practitioners from other organizations including tertiary educational institutions, and also commercial enterprises. In the spirit of naturalistic inquiry, interviews are being conducted on location. An interview protocol has been developed which sets out the goals of the interview and trigger questions to guide the interview (see boxed text below).

Teaching and Learning Experiences with Educational Technology

We are interested in *your story* and *your experience* with technology-enhanced teaching and learning. We would therefore like you to reflect on your experience with technology-enhanced teaching in terms of the following:

Planning

- What are your goals and motivations?
- What aspects of your teaching and learning are you trying to influence *(e.g., approaches to subject matter content representation, activation of learning, assessment, socialization, or provision of feedback)?*
- Why are they important, to whom and to what?

- Describe your approach to learning and teaching?
- What is unique or innovative about this approach?
- What limitations of theoretical perspective have you encountered?
- What unique challenges have you faced in planning your approach?
- How did you know if you were on the right track?

What you are doing?

- How did you go about choosing the tools and technologies?
- What influenced your choice of these tools and technologies?
- What challenges did you face in selecting these tools and technologies?
- What limitations did you experience; financial, technical or organizational?

What happened?

- What worked and what didn't work?
- What criteria did you use for evaluating the effectiveness of your progress?
- How did you make use of the data that was gathered?

What you learned?

- How did this innovation influence your view of teaching and learning?
- How did it influence your students' approaches to studying and learning?
- Did it impact your understanding of your students' studying and learning?
- What are your successes, failures, serendipitous findings, lessons learned?
- What would you do differently next time?

Interviews routinely begin with a discussion of this interview protocol and the trigger questions. This is to ensure that interviewees understand the questions, and are comfortable with the their motives. With the permission of the interviewees interviews are audio taped and subsequently transcribed. These transcripts comprise the raw data for the development of profiles of practice. The interview protocol follows the action research methodology, which comprises *planning, doing/taking action, observing* and *reflecting*.

Developing Profiles of Practice

Excerpts derived from the interview transcripts comprise the raw data. Researchers sift through these transcripts to develop individual profiles of practice along the lines of the interview protocol. These are then presented to each interviewee to allow the filling of gaps in the profiles, verification of existing materials and addition of any other thoughts on the matters raised during the interview. This in itself is an iterative process and involves further consultations with interviewees. The profiles are entered onto the database only when complete agreement has been reached between the interviewee and the researchers on the content of the profiles.

Development of the Database

The database is used to generate profiles of practice for a website that is available to all University of Melbourne academics. Data is entered using a simple web-based form to populate the following fields:

Planning	*Doing*	*Observing*	*Reflecting*
Summary	Summary	Summary	Summary
Goals & motivations	Choice of tools	What worked	Impacts on your view of teaching & learning
Approach to learning	Influences on choice of tools	What did not work	Impacts on your student's approach to studying
Limitations of the approach	Challenges in selecting tools	What criteria for success were used	What did you learn
Challenges	Limitations experienced	How those criteria were measured	What you would do differently next time

Data is also included for standard project details such as the names and affiliations of faculty and project leaders, date of implementation, and project type. Each profile also contains a brief summary of the project and current issues in the discipline. There is no requirement that all fields contain data.

Where appropriate, data can be provided in formats other than text. The database is used to generate a showcase of academic practice. Users of the site can customize the display of stories by focusing on a particular action research process, group of trigger questions, faculty or the complete profile of a particular project.

Display options include a choice of predefined categories, as well as browseable lists and individually constructed searches. Browseable lists allow the display of projects by faculty and department, as well as by action research process, including approaching the data from varying perspectives. Search functions provide for user-constructed views of the data that enable investigation based on specific interests. Keyword searching is also available across all fields of the database. Each story segment is displayed with fully linked metadata for the corresponding project. This provides a link to departmental databases containing other project information, and also to academics involved with the project. Links are provided to live course content where possible.

Sample Profile (Abbreviated)

Project Leader:	*Tim Van Gelder*
Faculty/Department:	*Arts/Philosophy*

Summary of Project

Reason!Able is a stand-alone PC package designed to assist students at all levels, including those with no explicit training in logic or argument, to acquire general informal reasoning skills. We looked at research about critical thinking courses and it showed that they just weren't having the effect that they were claiming to have had, and were perhaps actually hurting students' critical thinking.

Planning: Summary Comment

We wanted to help students to learn to acquire general and fundamental skills of reasoning and argument. We teach general skills that can be applied in any domain whatsoever e.g. in students' other academic subjects and in their chosen profession.

Planning – Goals and motivations

We wanted the students to go through a certain fairly standard, straightforward routine. We had initially used a HyperCard stack, but wanted to come up with a dynamic forming type of software tool, that would simultaneously teach the students all the concepts and procedures that they needed to know.

Planning – Approach to learning

I was fundamentally concerned with the problem that the students did not learn. They were trying to learn, but not succeeding, and not reflecting on the fact that they weren't succeeding. If you want to acquire skills, you've got to practice. It's true for cognitive skills just as much as practical ones. But it's not just any old practice; it's got to be the right kind of appropriately guided, scaffolded, and motivating practice.

Planning – challenges

The idea that targeted practice will lead to an improvement in skills is the one thing that has been absolutely constant. What we were trying to create with the *Reason!Able* software is what I have come to call an 'environment tool' for quality practice in reasoning.

Doing – Summary Comment

Teaching is still a cottage industry where a whole lot of people are just assumed to be able to do it and they go by unquestioned. There hasn't been the pressure to force change.

Doing – Choice of tools

We thought that maybe there were more ways of representing complex structures of reasoning, which take advantage of representational resources, which for practical reasons couldn't be used very effectively. In *Reason!Able* you'll see an almost complete switch from a HyperCard approach to an all-in-one workspace. All the information is at all times is available on the screen.

Doing: Challenges in selecting tools

Despite difficulties, it was the first time ever that somebody had built a way of handling argumentation that made it visual, manipulable, and graphical. It's a real turning point.

Doing - Limitations experienced
In a certain sense, we failed in our first attempts, because we found out that the task was a lot more difficult and challenging. I don't think it was a success from the point of what we said we would do at the beginning and what we delivered at the end. Although, I think that we've succeeded at the end of three attempts.

Observing - Summary Comment
We are dealing with a huge spectrum of intuitiveness and familiarity. It is very interesting, that many university students are having difficulty with critical thinking skills and yet, elementary school students are coping with it.

Observing - What did and did not work
Students have been more successful in learning how to think critically because of these visual elements. It is the visual element that is having the most impacts.

Observing - What criteria for success were used?
So far, our students gain three to four times as much as any other students in the world, in terms of critical thinking skills. The studies showed that this technology helps people learn critical thinking skills.

Observing - How those criteria were measured
Last semester, we did a number of studies, comparing the results from the University of Melbourne, with that from Monash University in Melbourne and McMaster University in Canada. Their results were only half as good as ours. There was something about our approach, which was working much better.

Reflecting - Summary Comment
It has changed me a lot, there's no question about that. We don't think hard enough about effectiveness and quality. We inherit a framework of practices and assumptions and we work within that so that what everybody else accepts is deemed fair and reasonable practice is what obviously I would accept as reasonable practice.

Reflecting - Impact on your view of teaching and learning
The software is tapping into a much larger set of brain resources than the typical ways of presenting arguments. We are getting students to use more of their brain. The software is partly visual, partly manipulable and that helps them and it makes life easier for them. It reduces the cognitive burden.

Reflecting - Impact on your students' studying and learning
The students are being affected far more than they realize. At a deeper level, they are being exposed for the first time to what it is to be critical and what it is to have a rational opinion. They're getting an understanding of what it takes, how complex the world is, what the issues are and how much work is involved in actually thinking through an issue.

Reflecting - What you learnt
If the primary role of this course is to improve students' critical thinking skills, then yes, I think I have become better at it. I am using better methods, better tools, and getting better results. I have also learned that if you're engaged in a challenging project, you have got to expect that it may not pan out the way you think it will. You have got to be prepared to change your direction, re-conceive the project, and keep pushing the boundaries.

Concluding Remarks

The work that is described and discussed in this paper grew out of a growing call for "evidence of the impacts" of information and communications technology in tertiary teaching and learning. While this is a question that has been asked many times before, answers to it have not been conclusive one way or the other. There is a lot of evidence to suggest that the use of information and communications technology in tertiary teaching and learning has many advantages. There are also suggestions that these benefits do not justify the cost,

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time and effort that this kind of work entails. Many of these findings are however, problematic as they are based on neither reliable nor valid research techniques. The work that is reported in this paper incorporates investigation techniques that depart from the commonly used approaches to the quantification of user perceptions with questionnaires and surveys of sorts.

Our goal in this work is to capture the experience base of practitioners with the use of a range of data gathering techniques that are grounded in the principles of naturalist inquiry. We realize that data derived from these kinds of approaches are not easily "generalizable" to other contexts. Among other things, generalizability is a function of sampling and we expect that over time, we will have in this gallery, the amount of information and data that is necessary to make meaningful generalizations from it to similar situations and contexts. We anticipate that this gallery will grow into an extremely rich resource of the experience base of not only many of our pioneering efforts but some of the most innovative work that is being undertaken in this regard at the University of Melbourne and elsewhere. A larger collection of profiles in the database would enable the examination of patterns and models of behavior among practitioners that could become the subject of study further down the road. Questions that might seem relevant would include: the reasons for particular approaches to teaching, and prominent approaches to student study behavior. We are hopeful that these questions would make interesting study towards explaining how the use of technology is impacting teaching and learning.

References

Ben-Jacob, M. G., Levin, D. S., & Ben-Jacob, T. K. (2000). The Learning Environment of the 21st Century. *Educational Technology Review: International forum on Educational Technology Issues and Applications*, Spring/Summer, *13*, 8-12.

Bernard, R. M., Rojo de Rubalcava, B., & St-Pierre, D. (2000). Instructional design for collaborative distance learning: The state of practice and research. *Distance Education, 21*(2), 260-277.

de Verneil, M., & Berge, Z. L (2000). Going Online: Guidelines for the Faculty in Higher Education. *Educational Technology Review: International forum on Educational Technology Issues and Applications*, Spring/Summer, No. 13, pages 13-18.

Dillenbourg, P. (Ed.). (1999). *Collaborative learning: Cognitive and computational approaches*. NY: Pergamon.

Evensen, D. H., & Hmelo, C. E. (Eds.). (2000). *Problem-based learning" A research perspective on learning interactions*. Mawah, NJ, Lawrence Erlbaum.

Koschmann, T. D. (Ed.). (1996). *CSCL: Theory and practice of an emerging paradigm*. Mahwah, NJ: Lawrence Erlbaum.

Koschmann, T. D., Kelson, A. C., Feltovich, P. J., & Barrows, H. S. (1996). Computer-Supported Problem-Based Learning: A principled approach to the use of computers in collaborative learning. In T. D. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm* (pp. 83–124). Hillsdale, NJ: Lawrence Erlbaum.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Beverly Hills, California: Sage Publications.

O'Malley, C. (Ed.). (1995). *Computer supported collaborative learning*. Berlin: Springer-Verlag.

Rogers, D. L. (2000). A Paradigm Shift: Technology Integration for Higher Education in the New Millennium. *Educational Technology Review: International forum on Educational Technology Issues and Applications*, Spring/Summer, *13*, 19-27.

Rumble, G. (2000). Student support in distance education in the 21st Century: Learning from service management. *Distance Education, 21*(2), 216-235.

Salmon, G. (2000). *E-moderating: The key to teaching and learning online*. London: Routledge.

Using JavaScript for Client-side Online Testing

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Abstract: The desire to learn and teach in an online setting often presents great difficulty for students and instructors due largely to the lack of face-to-face interaction. Online instructors are continually looking for methods to improve student engagement without monopolizing instructional time. Students desire feedback on their progress in a non-test setting. Using JavaScript and html to develop client-side online testing fulfills both of these goals and provides instructors and students with better tools for successful online education.

Introduction

One of the most significant challenges experienced by instructors of online courses is keeping students engaged and confirming that students are making satisfactory progress throughout the semester. The lack of face-to-face interaction makes it difficult for the instructor to determine which students are fully participating and comprehending the materials, and which topics are causing particular difficulty. Minimal interaction between the instructor and an individual online student could mean that the student has grasped all concepts and needs no further assistance, the student is inactive and will remain so until a mandatory deadline occurs, the student is unaware that he or she is not grasping the course material, or that the student is overwhelmed by the material and needs help to succeed.

In addition, the lack of immediate feedback from the instructor often leaves students in a quandary with respect to their current progress in the course. Frequently students receive minimal feedback in an online setting until an examination is graded, at which time it is too late to take remedial action. While these problems can also exist in the traditional face-to-face classroom, the misperceptions caused by the lack of mandatory meetings between the students and the instructor is magnified in the virtual classroom. To combat this, scheduled intermediate quizzes, perhaps weekly, can be created which measure the students' progress in a non-threatening environment, and let the students know which concepts the instructor feels should be emphasized to better meet the educational goals of the course. The benefits of the quizzes for the instructor and student are many.

1. Students are engaged weekly in verifiable activities.
2. Instructors can identify problem areas where more examples or clarification are required.
3. The quiz process is asynchronous so students can schedule time appropriately.
4. Students can measure their progress against a course standard.
5. Each student can take the individual time required to complete the quiz without fear of being judged.

It is certainly possible to meet these goals by merely posting a series of quiz questions for the students to answer, and then manually grading the responses. However, the use of automated grading on the client-side reduces the workload for the instructor while allowing the students to receive immediate feedback on their quiz. By providing results in this manner, the students have the opportunity to further research the questions they answered incorrectly while the topics are fresh in their minds.

Online Testing

In order to solve the problem efficiently and effectively in an online setting, content-specific quiz questions were selected and put in a standard format, an html version of the quiz was produced, a JavaScript program to grade the quiz was produced. To optimize the above, the system was prototyped once, and then automated to save the instructor time and minimize any associated errors. In this case Microsoft Excel was used to store the content-specific quiz questions.

Question Selection

Although a variety of formats for creating online quizzes exist, the system implemented includes html, Visual Basic and JavaScript. Prototypes were developed and then Visual Basic was used to generate future quizzes. The format for the example questions is multiple-choice, although any method that can be graded algorithmically is theoretically programmable.

Html Prototype

Prototype quizzes were created for online graduate courses. There are three buttons at the end of the quiz that provide students with the options to *Check Answers*, *Submit Solutions*, and *Clear Quiz*. The three options provide students with the capability to check their answers in a non-threatening setting. They can check their answers as many times as they like prior to submitting their answers. The amount of information provided in response to selecting the *Check Answers* button is controllable by the instructor, and can range from merely reporting the number of correct answers to detailed information about each question that was answered incorrectly.

JavaScript

The immediate feedback to the student is provided through JavaScript. The easiest method of using JavaScript on a web page is to embed the code in the html source. However, this allows anyone to view the JavaScript, which in this case will include the quiz answers, simply by viewing the page's html source. Since allowing the user to view the web page source is a basic function supported by all popular browsers, embedded JavaScript is not particularly effective for online quizzes. To ensure that the quiz answers are not trivially accessible, the JavaScript can be stored in a separate file on the server, and that file is then referenced from the html document. Anyone viewing the html source in this case will no longer have immediate access to the JavaScript code. Unfortunately this does not completely solve the problem. The file in which the JavaScript is now stored is likely saved in the browser's local cache directory, and can be opened by the student using any text editor, revealing the JavaScript source. However, it is likely that storing the JavaScript in a separate file is a sufficiently secure solution for most quizzes, while still providing the benefits of a client-side controlled interactive page. In the event that a more secure system is required the interactivity could be controlled on the server-side using CGI programming, which would also require a greater level of client-server communication.

Quiz Generation

The extensive ability inherent in current technologies to automate redundant tasks can greatly simplify the quiz construction process. The html for a collection of quizzes varies only in the quiz question contents, and any header information that the quiz creator chooses to include for supplementary information. The JavaScript varies in the construction of the answer array as a list of correct solutions. Thus for the collection of quizzes associated with a particular course, the html and JavaScript files should be identical except in the references between the files, question contents, and header information. The references between the files include the items necessary to correctly name the files and to associate the correct JavaScript file and path with the correct html file and path. The question contents include the textual questions and associated solutions. The header information includes quiz-specific information such as quiz number, course, etc. With so much similarity between these items, it certainly is possible to create one html and JavaScript prototype and modify each to create subsequent quizzes. With the ease of automation, this process can be greatly simplified with the possibility of associated error being minimized as a side effect. Perhaps one of the simplest methods is to put all of the content questions and associated solutions in a file, and then use Visual Basic to generate the associated html and JavaScript files. In fact, that is how the files in the figures above were generated, with minimal effort on the part of the quiz generator.

Conclusions

The client-side quizzing has been tried in several courses with very positive results. At first consideration, many students have difficulty immediately seeing that they can determine the correct answers to all questions by checking answers for each question individually. Beginning students, and those with minimal experience in the area of combinatorics change multiple answers at once, thereby greatly complicating the process of determining which answers are correct. The option to submit the answers has met with mixed results. It requires the students to remain connected to the server for submission and also increases the possibility of submitting answers before the student is ready through accidental means. Using client-side quizzes created by combining html and JavaScript provides students with the capability to measure their progress each week. The instructor can also choose to verify the results depending on the needs of the particular virtual community. This can guide the instructor in developing content focus areas, and can provide a valuable means to ensure that students are engaged throughout the course.

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Promoting Active Learning Strategies: *Doing* Economics in the Lab

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This case study reviews a new model that we have developed for our introductory economics courses that focuses on the use of technology to engage students in active learning strategies. This project is the result of a three-year grant awarded to the Economics and Mathematics departments at Fairfield University by the Davis Educational Foundation. Under the grant, each department has restructured the way it teaches introductory courses. The objective has been to use technology to improve quality and lower the costs of delivering high-quality learning opportunities to students. In this paper we discuss the economics portion of the project.

Our contention is that students can learn about economics, but to understand and use the theoretical models and quantitative techniques that we teach them, they must also *do* economics. Economics texts often say that students need to be able to understand the "economic way of thinking"; we argue that they also need to experience the "economic way of doing", to pose interesting questions, formulate hypotheses, collect data, analyze the data, and generate conclusions regarding the results of their experiments. In order to make this environment both *active* and *effective* in improving student learning outcomes, students need to be engaged in the process. Our solution is to infuse technology into the activities of the course so that it becomes the common denominator around which the course in constructed. Though our colleagues in the natural sciences have had students working in labs as active learning environments for many years, social scientists have not had easy access to similar settings for students. Computer time was expensive, and data files were often difficult or expensive for students to retrieve. The recent explosive growth in computer technology now makes it possible for economists to get students into a meaningful learning-by-doing environment in a cost effective way.

Introductory economics classes at our school have traditionally been taught in a 3x50 minutes or 2x75 minutes per week lecture format. Since the demand for introductory economics is great (the courses are required for our School of Business students), faculty members in economics often teach two sections of "intro" each semester. To give our students the opportunity to *do* economics we restructured our sections of introductory economics in the following way: Two sections were combined into one large (60+) student lecture. The class meets as a "large" lecture twice a week and in smaller groups (20-22) once a week in a computer classroom. There are two practical advantages to this restructuring. The first is that students are able to use the technology within the format of a three-credit course. No extra lab meetings or outside class assignments are needed to "add on" the technology. Rather, the technology has become an integral part of the class. Second, the instructor saves one class meeting per week. Typically, the two sections would have six 50-minute meetings per week; with the new model, there are two 50-minute lectures and three 50-minute labs.

Outside of class, we have two important assignments that engage students with course material using technology. Our department has used spreadsheet exercises in introductory-level courses for many years. These spreadsheet exercises, written by department members, guide students through introductory and then more complex spreadsheet operations in the context of economic problem-solving exercises. Students learn to use technology as they would paper, pencil, or calculator, as a tool to aid in their understanding of sometimes complex economic concepts. As students move into upper-division economics courses, additional spreadsheet concepts (like regression analysis) are added, and they learn other statistical software and simulation packages (like E-Views and the Fair model). We believe that this has become a distinctive component of our departmental curriculum; technology is infused into the learning process from the introductory level on so students are able to engage actively in the learning process.

To further enhance student engagement with technology outside of class, students in our sections participate in online threaded discussions on issues of their choosing related to the course. This allows them to continue to develop discussions that started in class but that were cut short as the class period ended. It also encourages them to try out new terms and ideas that they are applying to the economic world around them. The discussion board encourages students to experiment with new economic ideas and applications in a non-threatening environment.

There have been several challenges, particularly during the pilot phase of the project. Our computer classroom facilities have a high level of utilization and there was no guarantees that we would receive priority. Our restructured format has also required that students who enroll in our sections have two free time codes in their schedule – one for the lecture and one for the lab. This has perhaps deterred students from enrolling in our sections. We have also experienced our share of technology-related "glitches", which frustrate and discourage students and instructors alike.

Also, the students themselves were not always as receptive to the technology and hands-on learning environment as we had hoped they would be. Acquiring some "ownership" of the learning environment was not a concept that they universally desired. We need to do a better job of refining our lab materials so that the students are more engaged and eager to complete them. To do this, we have developed exercises that must be completed outside class and we have provided "homework" credit. This form of reward often works with our students, who like to know what the "payoff" is to their effort and attention.

In terms of the course material itself, "losing" a third of our lecture time presented a challenge. During year one of the grant we wondered how we could cover the same amount of material and still provide students with the hands-on experience we so valued. What we learned is that some concepts are covered better in the lab and we were able to eliminate or greatly reduce discussion of them in the lecture. Experiential learning is a much more efficient way to deliver some course concepts, we just need to understand which concepts these are and develop lab materials that encourage students to take more responsibility for their own learning. We realized that we were initially thinking of the lab as a place to work on material that we had already lectured over; what we realized was that students did not need to be "briefed" before they entered the lab. The lab exercises could be structured as self-contained units, presenting students with entirely new concepts and applications.

As yet, assessment results regarding improvements in student learning are inconclusive. We are administering pretests in introductory micro in the fall semester, the same multiple-choice questions will appear on course final exams. We hope that we can use the results of these tests to gain insights into how student-thinking processes are affected by our technology-enhanced approach to the courses relative to more standard formats. We are using the Flashlight cost assessment model, which has allowed us to track resources allocated to this project. We have concluded that extensive use of technology for teaching is a time-intensive activity.

In terms of student satisfaction, results have been mixed. Some students embrace the technology and enjoy working in the lab environment. Others see the lab work as an "add on", or as extra work, and prefer to take strictly lecture sections. Going into the project we assumed that since students are using computer technology to shop, to communicate with their friends, and to download the latest music they would recognize the importance of using technology to analyze data and enhance learning. We have found, however, that we have to work hard to convince students of the importance of using technology in their academic lives. In terms of instructor satisfaction, having the opportunity to develop a new course with a colleague has been one of the most rewarding aspects of this project. We have also found that this sort of project has encouraged us both to think carefully about the goals that we have for our courses and students. In order to center our pedagogy around technology and active learning, we have relinquished "center stage" and find ourselves playing the role of co-learner and coach rather than all-knowing sage. This has at times been difficult, but we believe that our students will benefit by better retaining what they learn about the economy. We also believe that these active learning skills will serve them well as they move through the rest of their academic and work place lives.

Computer Information Literacy Modules (CILM): Educating Online Users about Computer Crime Prevention, Ethics and Morals in Digital Communities, and Effective Information Processing

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Abstract: This paper describes the need for and the creation of an innovative, web-based learning tool intended to provide interactive, hands-on learning opportunities for students and employees in various institutions and businesses. Specifically, the Computer Information Literacy Modules (CILM) educate people about the relevant topics of computer crime prevention, ethics and morals in digital communities, and effective information processing. Each module provides basic information about the subject matter, interactive case studies and simulations, a self-evaluation, and a test to evaluate the learner's competency.

Introduction

Computer and communication technologies continue to be at the heart of both changes and important development in the new century. It is vital to our global educational and economic systems that online users gain knowledge about computer crime prevention, ethics in digital communities, and effective information processing. This knowledge becomes increasingly important considering the number of people entering the online community, as well as the number of problems reported as a result of computer crime and misuse. The Pew Internet & American Life Project reports that the "online adult population has hit 56%, totaling 104 million, and 16 million new users ventured online in the last 6 months (*USA Today* Website, 2001). A 1997 Computer Security Institute survey indicates that "75% of US institutions, corporations, and government agencies reported financial losses in the past year as a result of computer crime" (McKenzie 1998). While many isolated web sites cover these issues, they do not provide an interactive, hands-on, problem-centered, and competency-based learning opportunity for online users. The Computer Information Literacy Modules (CILM) learning tool assures employers and educational institutions that every employee and student has an equal opportunity to learn a basic level of competency about healthy participation in digital communities and effective utilization of computer and communication technologies in one comprehensive package without limitation of time and place. The CILM has the potential to be a learning tool not only for all incoming freshman classes at Ball State University, but also for students in high school systems, students in other higher educational institutions, and employees in different branches.

The web-based Computer Information Literacy Module was chosen because 1) there are national concerns and demands for today's online users in general and students in particular to have adequate knowledge and skills about computer crime prevention, ethical and moral issues, and information processing; and 2) there is not a comprehensive, web-based, interactive learning tool similar to CILM on the market. The Internet technology fits well with most learners, who have other responsibilities and concerns such as job, family, distance, and insufficient time. In 2000, grant money was provided in order to design and develop phase 1 of the CILM project.

A Description of the Computer Information Literacy Modules

The initial design of the CILM project includes the following four modules: Module 1, *Computer Crime Prevention*, is intended to help learners understand the main issues of computer crimes and their prevention in computer and communication technologies and digital communities. Module 2, *Ethics and Morals*, is intended to prepare learners in the areas of resource utilization, privacy, intellectual integrity, copyright, and other common standards in open-access environments and digital global communities. Module 3, *Information Processing*, is intended to help learners gain needed knowledge in searching for resources, selecting needed resources from overloaded databases, and processing vast anounts of information for needed knowledge. Finally, Module 4, *Ball State University's Infrastructure*, is intended to provide an opportunity for students to gain needed knowledge about Ball State University's technology-based facilities and resources, procedures and standards for their utilization, and available support systems. This module can also help new faculty and staff members to learn about technology infrastructure and support systems at Ball State University.

The instructional design of these web-based learning modules is based on the constructivism model, which supports the active participation of learners in learning activities. The subject matter, case studies, and simulations are designed and developed based on current issues, events, concepts, models, and concerns at local and global levels. Each module has four sections. The key elements of each module's four sections include the following: 1) A *description* provides basic information about the subject matter of each of the four modules for learners. This section helps learners to develop theoretical knowledge about the subject matter and prepares them for activities in the next section. 2) Rich interactive *case studies and simulations* help learners to gain practical skills and knowledge about the subject matter through hands-on activities. This section of each module has several case studies and simulations to cover a variety of situations. 3) A *self-evaluation* provides learners with an opportunity to evaluate their level of knowledge about each subject matter. If a learner does not meet a certain level of readiness, then he/she will be advised about necessary additional study. 4) Finally, a *test* section evaluates the learner's competency in each module and permits the learner to advance to the next module. A central database system records all learners' test results. The results of each module can be available to various academic departments for class credit and to organizations for future planning and action.

The instructional design of the CILM is perfectly suited for an audience with different styles, backgrounds, abilities, locations, and commitments. The asynchronous learning modules will provide learners with the flexibility to complete each module at times that are most convenient for them. Individual participants will gain adequate skills and knowledge from the CILM learning tool through varying amounts of effort and time. The World Wide Web is perfect for the Graphical User Interface (GUI) design and interactive multimedia programming of the CILM project. Today, any reasonably equipped PC with a basic connection to the Internet provides a good platform to access the CILM learning tool from anyplace at anytime.

Conclusion

The four sections of each module are designed in a way that serve all different learners' basic needs. The description section will help all participants gain some theoretical knowledge about subject matter in each module. The case studies and simulations section will help learners gain practical knowledge in addition to theoretical knowledge. The self-evaluation section will help learners to evaluate their progress in each module and, when needed, advise them about additional learning activities. Finally, the test section will certify their adequate competency in subject matter and will record the results in a database.

Ball State University's Information Technology Office, Student Affairs Office, University Computing Services, College of Continuing Education, and Computer Science Department already support the development and implementation of the CILM project for students at Ball State University and online learners in different branches in Indiana. The quality of the modules will be ensured by adherence to the formative evaluation plan and content review by experts in the field. For legal issues and accuracy of the content, local experts will be asked to review content before it is published on the Web. Phase I of the CILM project, completed in December 2001, can be found at <web.bsu.edu/cilm/>.

References:

Internet Population Reaches 56% of US Adults. (Feb. 2001). *USA Today Online*. <http://www.usatody.com>.

McKenzie, S. (1998). The Enemy Within. *Global Technology Business* (April 1998). 46-47.

LEARNING FROM E-LEARNING: TRANSFORMING CONFERENCES

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Abstract: Effectively applied, the lessons the elearning community has learned about designing and delivering education and training at a distance can enable organizations to evolve new and potentially better ways of conducting conferences. Travel's high cost and inconvenience have often been cited as the impetus for rethinking the role of the classroom. These reasons, coupled with the economic downturn, have led to rethinking the need for and the role of professional gatherings. Technology has transformed education and training, and similarly has the potential transform conferences in ways that can be beneficial both to participants and those who would like to participate.

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INTRODUCTION

Based on the number of e-mails I've seen recently offering extended deadlines, it seems that a lot of conferences are not attracting as many submissions or advance registrations as they would like. It made me wonder if conferences are evolving in a way that parallels corporate training in that dwindling enrollments, budgetary pressures, and new technologies have led to an interest in online alternatives. Will the same factors lead to the emergence of the "blended conference"?

I can track much of my professional career by conference attendance — absorbing as much wisdom as possible at the early ones and eventually networking and presenting with relative ease. I find conferences a source of ideas and inspiration, as well as a way to assess trends and the state of the art. I like writing conference papers and giving talks, because it forces me to reflect and think clearly about a subject. The conferences I like best are the ones where I know a lot of people and meet new people with interests similar to mine[1]. I collect business cards and stay in touch with people, and have even made some close friends at conferences.

Today's lower attendance levels — caused by security issues and the economic recession — concern many of us who savor the learning and networking opportunities conferences represent. Now, these circumstances have brought us to a crossroads where the basic model for conferences is being reexamined. For example, instead of being multi-day events at a convention center or hotel, some conferences are conducted online. Many more take a "blended" approach, using technology for submissions, registration, and advance programs, pre-conference activities, and broadcast or archive sessions.

To look at the effectiveness of online or blended conferences, you first have to consider why people attend conferences in the first place: To learn and network. They're a break from work, and they offer a chance to meet people, get new ideas and insights, reflect, have a change of scenery, and eat good food. These are the same reasons employees like off-site training. Conferences are also an immersive experience where people focus on conference activities and other attendees while professional and personal concerns are largely left behind. Conferences foster a sense of membership or belonging in a professional society or discipline. None of these attributes requires technology.

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[1] "The many manifestations of organizational change - downsizing, outsourcing, merging, splitting, acquiring, partnering, and the constant redrawing of internal organizational charts" - have led to a situation in which workers become more dependent on personal social networks that cross organizational boundaries. Conferences are among the best ways to establish and refresh the "intensional networks" defined in http://www.firstmonday.org/issues/issue5_5/nardi/index.html..

MOVING CONFERENCE ACTIVITIES ONLINE

Methods can be developed and refined for integrating online and in-person conference components in a kind of blended-learning approach. Teachers are well aware of the advantages of combining online and classroom activities: Pre-class activities reduce the quantity of in-class time spent covering basics, and they help level the playing field on which students tackle a new subject. Classroom time is spent on activities where face-to-face contact is most beneficial. In theory, these advantages can be applied to conferences.

When conference Web sites link to abstracts and papers, attendees can plan their schedules better and prepare for sessions. Both attendees and people who can't attend the conference can participate in e-mail discussions, virtual meeting places, or discussion forums. One blended-learning-like result is that actual conference time is used more efficiently. ASTD, www.astd.org, for example, has successfully implemented some of these components for its annual conference.

CHI 2002 offers CHIplace, www.chiplace.org, where anyone can set up a profile, see who else is there and what their interests are, preview and comment on papers, and discuss conference-related topics. I'm sure the most heavily accessed part is the personal profiles. I especially like the feature that generates random pictures of participants. It's similar to the serendipity of running into someone at a conference break. Unfortunately it doesn't provide the interaction or awareness indicators that make breaks so much fun.

MOVING CONFERENCE SESSIONS ONLINE

Some conferences Webcast sessions, which is not unlike COMDEX's broadcasts of popular sessions to overflow ballrooms. Some conferences archive sessions online as well. When I consider the benefits of Webcasting and archiving, I am reminded of my experiences teaching online: In general, it's hard to engage both present and distant audiences. The one time I was Webcast while presenting at a conference, I had trouble ignoring the cameras and focusing only on the audience. Then there are the speakers who present by videoconferencing to a "live" audience, which rarely is the same as being there for speaker or audience. However, I imagine the people "watching" — hard to call it participating — these sessions think it's better than not being able to listen to the talks at all.

PUTTING A CONFERENCE ONLINE

How can fully online conferences be made effective? Ultimately, the answer parallels the familiar e-learning/classroom debate: Rather than trying to figure out how to reproduce a conference as an online event, we should try something different online that exploits our delivery technology's capabilities for superior results.[2] Cost, comfort, and convenience are potential benefits of the online format.[3]

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[2] David Eastment, in the Guardian, http://education.guardian.co.uk/elearning/story/0,10577,603226,00.html, wrote about attending a fully online conference and thought it was "better online because you can flip forward and back through the presenter's screens rather than simply follow what is being said, and you can get up and stretch when you want" and switch sessions without stepping on toes. Eastment pointed out that "only a few presenters had had previous experience of speaking to an unseen audience," but, in general, conference presenters vary widely in how good they are, and there may be better opportunities to provide coaching for first-time online presenters.

[3] In some recent experiences organizing an on online seminar (Kim Vicente speaking about Cognitive Task Analysis, www.ctaresource.com) feedback was largely positive, including "I thought that it was a great way to hear a speaker. No

How much are people willing to pay for an online conference or online portions of an in-person conference? Online conferences and seminars are usually free, although I have seen a few charging high fees. There is a cost to using technology, and conference organizers may fear that, in using a blended approach, they lose attendees who prefer to participate online.[4] Over time we'll find out if online programs provide a viable option for those who wouldn't otherwise attend a particular conference at all, or if these programs are most successful at getting people excited about in-person attendance.

THE FUTURE OF CONFERENCES

Let's go back to my original list of reasons people attend conferences in person: education, networking, break from work, chance for reflection, new ideas, a change of scenery, good food, and a sense of connectedness.

I got my job by networking at a traditional conference, and it's hard to imagine replicating that experience online. And what's the likelihood of an online conference giving you a break from work and a chance for reflection? Limited, at best; in fact, the opposite is probably true. Because online conferences are typically crammed into existing work hours, frustration and fragmentation are the likely outcomes. The change of scenery and good food I can get on my next vacation. But the sense of membership or belonging is harder to acquire online. In-person conferences excel at promoting connectedness, scheduling breaks and receptions to increase physical presence, and using badges, t-shirts, and bags for a sense of inclusion.

Where can technology help further? At any multi-track, in-person conference, it would be great to know more about what you missed. I'd like to be able to replay some sessions, although I understand the dilemmas organizers face in determining how to price those capabilities and offer them in a way that doesn't lower registration numbers. I miss sessions because I'm talking to someone in the hall, and that experience is much harder to facilitate with technology.

Since I'm not great at standing up during sessions to ask questions, I'd like the opportunity to make queries online and see others' questions and answers. Presenters, attendees, and people participating at a distance could all use such a resource. While the prospect of piled-up work and full in-boxes may inhibit participation in post-conference discussions, extending the conference experience online may be the best way of increasing conferences' relevance back in the "real" world.

Based on where technology is now and how people and organizations respond to technology-delivered courses, I don't believe that online conferences are a substitute for on-site ones. Online conferences may be valuable for what they do offer: more diversity in the participants and more flexibility to reflect on and apply concepts. Current technologies, even telepresence, cannot replicate the immersive experience of in-person conferences.

We are still at an embryonic stage in the application of technology to conferences. Conference organizers are experimenting with and evaluating different approaches; the results to date have been interesting, as have been the diversity in their approaches. People's expectations of and comfort levels with technology change over time, and this, in conjunction with further experimentation and innovations, may be what ultimately leads to new and more successful models for technology-enhanced conferences.

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airfare, no conference fees, no hotel to pay for. It ... allowed people who would otherwise never get the chance to hear an accomplished person in the CWA field." "I loved being able to sit in my office… and put my feet on my desk."

[4] Duke University's Fuqua School of Business charges more for their online MBA program because people are willing to pay for the convenience. When they started their online MBA, they must have been concerned about it drawing students away from the campus program.

Implementing Technology Integration at the University Level: A Case Study of Changes in Faculty Behaviors and Attitudes

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Introduction

Modeling of technology integration by university faculty into their respective course delivery structures is a crucial element in the preparation of technologically proficient teachers (OTA, 1995; Topp, Mortenson, & Gradgenett, 1995; Wetzel, 1993). These "teachers in training" need to experience technology within the context of both their learning opportunities at the university and their student teaching experiences in the field setting. In order to model this type of framework within their pedagogy, university faculty must change attitudes and behaviors toward the use of technology (Joyce & Showers, 1983; Schrum, 1999). As Strudler and Wetzel (1999) assert, the "goal of technology integration is a moving target" (p.80), and therefore cannot be studied in a vacuum. Rather, faculty must be dedicated to beginning and/or continuing professional development of their own technology proficiencies within the dynamics of their learning organization. Furthermore, they must be cognizant of the extensive technology proficiencies required by state teacher certification standards. The following proposal details a local experience relating to a technology integration project designed to support the ongoing refinement of faculty technology skills within the context of the teaching and learning situation.

Important Features of Project

The Learning and Integrating Knowledge and Skills (LINKS) project is a three-year technology project is designed to integrate established and emerging technologies into the teacher preparation curriculum at the Texas Woman's University (TWU) and is supported by a U.S. Department of Education, Preparing Tomorrow's Teachers to Use Technology (PT^3)

implementation grant. The LINKS program supports both changes in university faculty roles and changes in curriculum content and delivery.

This paper addresses two primary questions: (1) how were the development of faculty technology proficiencies supported and (2) what was the progress of the participating faculty in infusion of technology in university web-based course delivery? To address these questions, second year findings regarding the examination of changes in faculty attitudes and behaviors and the effectiveness of the implemented LINKS project are provided.

Description of Problem

Integration of technology into university course delivery provides an essential model for pre-service teachers. Pre-service teachers recognize that, throughout the teacher preparation required coursework, they are expected to demonstrate technology integration skills prior to student teaching. Therefore, these future teachers expect university faculty to model these behaviors within the context of their university learning experiences. Increasingly, faculty from Arts and Science as well as from Teacher Education recognize the need to model within their own course delivery a variety of ways to integrate technology into teaching and learning. This faculty challenge encompasses both the new technology proficiencies and contemporary issues in pedagogy.

Description of Need, Population, and Implementation of Project

Need

A needs assessment from a purposive sample of current faculty addressed faculty needs relating to the integration of advanced technology tools into course delivery. Their perceived critical needs were in four areas of: (1) productivity; (2) connectivity; and the integration of technology.

Faculty members see **productivity** as a priority including support in development of their skills related to multi-media presentations and the creation of a professional web page for use in classroom instruction and communication with pre-service teachers. The survey data indicated the need for training to extend their multimedia presentations with more advanced media tools and the use of **connectivity** tools such as the World Wide Web and asynchronous and synchronous forms of communication.

In order to provide a model for our pre-service teachers, faculty must **integrate technology** into the design and delivery of all instruction. Advanced forms of technology must be infused throughout all courses, not just a separate technology method course, as transparent tools for thinking, learning, and constructing new knowledge. According to survey data, support for the use of web-based curriculum and instructional materials were high priorities for the faculty. They identify their need for training in evaluation and utilization of advanced forms of media, of content related Internet resources related to content areas, and of appropriate CD-ROMs and content-specific software.

Beginning in the spring of 1999 the LINKS program for faculty was created and implemented to respond to these perceived needs.

Population

Faculty volunteers from a variety of disciplines were recruited to attend technology-training sessions began September 2000 and were completed in April 2001. These faculty members were recruited from the group responsible for coursework within the teacher education sequence. Their only compensation was the use of a University laptop outfitted with web page browsers, Microsoft Office, multimedia software, and Ethernet connections for the duration of their participation in the LINKS project. This volunteer sample of university faculty (N=20) registered for each LINKS training session one week before the session date. If vacancies became available for any session, the training on that day was opened to interested faculty from the College of Professional Education and the College of Arts and Sciences. At each session data were collected on faculty stages of concern, levels of use, and perceptions of the effectiveness of the training they had received.

Implementation of Project

Training Goals. The primary training goals were: (1) the introduction of LINKS standards and resources, and (2) support for faculty delivery of web-based courses as models for future teachers. The goals were addressed through two types of sessions. Hands-on professional development sessions focused on specific areas for remediation or for more advanced work and whole-group development sessions addressed broad topics essential to all participants.

Training Session Overview. All sessions served as an orientation to the required technology proficiencies Texas pre-service teachers are expected to master and demonstrate. To provide a cohesive model, faculty were encouraged to integrate technology into the design and delivery of their instruction. These sessions also served as a training vehicle for the preparation of web-based course delivery via Blackboard, the University's web-based course delivery template.

Fourteen sessions were available throughout the 2000-2001 year, seven per semester. These two-hour sessions were delivered in a University computer lab providing Blackboard access. All materials were available on a "class" Blackboard site for later reference. By using a web-based course delivery system to communicate with faculty participants, meaningful learning was integrated into their own web-based course development.

LINKS infused advanced forms of technology throughout training sessions as transparent tools for thinking, learning, and constructing new knowledge. Integrating technology as a transparent tool includes the use of advanced forms of media such as optical technology, scanners, video and sound, digital and document cameras, and streaming video.

Many sessions were designed as hands-on workshops. Faculty were encouraged to bring course materials, syllabi, graphics, and other materials to use as they converted traditional courses to the electronic medium. LINKS provided practical printed reference materials, related web page URLs, and individual assistance as needed. Additional one-on-one assistance was available from

LINKS staff by request. Personnel from Information Technology Services (ITS), the Distance Education Support Team, and from the library services collaborated with LINKS personnel in organization and implementation of the training.

Training Session Topics.

- *Session I: Orientation and Data Collection.* A whole-group session which served as an orientation to the LINKS project and PT^3, including student and faculty benefits. The research methodology was outlined, and data was collected via online tools.
- *Session II: Exploring Internet Resources.* A whole-group session designed as an orientation to TWU Library resources, search engines, and other tools.
- *Session III: Searching Without Losing Your Composure.* A hands-on session with step-by-step procedures for searching the Internet using tools available on the Internet.
- *Session IV: Getting Your URLs Organized and Creating a Virtual Office.* A hands-on session designed to organize favorite and frequently used resources into directories for Bookmarks or Favorites.
- *Session V: Introduction to Blackboard.* A whole-group session designed to address questions concerning the creation of courses, getting access from a remote location, and managing information and sharing information in the course.
- *Session VI: ABC's of Preparing Documents for Blackboard.* A hands-on session which discussed the philosophy of organizing course materials.
- *Session VII: Shortcuts and More.* A hands-on session with an emphasis on keyboarding and toolbar shortcuts in Microsoft Word and PowerPoint.
- *Session VIII: Exploration of Blackboard.* A whole-group session which covered upgrades from Blackboard 4.0 to 5.0. Collection via online tools was also administered.
- *Session IX: Adventures in Uploading for the Tentative.* A hands-on session that related to the uploading of documents into Blackboard for the novice user.
- *Session X: Cliff Walking on the Rocky Blackboard Range.* A session for the more experienced user that related to uploading different document types.
- *Session XI: Refinement of Blackboard.* A whole-group session specifically related to information dissemination addressing pedagogical issues pertaining to Blackboard. Speakers discussed recent finding from EduTex, a regional conference of EDUCAUSE, in San Antonio. Spotlighted were best practices and how other TWU faculty members are using Blackboard.
- *Session XII: Beyond Simple Documents.* Adding PowerPoint presentations and graphics to online classes.
- *Session XIII: Braving New Frontiers.* Using HTML coding.
- *Session XIV: Symposium and Data Collection.* A whole-group session that consisted of closure, overview of lessons learned, best practices models and presentations, and online data collection.

Data Sources. The purpose of related research inquiry and associated program evaluation of the LINKS project was to assess the changes in faculty behaviors and attitudes related to the integration of technology and to measure the effectiveness of training. Intrinsic to the examination of behaviors and attitudes of participating faculty was the use of the Concerns Based Adoption Model (CBAM). The module was developed by Hall, Wallace, and Dosset (1973) at the University of Texas at Austin Research and Development Center for Teacher

Education. Because the faculty could be followed and supported as they adopted the innovation (i.e., use of a web-based course delivery system), the CBAM model was implemented with this population through the Stages of Concern Questionnaire (SOCQ) and the use of a modified online survey structured from the Levels of Use (LoU) interview process.

Hall et al. (1973) discovered that an individual progresses through three clusters of concern as she or he adopts an innovation--self concerns, task concerns, and impact concerns. Three diagnostic dimensions were identified that are used to monitor a person's progress through these stages: Stages of Concern Questionnaire (SoCQ), Levels of Use Interview (LoU), and Innovation Configuration (IC). Both the SoCQ and the LoU were used to assess progress toward innovation adoption or the IC.

To gauge the effectiveness of the provided training opportunities, faculty completed evaluation questionnaires at the end of each two-hour session. The evaluation questions related to the session's impact on their motivation to apply new knowledge and skills and the ability to use technology more effectively in the classroom. Additionally, an overall perception of session quality was obtained. The evaluations of individual training sessions were utilized to refine management and enhance training in subsequent semesters.

Analysis. Pre- and posttest data were collected for the SoCQ and Levels of Use. Parametric paired-sample t-tests assessed differences across time. Qualitative analyses were conducted for open-ended items on session evaluation forms.

Implications for the Local Setting

The primary goals for the university faculty were introduction of the LINKS standards and resources, and support for faculty delivery of web-based courses as models for the future teachers. Descriptive statistics and profiles for the SoCQ suggested that the faculty had high informational and personal concerns as well as increased consequence and collaboration concerns. These types of concerns are consistent with movement through the change process. Analysis of the LoU revealed that all individual faculty made significant progress in levels of use, although they began at different levels. Qualitative analyses of open-ended evaluation questionnaire items suggested issues related to individual technical ability, to the time needed for implementation and integration of technology, and to the applicability of new learning to specific teaching situations. Additional analyses of implementation data have been conducted and will be reviewed during the course of this paper presentation.

The LINKS project provided a wealth of training opportunities for TWU faculty volunteers relative to the teacher preparation program. The following are key findings:

- Personnel from various campus departments collaborated to deliver staff development for faculty.
- LINKS training was tailored to accommodate faculty' broad range of technology abilities.
- LINKS activities raised university faculty' awareness of technology proficiencies needed by future Texas teachers.

- LINKS training positively impacted university faculty' motivation to use and capacity to integrate technology.
- Suggestions for training improvement centered on the individualization of training to meet faculty' particular needs.
- Faculty' main concerns centered on time, personal skill proficiency, skill retention, and resources.
- Faculty' concerns with web-based course implementation, as measured by the SoCQ, changed over time.
- Progress toward higher levels of web-based course delivery use varied for particular faculty.

Implications for External Settings

Even though the benefits of technology integration has been well established in the literature, the United States Department of Education (USDE) finds that "relatively few teachers (20%) report feeling well prepared to integrate educational technology into classroom instruction" (2000a). In a separate report, USDE suggested that "teachers have been prepared for a model of teaching dramatically out of step with what is needed to prepare the nation's students for the challenges they will face in the future" (USDE, 2000b). Findings presented regarding the implementation and effectiveness of the LINKS project has implications for increasing the technology proficiencies of entry-level teachers as well as providing a model for other universities undertaking similar changes and institutionalization efforts. Findings have particular relevance to explain how university faculty can be nurtured and supported as effective models of technology use in web-based course delivery and electronic communication with students.

Through the examination of the change process and the utilization of this information to support faculty to become users and modelers of technology, multiple benefits are evident. By providing a supporting scaffold, university faculty become less fearful of change and their attitudes take on a willingness to engage in increased learning experiences. When pre-service teacher witnesses technology integration within the auspices of their university coursework they are more likely to adopt the same technology integration and model that back to their future students thus encouraging a true technology integration model.

References

Hall, G., Wallace, R., & Dossett, W. (1973). *A developmental conceptualization of the adoption process within educational institutions* (Report No. 3006). Austin, TX: University of Texas at Austin Research and Development Center for Teacher Education. (ERIC Document Reproduction Service No. ED 095 126)

Joyce, B. & Showers, B. (1983). *Power in staff development through research on training.* Alexandria, VA: Association for Supervision and Curriculum Development.

Office of Technology Assessment (1995). *Teachers and technology making the connection.* Washington, D.C.: United States Congress, Office of Technology Assessment.

Schrum, L. (1999). Technology professional development for teachers. *ETR&D, 47* (4), 83-90.

Strudler, N. & Wetzel, K. (1999). Lessons from exemplary colleges of education: Factors affecting technology integration in pre-service programs. *ETR&D*, 47 (4), 63-81.

Topp, N.W., Mortenson, R., & Grandgenett, N. (1995). Building a technology-using faculty to facilitate technology-using teachers. *Journal of Computing in Teacher Education, 11* (3), 11-14.

United States Department of Education. (2000a). *The secretary's conference on educational technology: Measuring impacts and shaping the future.* [WWW document]. URL http://www.ed.gov/Technology/techconf/2000/report.html

United States Department of Education. (2000b). *E-learning: Putting a world-class education at the fingertips of all children.* [WWW document]. URL http://www.ed.gov/Technology/elearning/index.html

Wetzel, K. (1993). Teacher educators' use of computers in teaching. *Journal of Technology and Teacher Education 1* (4), 22-27.

First Steps in Telelearning –

Simple and most flexible ways to realize distance-learning with children at the age of 6 – 10 years

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Abstract: First steps in Telelearning is the title of our project (started at the beginning of the schoolyear 2001/02) in which we try to evaluate methods of telelearning for children at the age of 6-10 years. We are interested in the aims, chances and borders of telelearning at this age.

1. Introduction and Basic Information

Our main intention is to find out, how models of telelearning could be adapted for children at the age of 6 to 10 years: We try to find out, which basic-skills are absolutely necessary to enable children to use telelearning tools. We are interested to find and evaluate ways to guide children to a self-motivated and self-guided learning and try to find out the limits of telelearning-projects for children at this age.

2. First steps: Training of basic competences in using IT

Before starting the telelearning-project itself, we had to train the kids (and some teachers) the basic skills in using computers and modern IT. To motivate children we always start with very simple and easy computer games and similar things: Using Windows and its basic functions, use of very simple standard-software (wordpad, paint, …), first steps in handling data, ...

3. Network-Technology

First steps in understanding network-technology: Right from the beginning we are using the network: We "force" the children to save their data on network-drives. Beside that we begin to communicate using the LAN. Then we start *the first steps in the www* ("guided tours", finding & saving information, …) with a short basic training. After that children should find different informations (using different search-engines). While training the basic internet-skills children are also learning to use mailing to communicate: Each child creates his own mail-account (webbased) and sends/receives e-mails. Another part of our "basic-training" is to use chat-engines: Pupils begin to chat using an Austrian chat-engine, created by Prof. Dr. Rita Humer (Pedagogic Academy) especially for children (www.antonwelt.at).

4. Netmeeting

As a consequence of our idea to base our project on standard-software and very common used tools, we mainly use software-products of Microsoft. MS Netmeeting enables us to communicate in a simple way in our LAN as well as in in the www.

5. First Telelearning-Projects

Our first projects & tests were based on projects and contents of regular lessons: The pupils began to use MS Netmeeting as a part of the "daily school-life": *Contacts to parents, contacts to different "professionals"*. The

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first challenge was to take part at the *"Interpaedagogika 2001"* (November 8^{th} – 10^{th}, 2001) with 20 of our pupils: Ten pupils in Linz (at the fair) and ten in Vienna presented how to communicate with netmeeting & "antonchat" (www.antonwelt.at). As a consequence of the special knowledge of those children, they could also present the possibilities of application-sharing and worked together with different software-products (to show, how to solve several problems together using the web). Another part of the presentation was working with word and excel in a "long-distance-team". In the future we plan to establish *National & International Partnerships:* We initiated a partnership with a small school in Salisbury (country). Now the children have the opportunity to learn to communicate with "strangers": They have to get to know each other by the web-based communication. The latest project and next step is to organize an international partnership wit h schools of other European countries: The "Comenius-Programm" is the basis for this plans. - ***We are interested in establishing a longer lasting partnership: Pupils of the different countries shall learn about each other and about the different hometowns/countries.***

6. Accompanying projects and outcomes

Another part of our work concerning our telelearning-project is to enable the pupils to use the opportunities of modern distance-communication and IT for their school-duties, their individual learning and their daily life. *"Learning at home"* - Home exercises, using e-mail, encourage special interests: We noticed, that some pupils began to communicate with members of their family, they did not see every day: For instance there are some children, whose parents are divorced. They by themselves began to communicate by using e-mail, chat-engines and MS Netmeeting to establish contact.

7. Problems & Limits

First there are *technical and software-problems:* e. g. bandwidth; most of the user-interfaces (hardware and software) are not created for children's use.
On the other hand there are *problems and limits of telelearning especially for children at this age*(6 – 10 years) as there are:
Usage of the mother tongue: Children are taught to read and to write at the age of six years. But this culture technique is the minimum base for the use of "usual" tools of modern IT and web-based communication:
- *Capability of reading:* Reading speed of pupils at this age is very low; so they need much time to read the informations they are given by the computer-human-interfaces.
- *Capability of writing:* Children are able to type letters, but they are typing very slowly – the speed of text-based communication often is to low. Therefore it is very important, to work with video-/audio-support or by using very intuitive graphic-interfaces (bandwidth!).
- *Language-style of the children:* The development of the language-style is very intensive at this age. So children are often not able to express what they mean. While they mostly can speak out their thoughts orally, they are not able to do this by written language in the same way).

Foreign language: The most important "computer-language" is English - but usually children begin to learn this foreign language when they start school. But most of the the web-information is in English and so our German speaking children are not able to use them!

8. Accompaning Measures

Teacher education and advanced classes for teachers with experience in working with computers: We always try to involve students of the Pedagogic-Academy to our project: It is also a very important aim for us, to motivate and enable them to use IT for their future educational work. Another very significant part of our project is to *teach the teachers*: Most of those teachers were able to handle their computers but did not have the necessary skills to train their children in using web-based communication tools. So we had to organize special workshops and lessons to train teachers. Since that we are organizing special workshops in cooperation with the Pedagogic Institute of the Archdiocese of Vienna.

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Making Web-based Learning Adaptive

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Abstract: This work stems from a project funded by the Arthritis Research Campaign (ARC) to develop a web site, *JointZone*©, for the study of Rheumatology for both undergraduate medical students and practicing doctors. The educational application incorporates both declarative and procedural knowledge, providing students with a chance to acquire knowledge on rheumatic disorders as well as develop clinical reasoning skills through a series of graded case studies. In order to enhance learning and reduce cognitive overload, which can be associated with hypermedia environments, adaptive hypermedia techniques (Brusilovsky 2001) have been integrated into the core of a web-based learning environment. This paper discusses the adaptive features employed and the pedagogical rationale involved in developing the web site.

1. Introduction

Resources in an information-rich hypermedia environment allow users to browse the material in an informal way until something of interest commands greater attention. Alternatively, they may search the material in a goal-directed manner to find the information they need. The former is analogous with an informal learning environment (Duchastel 1989) where one's attention skims a wide range of information. However, a corpus of information in a hypermedia environment is not necessarily an ideal learning environment as it is essentially 'non-pedagogical', and generally provides minimal structural support (Duchastel 1992). However, this mode of learning can be effective if the reader already has a fairly well developed schema (a personal construct of related information) for the material being read. A schema acts to filter incoming information and provides a framework for processing information. For a well-developed schema, paying scant attention to material as often happens when browsing, is very often enough to modify a schema, and hence learn. Practitioners, or those knowledgeable in a field therefore, may use this technique in a casual manner and informally upgrade their knowledge of a subject. Novices on the other hand, with less well-developed schemas, are more easily overwhelmed and quickly suffer from cognitive overload. General browsing therefore is not necessarily an effective learning method for them (Mayes et al. 1990). Goal-directed learning on the other hand is more focused, affording a greater opportunity to attend to the material. It is important therefore to provide guided support, or scaffolding for novices while allowing the more advanced reader to move more quickly through the material. The nature of hypermedia as a searchable network of information can enhance goal-directed learning through effective search facilities while also allowing easy access to a wide variety of material for browsing. However, both these functions of hypermedia can still lead to a cognitive overload (Thuring et al. 1995) as even with goal-directed learning a vast array of linked resources can be presented to the learner. Adaptive hypermedia is one approach that takes into account the reader's knowledge level and can present an appropriate selection or an adapted set of content nodes - adaptive presentation. It can also provide adaptive navigational support offering a selection of links based on reader knowledge and, or readers' browsing history (Brusilovsky 2001). In both these cases, adaptive mechanisms support the reader by offering a guided set of documents/ or links with the aim of reducing the cognitive overload, thus enhancing the reader's ability to attend to pertinent documents and learn. In view of these issues, our task within this Rheumatology project has been to place learning materials online which ensure coherency and a good accessibility to information without causing

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disorientation. Since we are using a closed corpus of information, we are able to collect information from the user on entry which is used to develop a supportive learning environment through adaptive hypermedia techniques.

Three major roles have been involved in the development of this project to encourage effective web-based learning. There is the *web author*, whose major responsibility is to develop a coherent information model employing adaptive hypermedia techniques, changing a static website into a dynamic one with tailored links and navigational aids to enhance orientation and reduce cognitive load. There is the *domain expert*, whose role is to provide information (declarative knowledge) on various topics within the domain, and learning material that encourage readers to structure this knowledge by constructing relations between pieces of information (structural knowledge). In addition, an opportunity is provided for readers to interpret various elements within a virtual clinical interview (procedural knowledge), emulating the activity of an expert practitioner (Jonassen 1991). Finally, there is the *education expert*, whose role is to understand the structure of the domain, anticipate the needs of readers and their potential understanding of the content at any given point. This role offers advice on learning support and scaffolding strategies that enhance readers' ability to develop their current schemas, construct new ones and develop cognitive skills that allow them to apply the knowledge they have within their professional context.

In this paper we shall first outline the implementation of *JointZone*© and our pedagogical approach in developing readers' procedural knowledge through a cognitive apprenticeship model. Then we shall explain the adaptive mechanism employed in *JointZone*.

2. Implementation

When constructing a framework for the *JointZone*© application, an information model (see Fig. 1) was developed to feature three types of 'separation' (as described in (Lowe & Hall 1999, p.67)) namely: the separation of presentation code from information (content), the separation of links from content, and the separation of logic from information.

These three features were taken into consideration in the design in order to reduce the authoring effort by re-using the resources and to facilitate the maintenance of the application. As shown in Fig. 1, the information model outlines the different entities in the application (content, user data, link data, presentation code and logical data) and they are implemented using different web technology to emulate the notion of separation of concerns.

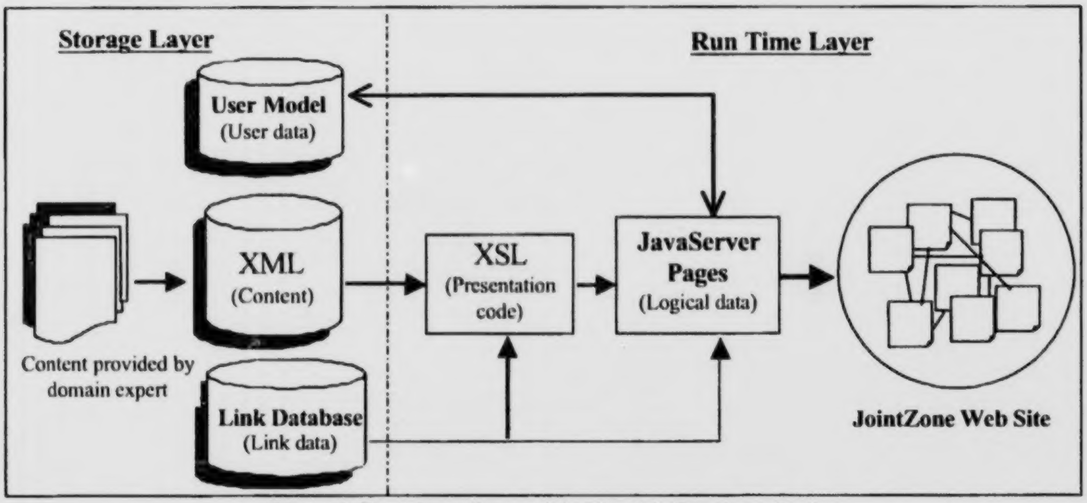

Figure 1: The information model of the *JointZone*© application

The latest web technologies such as XML[1], XSL[2] and JavaServer Pages ™ have been used to implement the model. XML is used to store and structure the content while XSL is responsible for its presentation style. This allows data to be separated from information and encourages information re-use. For example, the same copy of XSL style sheet can be used to display more than one XML page. Likewise, only one copy of XML content is maintained even if it is presented in different ways in the browser. On the other hand, the logical bits of the web site, i.e. session tracking of users' activity, the adaptivity engine and the search mechanism have been implemented using JavaServer Pages ™ (JSP). The JSP technology allows the integration of Java™ codes into HTML pages to facilitate dynamic content generation, which makes the adaptation of links and contents possible. In short, all the components described above contribute to the notion of separation of concern, which facilitates maintenance.

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[1] XML (Extensible Markup Language) is the markup language that provides a mechanism for inventing new elements.

[2] XSL (Extensible Stylesheet Language) is the style sheet that renders the presentation of XML on a web browser.

We employ link databases or *linkbases* (Hall et al. 1996) to store links separately from the documents to which they refer. This implies the separation of links from content. Links are not only a means to traverse the web site but also embody the semantic relationship between the nodes (web pages). Proper link management therefore is essential for the orientation and usability of the application. From the perspective of learning, good management of links can reduce users' cognitive overload that can result from poor orientation and navigation facilities. Hence we employ the use of different types of links to better manage the linking of information pieces. We adopted the following link taxonomy from (Lowe 1996, p. 33):

Structural links illustrate the structural layout of the web site. These include 'jump' links within a page to provide direct access to page fragments, 'next' and 'previous' page links that ensure coherency between the documents, and the provision of the 'table of contents' to give a meaningful overview of the information site.

Referential links are essentially glossary links that relate a word in context to its definition. The main difference between structural links and referential links is in their linking mechanism. Referential links are abstracted from the idea of generic linking (Hall et al. 1996) where links are not embedded inside the documents but stored in the link databases. They can appear anywhere in any document where a glossary word exists. Hence these links are not handcrafted but automatically generated using an offline pre-processing mechanism, another feature that eases authoring effort. The glossary links are highlighted in green and are resolved in real time from the link database once followed by the users. The effect will be a pop up window explaining the word that a user has selected. From the learning perspective, the glossary links are useful for learners to expand their knowledge of the terminology within the knowledge domain.

The idea of generating *associative links* comes from the usual phenomenon of users browsing in the current context to find more information about a particular concept. For example, when users are reading a document or solving a problem that concerns concept 'X', links to other documents are suggested, which they could find out more about 'X' in other documents (Lowe & Hall 1999). Hence, these links are called associative links because they associate two or more documents based on a common concept. Associative links are stored in a linkbase where each of them is indexed or retrieved based on a keyword or concept. From a learning perspective, this link type is used for goal directed learning where the user will search on a concept to find a series of related documents.

3. Learning Issues

JointZone© provides a rich source of material to enrich users' domain (declarative) knowledge in: basic science, rheumatic disorders, approach to patient, investigation and disease management. This network of information can be used by all readers in a browsing or goal-directed learning mode and is suitable for medical students and practising doctors. Information can be found using the site's internal search engine or selecting sections from the side menu bar to reveal documents, and as documents are selected, their linked structure becomes visible on the side menu. However, domain competence is more than domain knowledge, it also comprises a whole range of skills and for medicine, skills based competence is vital. These skills are: a) physical, e.g. equipment and procedures and, b) cognitive, e.g. analysis, interpretation and decision-making. It is the cognitive skills that demand a more sophisticated learning process if they are to develop (Kinshuk 2001) and with adaptive hypermedia mechanisms we are able to match the content level with the student's knowledge through interactive case studies. A case study approach was adopted for *JointZone©* as it can holistically represent the complexity of clinical reasoning. Students are then able to develop their procedural knowledge, which elaborates how doctors approach problems, interpret clinical information and make decisions (DesCoteaux & Harasym 1998).

3.1 Developing Cognitive Skills through Procedural Knowledge

Some of these critical skills and processes that medical students need to learn are decision-making, reasoning and problem solving (Greening 1998); essentially skills that relate to a clinical diagnosis and management which is a pivotal activity for all physicians (Nkanginieme 1997). To develop these skills, it is important for students to practice relating disparate pieces of information from a patient within the clinical context. The graded case studies in *JointZone*© provide clinical medical education that develops students' clinical reasoning skills within the domain of Rheumatology.

The *advanced* case studies were developed to encompass a wide range of information available in the clinical context. These were generated following a heuristic analysis of the clinical decision making process by an expert practitioner. Our analysis reflects the cognitive skills identified by Nkanginieme (Nkanginieme 1997), namely that physicians: a) obtain and recognise symptoms in the patient, b) identify the appropriate system involved, c) speculate on the pathological processes, d) differentiate pathological processes, e) identify the possible causes of the pathology, f) evaluate all pieces of information and make a clinical diagnosis. To support student development of these cognitive skills, explicit procedural steps for the clinical interview were presented: the referral letter, patient history, the examination, investigations, diagnosis and clinical management. On working through these stages, students are confronted with a wide range of options, such as results from investigations: diagnostic imaging, haematology, immunology, microbiology, serology, and synovial fluid aspiration, which give students information pertinent to the case under study. The clinical observations they gather by working through the case study are recorded so the student has ongoing access to this information as they proceed. At the diagnostic stage, students are given a complete record of the examination findings and investigations. If the system feels insufficient or inappropriate information has been gathered this will be pointed out to the student. From a list of possible diagnoses, students select their preference based on their interpretation of clinical information gathered. They then obtain subsequent feedback on why that diagnosis is likely to be appropriate. This feedback, and the feedback across all case studies, makes explicit the expert's heuristics of clinical reasoning. This is an attempt to share that clinical expertise through a modelling or a cognitive apprenticeship (Collins et al. 1989) approach, and it displays the underlying principles and rationale of the clinical diagnosis and completes the process. This enables students to develop their cognitive skills, providing a framework for problem solving and hence clinical reasoning.

Case studies for *beginners* and *intermediate* level students are much narrower in scope and the choices are more restricted. However, as with the advanced case studies, the feedback mechanism serves to model expert thinking in how to solve these problems. The goal for beginner case studies is to recognise the value of particular pieces of clinical information, identify the pertinent investigations and make a diagnosis. For the intermediate students, the goal is to reassess a case in which the original diagnosis is under question. For both these levels, students are given scores on their performance in reaching a diagnosis. A random selection of items is penalised. Through these case studies, students learn to recognise and interpret the value and relevance of disparate pieces of information that are integral to any clinical scenario. In this way students construct their own understanding of the relationship between the pieces of information rather than having it imposed upon them. This encourages a cognitive flexibility (Spiro et al. 1992) that is vital for the complex world of the physician.

3.2 Bridging the Declarative and Procedural Knowledge Adaptively

At the end of all case studies, students have access to an 'adaptive reading room' (see section 4) where links to pertinent domain knowledge are made available. This adaptivity feature gives advanced users a wider range of pertinent documents than those with less knowledge. An example of this is for the concept 'osteoporosis', advanced students have access to the following sub-concepts: *osteoporosis*, *crush fracture*, *densitometry*, *bone scan*, and *corticosteriod* while intermediate students have access to *osteoporosis*, *crush fracture* and *densitometry*, and beginners have access simply to *osteoporosis*. However, there is no restriction to information for any user group should they wish to investigate further. The list of suggested reading titles is identified for each case study and presented adaptively. Each document title in the list will indicate the amount of attention that reader has already paid to the particular document through a green icon indicator alongside the title, (see Section 4). Hence, the 'adaptive reading room' and the textual glossary links throughout all cases act as a bridge between declarative and procedural knowledge in the application.

4. Integrating Adaptive Features

We have briefly mentioned adaptive case studies (for beginner, intermediate and advanced level) and the adaptive reading room in the previous section. For some background, adaptive hypermedia (AH) (Brusilovsky 2001) systems essentially revolve around the idea of adapting information to users' differences (knowledge, background, interest etc). One of its aims is to protect users from getting lost in hyperspace by limiting their browsing space or providing advice. In our case, the integration of adaptive hypermedia will hopefully counteract some of the negative effects of self-exploratory learning on the web.

Our main reason for integrating adaptive features into a web-based learning environment is to cater for users' needs that arise due to individual differences. This can be accomplished by adapting information to users in several ways. Firstly, their *knowledge level*, where information is presented based on users' current level of knowledge. Each user's knowledge level is evaluated by means of either a prior knowledge test upon initial entry to the application or a self-selecting level based on registration details. Secondly, the user's *browsing history* provides personalized browsing aids for individuals, so that they can concentrate on pages they have not read adequately. The browsing history is a record kept by the system to keep track of pages that have been read by the users and how much time they have spent on those pages. The system estimates the degree of effort a user has spent on a particular page by comparing an optimal reading time (set by the system on each page) with the actual time spent by the user on the page. In order to make the estimation more accurate, the system will consider the individual's effective reading speed (Jackson & McClelland 1979) and the length of the page when estimating the effort that has been spent on each page (Ng et al. 2001). Thirdly, the *goal* of the user is employed, by pointing users to pages based on their selected reading goals. These short-term goals are captured explicitly from the users' input, when they select a reading goal. From a learning perspective, short-term goals provide guidance in a self-exploratory learning environment where the user's declarative knowledge of the domain can be enhanced. Instead of free browsing, users can therefore focus on a topic or goal.

In *JointZone©* we have used adaptive features based on users' knowledge level, browsing history and reading goals mentioned above. In *adaptive case studies* (as explain in Section 3.1), users are directed to the graded case study section based on their current knowledge level. The *personalised site map* (see Fig. 2) provides an overview of the web site showing all the web pages and their physical layout (headings, subheadings) on the site. Once a user has registered with the system, their browsing history and time spent on each document is logged, enabling this personalised site map to be presented. Pages are annotated with a three-color-band code to indicate their reading gauge – a visual representation of the amount of time a user has spent reading individual pages. The *personalised topic map* is similar to the personalised site map, but instead of showing all pages on the site, it shows only the pages that are related to the current reading topic. To initiate this, a user is required to choose a reading topic from a pull down menu, for example 'gout'. A topic-based map will then be presented showing only pages that are related to the reading topic and the pages are highlighted adaptively according to the user's browsing history. Finally, the *adaptive reading room* supports user-driven tasks. Unlike the two navigational maps mentioned above, which apply to general free browsing, adaptive reading hints are integrated with the interactive case studies. When a user has finished working on a case study, he or she might want to know more about the concepts related to that case study. The adaptive reading room hence offers a reading list that is adapted to the user's knowledge level, *as described in section 3.2*.

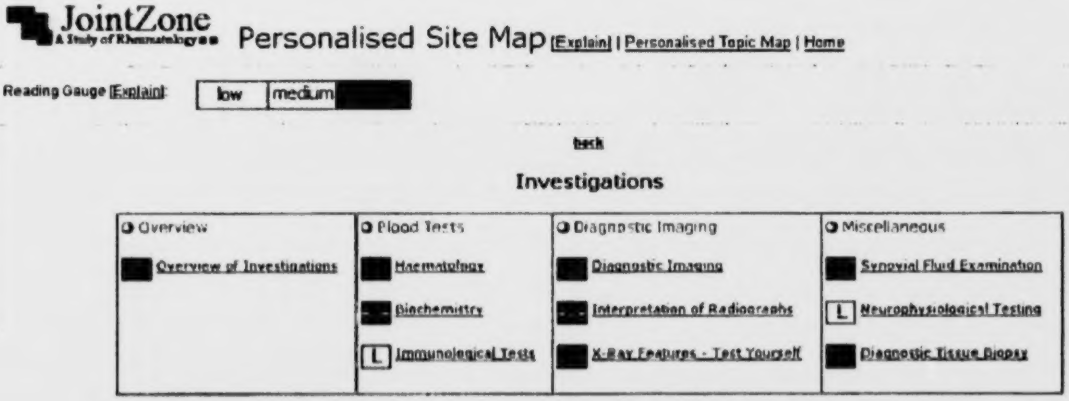
JointZone
A Study of Rheumatology
Personalised Site Map
[Explain] | Personalised Topic Map | Home
Reading Gauge [Explain]:
low
medium
back
Investigations
Overview
Overview of Investigations
Blood Tests
Haematology
Biochemistry
L
Immunological Tests
Diagnostic Imaging
Diagnostic Imaging
Interpretation of Radiographs
X-Ray Features - Test Yourself
Miscellaneous
Synovial Fluid Examination
L
Neurophysiological Testing
Diagnostic Tissue Biopsy

Figure 2: A partial screen shot of the personalised site map

6. Conclusion and Work

The overall aim of this web-based learning environment was to provide a rich source of information that effectively supports the learner through the adaptive features and allows users to engage with material more effectively. We set out to achieve this through careful hypermedia authoring while maintaining a constant awareness of users' needs. Our main strategies for developing an effective learning environment on the web were to:

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- provide a personalised information delivery system that through adaptive hypermedia technique, allowed users to maintain an overview of the documents they had read or not read. We have also linked the procedural and declarative knowledge in the application adaptively, to prevent cognitive overload and facilitate the process of learning.
- design learning materials that develop medical students' cognitive skills in clinical reasoning via, graded interactive case studies.
- reduce authoring effort and increase maintainability of the application through the separation of concerns in authoring.
- increase the usability and accessibility of information through various linking strategies.

A comprehensive evaluation of the adaptive features is currently being undertaken to scrutinize their effectiveness in terms of learning and information access. This evaluation will give us some insights into whether adaptive web-based learning really benefits the students or whether it is a mere technology-driven technique in a learning paradigm.

References

1. Brusilovsky, P. (2001). Adaptive Hypermedia. *User Modeling and User Adapted Interaction*, Kluwer Academic Publishers, vol 11, 87-110.
2. Collins, A., Brown, J. S., & Newman, S. (1989). Cognitive Apprenticeship: Teaching the Craft of Reading, Writing & Mathematics. In L. B. Resnick (Ed.), Knowing, Learning and Instruction: Essays in honor of Robert Glaser. Hillsdale, New Jersey: Erlbaum.
3. DesCoteaux, J. G. & Harasym, P.H. (1998). Procedural Knowledge! How important is it to converting novices to experts? *The Bulletin*, available from: http://www.med.ucalgary.ca/education/umc/thought-exchange/Procedural.htm 4(6), March.
4. Duchastel, P. (1989). Formal and Informal Learning with Hypermedia. In D. H. Jonassen and H. Mandl (Eds). *Designing Hypermedia for Learning*, Springer-Verlag, Berlin, Heidelberg, New York.
5. Duchastel P. (1992). Towards Methodologies for Building Knowledge-Based Instructional Systems. *Instructional Science*, v20 n5-6, 349-58.
6. Garzotto, F. & Paolini, P. (1997). Systematic Evaluation of Hypermedia Applications. *The Eighth ACM Conference on Hypertext*, Southampton, UK.
7. Greening, T. (1998). Scaffolding for Success in Problem-Based Learning. Med Educ Online. Available at http://www.med-ed-online.org/issue2.htm#v3, 3(4).
8. Hall, W., Davis, H. & Hutchings, G. (1996). *Rethinking Hypermedia The Microcosm Approach*, Kluwer Academic Publishers, Dordrecht, Netherland.
9. Jackson, M. D. & McClelland, J.L. (1979). Processing Determinants of Reading Speed. *Journal of Experimental Psychology: General*, 108, 151-181.
10. Jonassen D. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? *Educational Technology, Research and Development*, 39, 3, 5-14.
11. Kinshuk. (2001). Intelligent Learning Systems for Cognitive Skills Development. Paper presented at *the Informing Science: Challenges to Informing Clients: A Transdiciplinary Approach*, Krakow, Poland. Available from: http://ecommerce.lebow.drexel.edu/eli/pdf/KinshukEBKIntelLearn.pdf
12. Lowe, D. & Hall, W. (1999). *Hypermedia and the Web – An engineering Approach*, John Wileys & Sons
13. Mayes,T., Kibby, M., & Anderson, T. (1990). Learning about Learning from Hypertext. In D.H. Jonassen and H. Mandl (Eds.) *Designing Hypertext /Hypermedia for Learning*, Heidelburg, Springer-Verlag.
14. Ng, M., Hall, W., Maier, P. & Armstrong, R. (2002). Using Effective Reading Speed to Integrate Adaptivity into Web-based Learning. To be published at the 2nd International Conference on *Adaptive Hypermedia and Adaptive Web Based Systems*, Malaga, Spain.
15. Nkanginieme, K. E. O. (1997). Clinical Diagnosis as a Dynamic Cognitive Process: Application of Bloom's Taxonomy for Educational Objectives in the Cognitive Domain. *Med Educ Online*. Available from: *URL* http://www.med-ed-online.org/issue2.htm#v2, *2*(1).
16. ReadingSoft.com available at http://www.readingsoft.com
17. Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). Cognitive flexibility, constructivism and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. Duffy & D. Jonassen (Eds.), *Constructivism and the Technology of Instruction*, Hillsdale, NJ: Erlbaum.
18. Thuring, M., Hannemann, J. & Haake, J. M. (1995). Hypermedia and Cognition: Designing for Comprehension. *Communication of ACM*, Vol.38, No.8, August.

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Integrated Environment for Web-based Experimentation in Engineering Education

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Abstract: The Swiss Federal Institute of Technology in Lausanne is currently developing an environment for Web-based experimentation in engineering education. This environment aims at providing students with the facilities to reinforce their learning process by carrying out practical experimentation. This paper focuses on the concept of Laboratory Journal, a component of the environment, which has been developed to support knowledge acquisition and reinforcement in a collaborative way. The Laboratory Journal is designed and implemented as an integrated space that supplies the needs for collaborative learning and fulfils hands-on session requirements, using the latest communication and information technologies. It has been developed as a Web-based application with client/server architecture. The implementation is based on the use of Java and XML technologies.

1.Introduction

The rapid development of computer networking and the Internet in the last decade has provided new possibilities and also new challenges for designing and deploying distance and collaborative learning systems. Nowadays, one of the useful and interesting trends to support active learning is to expand the available educational resources by providing virtual and real experimentation facilities (Gillet, D. & Farkas, G., 2001). This is especially important in engineering education where the practical approach to learning is as necessary as the theoretical one. Thus, there is now a growing demand of developing remote experimentation environments for educational purposes.

The deployment of Web-based experimentation facilities is carried out at the Swiss Federal Institute of Technology in Lausanne (EPFL) in the framework of the *eMersion* project. This project aims at providing [illegible]n environment for engineering education based on new learning technologies resources, which facilitates experiments through Web-based simulation and/or remote manipulation of laboratory setups. eMersion proposed an integrated environment that allows students to execute remotely *Experimentation Modules* over the Internet to support their learning activities. The environment has a Cockpit-like graphical user interface. This so-called *Cockpit* environment contains all the components necessary to complete successful experimentations. In particular, the Cockpit includes three main parts: the *Experimentation Console*, the *Toolkit Console* and the *Laboratory Journal*. The Experimentation Console can be regarded as the *interaction* part that enables the actual realization of experiments. The Laboratory Journal constitutes the *collaboration* part that facilitates reporting as well as knowledge integration and sharing. The Toolkit Console provides students tools to carry out interactive design and analysis activities related to the experiment. The portal of the Cockpit environment for automatic control modules is shown in (Figure 1). Currently, the environment is used for pilot-courses in automatic control, fluid mechanics and biomechanics at the EPFL.

This paper introduces the collaborative part of the Cockpit namely the *Laboratory Journal*. It is organized as follows: section 2 discusses about the concepts of collaborative learning in engineering education. Sections 3 and 4 present the features and implementation of the Laboratory Journal. Section 5 shows the user case validation. Section 6 talks about the future work and section 7 concludes the paper.

eMersion
A New Learning Technologies Project

Figure 1: The portal screen for the automatic control module.

2. Collaborative Learning in engineering education

CSCL (Computer Supported Collaborative Learning) studies how computer science can support learning processes promoted by the collaborative efforts of students working on a given task (Santoro, F. M. et al., 2000). CSCL supports active collaborations. That means it not only provides the delivery mechanism for collaborative interactions provided by CSCW (Computer Supported Collaborative Work) but also provides additional controls and services required to guide collaborative learning in an active fashion, based on the requirements of the peers involved in the interactive learning (Clemson University Notes). Collaborative learning not only helps group works but also encourages individual's activities and contributions in the group. Each member in a group has some specific authorities, responsibilities and roles when taking part in the group 's activities.

Taking ideas from CSCL, many *collaborative learning environments* (CLEs) have been developed and proposed for the tutor and student to work together. These CLEs are generally made of a collection of tools and services that supports teaching and learning processes to help tutors and students show their opinions without face-to-face judgement. Nowadays, the WWW is becoming an ideal platform for developing CLEs.

In engineering education, the practical part is as important as the theoretical part. In the spirit of flexible learning (Gillet, D. & Farkas, G., 2001), the students should be allowed to carry out the experimental work in laboratories as well as from distance. Hence, to facilitate the practical learning, the physical and virtual experimentation setups should be both supported. Those are used by the tutor for demonstrating and also by the students for hands-on exercises (Gillet, D. et al., 2001). The virtual experimentation could be a combination of graphical animations and numerical simulation tools. During the experimentation process, students need a shared working space (or shared workspace), i.e. the collaborative space, where they can take notes about their experimental works, store results and observations, discuss, share information and materials, ask or provide assistance with other students.

In academia as well as in industry, there are a lot of simulation tools, which support practical activities in engineering education. For example, in (Mateos et al., 2001) PROSIMAX, a Windows based tool for testing control programs implemented on different control devices, is presented. It is intended to minimize the main drawbacks of classical tools used for test in educational environments. DEVRE is presented in (Ridao, P. et al., 2001) with the aim to assist engineers during the software development and testing in the laboratory prior to real experiments. (Sepe et al., 2001) has constructed VE-LAB, a Web-based virtual engineering laboratory for collaborative experimentations on a hybrid electric vehicle starter. Using these environments, users can perform virtual experimentations. DEVRE and VE-LAB are built in a distributed environment (Web-based environment in case of VE-LAB). However, users have no way to collaborate (the collaboration is poor supported in VE-LAB) and/or to share, to exchange their ideas, experimental results and information. In other words, these environments don't support working in groups.

Recently, there is a growing interest to support collaborative work over the Internet. Maybe one of the most popular collaborative tools in academia is BSCW (Basic Support for Cooperative Work) (Klöckner, 2000). This is a shared workspace where users can share information; collaboratively perform their activities over the Web. However, BSCW doesn't support task manager; i.e. the capability of the supervisor to fragment a big project into small tasks and distribute to different groups, assign responsibilities to group members, monitor the progress of groups when performing tasks. In addition, the synchronous collaboration among users in BSCW is not much either supported.

The goal of the INVITE project (Bouras et al., 2001) is to build a platform for synchronous tele-learning that can be interfaced with standardized content management and/or industrial management system.

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INVITE is a collaborative virtual environment that supports e-learning. It is based on distributed virtual environment technologies. However, the avatar representations in INVITE are not really comfortable for information sharing and discussions for engineering students.

Edelson et al. from Northwestern University has developed the CoVis Collaboratory Notebook (Daniel C. Edelson, D. Kevin O' Neil, 1994), which is a shared, hypermedia database that supports communication and collaboration both locally and remotely over the Internet. Nevertheless, the synchronous communication in CoVis is not supported. And in fact, CoVis Notebook is used only for high school science learning. Thus, the idea of collaboration in this project is still simple. It is mainly a medium for students to record their thoughts and actions as they perform scientific inquiry.

Other Web-based collaborative tools or architectures could be considered in (Fredj Dridi & Gustaf Neumann, 1999; Beca et al., 1998; Dan Suthers & Dan Jones, 1997; TeamWave; Lee, M. J. et al., 2000). Because all of the collaborative tools presented above are not well designed for engineering education, remote experimentation and simulation cannot be sustained.

As presented above, there are a lot of simulation/manipulation as well as collaboration tools in academia and industry. But so far, it seems that there is no product that integrates these two aspects. In eMersion project, the goal is to develop a global and flexible infrastructure that supports the remote execution of Experimentation Modules over the Internet and the collaboration between actors (students, tutors, pedagogical team, etc.). One important thing to notice is that these two parts of the Cockpit environment (Experimentation Console and Laboratory Journal, or Interaction space and Collaboration space) are connected so that materials (files, experimental results, configurations, etc.) can be automatically transferred from one part to another. By this way, the collaboration between the student and the tutor as well as between the students when performing remote experimentations is well supported. The next sections will describe the features and the implementation of the Laboratory Journal.

3. Laboratory Journal features

The Laboratory Journal is developed based on the concept of electronic journal. Normally, text, sketches, graphs, tables, signatures, images and other kinds of data are "written" (or "recorded") on electronic journal "pages", which can be read and navigated (Daniel C. Edelson, D. Kevin O' Neil, 1994). The electronic journal allows easily input of scientific data (for example, the experimental results in the form of image or mathematical formula). As indicated in (Al Geist & Noel Nachtigal, 2001), an electronic journal has many advantages, it can be shared by a group of users, can be accessed remotely, cannot be lost (if carefully backed up but this task is easily done), can be searched for information, can include multimedia or hyperlinks to other information, etc.

In our system, the Laboratory Journal is constructed as a collaborative working space (or collaborative workspace for simplicity) for students when performing Web-based experimentations. In other words, it is a Web-based medium where engineering students can remotely record aspects of experiments that are conducted in the framework of a virtual practical exercise. The Laboratory Journal lets students access their preparation materials, store and post-process their experimental results. Logically, we have two different spaces for working. The private Journal components can only read or modified by its single owner, and group Journal space is the shared space for a group. The student and tutor can work on their private Journals before sharing them with others. Each group Journal is dedicated to one group for one experimentation module. Authorization or access rights relate to the operations available to the user. The authorization is changed from one Journal to another. It depends on the role as well as on the context. To prevent conflicts when co-editing the Journal, the locking mechanism is provided.

The Laboratory Journal provides the possibility for documenting and reporting, and it facilitates the key activities of knowledge integration and knowledge sharing (Gillet, D. et al., 2002). It takes many advantaged features from structured document concepts (Adre, Furuta & Quilt, 1989). The structured document permits the flexible reuse of the document and of its elements. The relationships between elements are based on the document's logical structure and not the physical appearance of the components displayed on the page. Students just concern with the content of the document. In the Cockpit environment, they use the Laboratory Journal to collaboratively prepare reports. Thanks to the hierarchical structure of the Journal page, users can co-edit the whole or just some parts of the report. Also thanks to the DTD (Document Type Definition) (Harold, E. 1999) defined for the Cockpit and the Laboratory Journal interface, the Laboratory Journal 's views can be changed depending on the user's profiles and the report can be automatically generated based on the inputs from the user.

In the Laboratory Journal, many kinds of elements can be defined, for instance: text, image, table, etc. The artifacts in the workspace are called *fragments*, which can be composed of objects and used to construct the report. The text fragment can be edited by hand or extracted from documents imported by different students. The imported documents are transformed into structured document format. When the imported documents cannot be transformed, they remain as attached documents. Other kinds of fragment can be uploaded from a file server or transferred from the Experimentation Console using the *Data Tunnel*, which is constructed as a tunnel for data transmission between different parts of the Cockpit environment. In addition, the student can create and edit notes, which will be used in the report, to memorize the observations or anything else when performing the experiment.

The report is constructed by inserting fragments. The fragment is chosen in the workspace and then inserted to the report. The delete, modify possibility is also allowed in the report editing space. Every time the report is modified, the previous version is saved. This version control functionality helps students to review their working history. After being edited, the report is sent to the tutor as HTML or PDF file by email. After being submitted to the tutor, the group report cannot be modified anymore.

The member of a group communicates with other members in the same group or with the tutor either directly through message exchange or indirectly through annotations, which are added to the fragments (or the shared artifacts) in the workspace. The annotation provides the meta-information about the fragment. For example, it could help students and tutors know that this fragment was created by whom and when. Different annotations from different users can be attached to the same fragment. The communication between members is also enabled by the way the student provides the "write" permission to other members in the same group or the "read/write" access to the tutor. Thus, the tutor or other members can also modify the fragment or to give some feedbacks to the student-author. The communication mechanism is in fact provides students and tutors the awareness information in collaboration process. The general concept of awareness was defined by (Paul Dourish and Victoria Belloti, 1992) as an understanding of the activities of others, which provides the context for each member's activities.

A group task manager is also constructed to solve the need to fragment a whole task (for example, group 1 prepare a report for experimentation module A) into specialized smaller sub-tasks that are to be performed by different students working within a single group (for example, who does what). Common tasks may be shared and manipulated independently by a number of users with different kinds of access control. With this tool, students monitor their progress or organize cooperative tasks; for example, create, refine or modify a task. To create a task means to define this task, to allocate some resources and assign it to some specific students.

4.Laboratory Journal implementation

(Figure 2) shows the Cockpit environment when performing experimentation module about electrical drivers. In the top of the figure is the *Navigation and Supervision Area*. In this part, we could find the objectives and the status of the task currently being processed (for example, the task is finished or currently implemented). The *Protocol* space in this Area describes step-by-step procedures necessary to perform the experimental work. The Navigation and Supervision Area also provides the possibility to access other relevant supplementary information such as *reminders* or *links* representing the theory, a *description* of the environment, etc. The bottom left of the figure represents the Experimentation Console (the higher part) and the Toolkit Console (the lower one). The Laboratory Journal is showed in the bottom right of the figure.

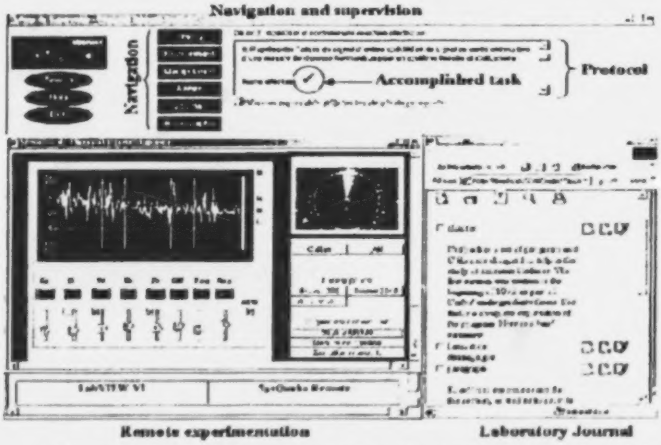

Figure 2: The Cockpit environment for the automatic control module.

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To represent the concept of structured document, XML (eXtensible Markup Language) (Harold, E., 1999) is chosen. It is the universal format for structured documents and data on the Web. XML data only contains data; that means what is to be presented. The presentation part is done by stylesheets. Using a stylesheet, the correct style will then be generated in different formats such as PDF or HTML.

The Laboratory Journal is constructed using Web-based client-server architecture. Users can use Java-enabled browsers to access Web pages, which contain codes (Java codes and scripting codes such as Javascript) used to invoke services. The Web pages in our system are in fact the JSP (JavaServer Pages) (Aveda et al. 2000) ones. JSP pages can provide the full power of the Java language to process and transform XML documents. The DTD (Document Type Definition) is defined at the server side. The server side is an extended HTTP server, i.e. an HTTP server with some application servers (written as Java applications) to enrich processing functionalities. In the Cockpit environment, a TOMCAT version 4.0 from the Apache Software Foundation is used as the Web server. A relational database (mySQL (see MySQL) in our case) and a file system are used to store data in the central server. Depending on the requests from the clients, the appropriate XML files are created. The XML files are then transformed by XSLT stylesheet (see XSLT) into formatting object trees. The object tree is parsed by Java codes to create objects in the Journal.

5. User case validation

Since October 2001, a group of 25 EPFL volunteer students for each semester has used the Cockpit environment to carry out laboratory assignments in automatic control under observation. They were asked some preliminary questions listed in the Cockpit protocol and then the answers are added to the Laboratory Journal by creating notes or attaching documents. This is considered as the *pre-lab* task and when finished, it is made visible (by providing permissions) so the tutor is able to grade it.

The answers are corrected and annotated by the tutor within the Laboratory Journal context. The students are then authorized to perform the practical part of the experimental assignments using the Experimentation Console. (Figure 2) illustrates a laboratory assignment, in which the student performs the experimentation in modeling and digital controlling of servo drive.

During performing experimentations, the student takes notes in the Journal. The experimental results and observations are saved in the workspace in order to create the reports.

The volunteers have been observed and interviewed by pedagogues to evaluate their reactions regarding the Web-based environment and the flexible learning approach. The evaluation detail is described in (Gillet, D. et al., 2002).

6. Future work

Currently, the Laboratory Journal is in the phase of design and implementation. There are still many theoretical and technical problems to deal with when developing the system. The future version of the Laboratory Journal will fully support the collaboration when performing activities on Journal pages and Experimentation Console. The ability to generate automatically the report based on the user's inputs (thanks mainly to the well-defined XML files stored in the server) will be implemented as well.

7. Concluding remarks

In this paper we described the Cockpit environment as a paradigm introduced at EPFL in engineering education to sustain hands-on learning activities. We have defined the Laboratory Journal, the collaboration part of the Cockpit, as an infrastructure that supports collaborations among students when performing Web-based experimentation. Our system relies on a variety of flexible, scaleable and platform independent components. We have shown the concepts related to the Laboratory Journal, its features and implementation. Currently, the environment supports three courses taught to students in automatic control, biomechanics and fluid mechanics. An evaluation is currently carried out in collaboration with a usability team and pedagogical experts in order to assess the effectiveness of the deployed solutions.

Acknowledgement

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References

Adre, J., Furuta, R., Quilt, V. (1989). *Structured Document.* Cambrigde University Press.

Al Geist & Noel Nachtigal (2001). ORNL electronic notebook project. *Enote software report.*

Avedal et al. (2000). *Professional JSP.* Wrox Press Ltd.

Beca, L., et al. (1998). Component architecture for building web-based synchronous collaboration systems. *Proceedings of the IEEE 8th International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises.*

Bouras, Ch., et al. (2001). Architectures supporting e-Learning through Collaborative Virtual Environments: the case of INVITE. *IEEE.*

Clemson University Notes. Collaborative Learning Environment. Notes. See http://cle.clemson.edu.

Daniel C. Edelson, D. Kevin O' Neil (1994). The CoVis Collaboratory Notebook: Computer Support for Scientific Inquiry. *Presented at the Annual Meeting of the American Educational Research Association*, New Orleans.

Dan Suthers & Dan Jones (1997). An architecture for intelligent collaborative educational systems, *AI&ED 97*, Kobe, Japan.

Flavia Maria Santoro, Marcos R. S. Borges, Neide dos Santos (2000), An infrastructure to support the development of collaborative project-based learning environment. *IEEE 2000.*

Fredj Dridi & Gustaf Neumann (1999). How to implement Web-based groupware systems based on WebDAV. *Proc. of WETICE`99, IEEE 8th Intl. Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises*, Stanford.

Gillet, D. et al. (2001). Hands-on laboratory experiments in flexible and distance learning. *Journal of Engineering Education.*

Gillet, D. & Farkas, G. (2001). eMersion: A new paradigm for web-based training in engineering education. *International Conference on Engineering Education*, Oslo, Norway.

Gillet, D., Geoffroy, F., Zeramdini, K., Nguyen, A.V., Rekik, Y., and Piguet, Y. (2002). The Cockpit: An effective Metaphor for Web-based Experimentation in Engineering Education. Submitted. *International Journal of Engineering Education.*

Harold, E. (1999). *XML Bible.* IDG Books, USA.

Klöckner (2000). BSCW - Educational Servers and Services on the WWW. *Proceedings of the International C4-ICDE Conf. on Distance Education and Open Learning "Competition, Collaboration, Continuity, Change"*, Adelaide, Australia.

Lee, M. J. et al. (2000). CoWare: A Web-based Groupware for Effective Collaboration, *Proc. of the 4th Korea-Russia Int. Symp. on Science and Technology.*

Mateos, F.; Lopez, A.M.; Gonazalez, V.M.; Enguita, J.M. (2001). Improving laboratory training for automation and process control courses with a specifically designed testing software application. *IEEE Transactions on Education.*

MySQL. See www.mysql.com

Paul Dourish and Victoria Belloti (1992). Awareness and Coordination in shared workspaces. *ACM.*

Ridao, P.; Battle, J.; Amat, J.; Carreras, M. (2001). A distributed environment for virtual and/or real experiments for underwater robots. *IEEE International Conference on Robotics and Automation.*

Sepe, R.B., Jr.; Short, N. (2001*).* Web-based virtual engineering laboratory (VE-LAB) for collaborative experimentation on a hybrid electric vehicle starter/alternator. *IEEE Transactions on Industrial Applications.*

TeamWave software Ltd.. See http://www.teamwave.com

XSLT, eXtensible Stylesheet Language Transformation. See http://www.w3.org/TR/xslt20/

A Tool for Real Time On-Line Collaboration in Web-Based Learning

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Abstract: This paper describes the design and implementation of a real time on-line collaboration tool, EDUCO. The main focus is to demonstrate how the tool is applied to a real life on-line distance-education course, discuss the preliminary research findings of qualitative empirical study, and propose directions for future work and implications. The preliminary results show that some of the features used in this tool can be directly applied to a wider context of modern computer-based learning environments.

Introduction

The main objective of the EDUTECH project is to develop methods for applying probabilistic modeling techniques, such as Bayesian network models, in building and using personalized, adaptive software components for digital learning environments. The research focuses on developing intelligent autonomous but interoperabile modules for educational purposes from assessment techniques to the support of co-operative activities and personalized adaptive learning materials.

The *first phase* of the EDUTECH study period (1999-2000) concentrated on the development of intelligent questionnaire software EDUFORM (Kurhila, Miettinen, Niemivirta, Nokelainen, Silander and Tirri 2001). EDUFORM allows for an adaptive and dynamic optimization of questionnaire propositions and profiling of learners on-line. This software module is applied to varying types of assessment applications both in business and educational domains.

The ongoing *second phase* (2001-2002) of the project has two sub-phases. Firstly the research group has developed an experimental version of a tool for on-line computer supported collaborative learning. The latter ongoing part of the research is focused on utilizing and combining the co-operative aspects of profiling information gained from EDUFORM by providing mechanisms for intelligent matching with co-students.

The major goal of this paper is to describe the design and implementation of a real time on-line collaboration tool, EDUCO. The main focus is to demonstrate how the tool is applied to a real life on-line distance-education course, discuss the preliminary research findings of qualitative empirical study, and propose directions for future work and implications.

The Role of Real Time Interaction in Web-Based Learning

The concept of computer supportive collaborative learning (CSCL) consisting intentional active learning, process aspect knowledge and methods of knowledge-building resources necessitates a flexible and synchronous learning situation (Scardamalia and Bereiter 1994). When we compare these conditions for learning and the implications from CSILE and Knowledge Forum to modern platforms for web-based learning, such as WebCT and Learning Space, we must admit that the real time component of on-line learning process is still very static and inflexible.

How, then, the task-related social interaction, which should play a significant role in a learning process, is implemented in available educational software? Comparison between the software is relatively simple to carry out due to the fact that popular platforms have relatively similar functionality. They all provide the learners with tools to go through the learning material, perform tasks like answering to quizzes and submitting assignments, and communicating with peers or teachers (see e.g. Landon 2001). However, in these "traditional" web-based learning environments the real time social interaction is limited to a simple chat and web board services. When a user is actually using the platform, the learning experience can be perceived as a lonesome activity, since there is no *feeling* of other live learners or teachers within the environment. The concept of *social navigation* (Munro, Höök and Benyon 1999) provides one viable solution to the problem.

Considering social navigation from the standard perspective, the concept means providing the users with information from the actions of other users of the environment. For example, showing the hits for different web pages is a simple form of providing means for social navigation. In the seminal book of social navigation, Munro et al. (1999) use an on-line grocery store as an example: if people visiting the store are given recommendations what other people have bought, it is a form of *indirect social navigation*. If a shopper in the grocery store has a sense of other people moving about the store and can engage in seeking e.g. assistance, it is a case of *direct social navigation*.

Experiments with social navigation have mostly fallen into the category of indirect social navigation. Still, in some sense the feeling of other users can be achieved even if the actions are not delivered to other users in real time. For example, in CoWeb (Dieberger 1999) the feeling of *aliveness* is carried out with persistent discussion spaces that allow any user to modify any hyperdocument. CoWeb uses indirect social navigation in generating footprint markers that indicate the amount of recent traffic to pages and when the pages were last modified. The markers provide an additional sense of awareness of activities in the information space and thus increase the sense of the CoWeb as a social "place".

However, the indirect social navigation approach does not add to the need for really *live* users. Therefore, we have implemented a tool for real time on-line collaboration called EDUCO. EDUCO appears to the users as a visual collection of web sites, where the users can navigate the documents and see when other users are navigating those same documents. Users can engage in chat simple by clicking the dots representing users in EDUCO. Furthermore, EDUCO users are able to set "alarms" which are triggered when a certain person, group member (Hoppe and Ploezner 1999) or any user arrives to the systems or to a certain document. Search functions to locate users or documents with desired keywords in the title exist as well.

The Design of the Study

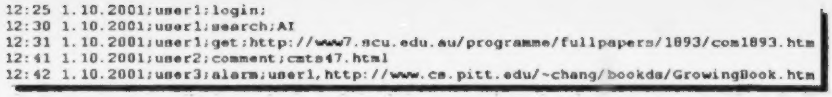
The first experiment with EDUCO was a course given at the Department of Computer Science, University of Helsinki, Finland. The topic of the course was Web-based learning. The first meeting was an introduction to the topic and to EDUCO. The following weekly or bi-weekly sessions were carried out on-line with EDUCO as an interaction tool until the final day when students presented their papers. Students (N=24) taking part of the course were expected to form a group of two, pick a topic in the field of web-based learning and prepare a paper and a presentation about the topic. In addition, there were several time-limited mini-tasks given by the teacher on-line, and tasks where the students were supposed to comment on research papers on web-based learning. The data set was gathered in three stages: (1) Pre test on the first day of the course measured motivational level and learning strategies, (2) user log was gathered during the course, and (3) post test after the course measured how students' expectations faced the reality.

Pre Test

Motivational profiling in this study is based on the Motivated Strategies for Learning questionnaire (MSLQ), which is developed on the basis of motivational expectancy model (Garcia and Pintrich 1994). MSLQ measures both motivational factors and learning strategies and has been adapted to the research field of Finnish vocational and higher education (Ruohotie 2000). The motivation section (A) of the questionnaire consists of 17 items that were used to assess students' value for a course, their beliefs about their skill to succeed in the course, and their anxiety about tests in the course. The learning strategy section (B) includes 13 items regarding student's use of different cognitive, metacognitive and resource management strategies. A 5-point Likert type scale ranging from 1 ("Not at all true of me") to 5 ("Very true of me") was used for all items. Students were divided into three groups based on their motivational level scores from "A" section of the questionnaire: *Group 1* (blue, N=10) characteristics: Extrinsic goal orientation, test anxiety and meaningfullness of studies, *Group 2* (green, N=8) characteristics: Efficiency beliefs, intrinsic goal orientation and meaningfullness of studies, *Group 3* (red, N=6) characteristics: Control beliefs and intrinsic goal orientation.

Data Collection During the Course

User log from EDUCO (time stamp, user id, action) was recorded during the course from September 24 to November 20, 2001. (Figure 1).



```
12:25 1.10.2001;user1;login;
12:30 1.10.2001;user1;search;AI
12:31 1.10.2001;user1;get;http://www7.scu.edu.au/programme/fullpapers/1893/com1893.htm
12:41 1.10.2001;user2;comment;cmts47.html
12:42 1.10.2001;user3;alarm;user1,http://www.cs.pitt.edu/~chang/bookds/GrowingBook.htm
```

Figure 1: A sample of EDUCO log file.

Post Test

An email survey consisting of 15 open propositions (10 responses out of 24) was conducted two weeks after the course in December 2001. Propositions measured users experiences and expectations towards computer supported education together with EDUCO-related attributes (usability issues, user interface, features etc.).

EDUCO Architecture

From a technological point of view, EDUCO consists of a server, a Java applet for every user and several cgi-scripts. The server tracks the state of the distributed system and informs the clients as changes occur. Examples of possible changes in the environment are users moving to another page and initiating a chat. The implementation of this kind of a scheme in real time requires the clients to maintain an open connection to the server throughout the session.

To avoid any copyright or other intellectual property right issues we have taken the approach that the documents (i.e. HTML-files) chosen to be part of a particular instance of EDUCO are not copied to our server. Instead, they can be located anywhere on the Web. This being the case, the server needs to know which page each user is viewing. We have solved this problem by using our EDUCO-server as a kind of proxy, which means that the documents are routed through our server instead of being sent to the client directly from their actual location (Figure 2).

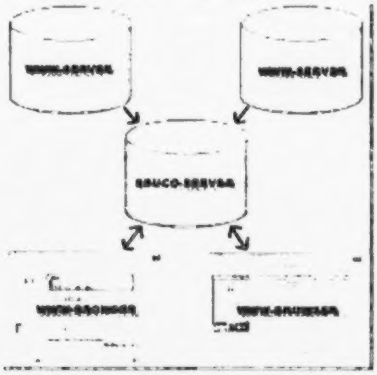


Figure 2: Data flowin EDUCO.

EDUCO User Interface

The EDUCO user interface consists of six elements of which only one is concurrently visible: (1) Map, (2) Chat, (3) Search, (4) Alarm, (5) Preferences and (6) Help. The EDUCO interface is small, only 200 x 300 pixels, and thus placed into the left-hand side of a www-browser frameset. The right-hand side of the browser frameset, usually more than 440 pixels, is reserved for the content (i.e. hyperdocuments) and the space below EDUFORM is reserved for the document specific comments. Commenting is based on ordinary html-forms. Each document has an associated comment file, which is opened to its designated frame and can be updated by the users. The server keeps track of modifications and the visits of individual users. This way the documents that have been commented after the last visit can be distinguished visually from those that contain only comments the user has already seen. (Figure 3.)

"Map" is a view to a visualization of the hyperdocument structure and the people present in the learning environment. The material is organized in clusters consisting of related hyperdocuments. People are shown as coloured dots. Colour indicates different group membership or types of user

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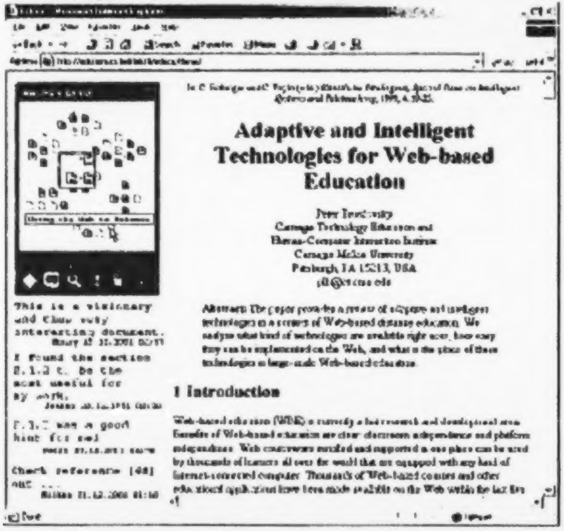
profile, and the location of the dot depends on the document the person is currently viewing. When mouse is placed on top of the symbol of document or person, a tool tip appears showing the name of the person or the document. Clicking a symbol selects it for further use; double clicking a document opens it in the browser window. The documents change their colour on the map depending on how much they have been read relative to the others. The total time all users have spent reading each document is recorded by the server on an hourly basis. The change in the colour of an individual document is determined by the distance of its moving average for the last 24 hours from the same average for all documents. (Figure 4.)



Adaptive and Intelligent Technologies for Web-based Education

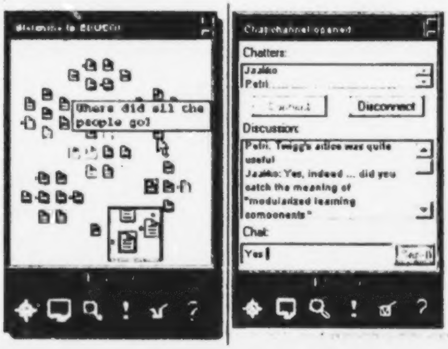
1 Introduction

This is a visionary and ... interesting document.

I found the section 2.1.2 to be the most useful for my work.

Figure 3: EDUCO user interface with Map view active and open document with related comments.

"Chat" enables synchronous communication with other peers. EDUCO Chat sends messages only to those people sender has actively contacted by e.g. clicking dots on the Map. The number of participants in the discussion is unlimited, but one person may use only one chat channel simultaneously. (Figure 4.)



Where did all the people go!

Chatters:

Jaakko
Petri

Discussion:

Petri: Twigg's article was quite useful

Jaakko: Yes, indeed ... did you catch the meaning of "modularized learning components"

Chat: Yes

Figure 4: EDUCO Map (left) and Chat (right) views.

EDUCO "Search" is useful for finding people or documents. The search is targeted to the titles of documents and names (and nicknames) of users online. Search sdection affects also to the other views ("Map", "Chat" and "Alarm"). "Alarm" defines a condition to be monitored by the system. If a user wishes to seek for a work mate who is also interested in certain document (or topic), he can tell the system to send a notifying message to the title bar of EDUCO when predefined conditions are met, i.e. other person arrives to the document specifying the task. Alarm is helpful when user wishes to conduct a collaborative time-related assignment with a friend who has not yet logged into the system. See Figure 5 for screen dumps of Search and Alarm views.

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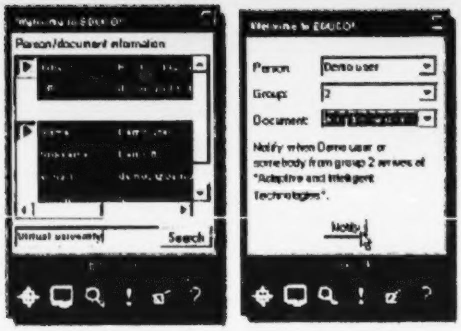


Welcome to EDUCO!

Person/document information

Virtual university

Welcome to EDUCO!

Person: Demo user

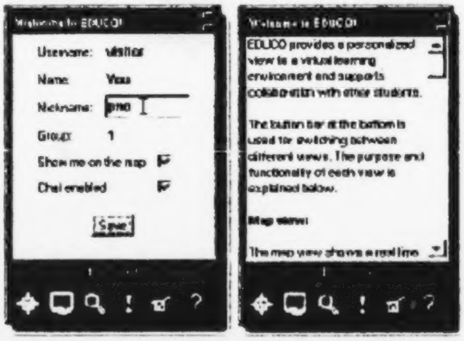
Group: 2

Document: [illegible]

Notify when Demo user or somebody from group 2 arrives at "Adaptive and Intelligent Technologies".

Figure 5: EDUCO Search (left) and Alarm (right) views.

On the "Preferences" view the user is allowed to change personal settings i.e. what is the preferred nickname, is he or she visible to other users (and vice versa) or is the chat enabled. Help view provides information about the program. (Figure 6.)



Welcome to EDUCO!

Username: visitor

Name: Vesa

Nickname: pino

Group: 1

Show me on the map ☑

Chat enabled ☑

Welcome to EDUCO!

EDUCO provides a personalized view to a virtual learning environment and supports collaboration with other students.

The button bar at the bottom is used for switching between different views. The purpose and functionality of each view is explained below.

Map view:

The map view shows a real time

Figure 6: EDUCO Preferences (left) and Help (right) views.

Results

The main focus of this study is on the design and implementation of EDUCO software and thus profound analysis of the empirical results of all three forementioned stages is unbearable to carry out. Next we will present some preliminary results of the post test. Seventeen respondents (71 %) out of 24 replied to the email survey. In this paper we analyse briefly following four propositions (Table 1):

Table 1: Selection of preliminary propositions of the post test.

5. What is your opinion of the essential added value of EDUCO compared to traditional computer-based learning?
9. Give your comment on the Map view's functionality considering it as a tool for a) navigating from one hyperdocument to another, b) commenting (annotation) hyperdocuments, and c) social navigation and interaction.
10. How relevant the Chat was to you?
11. What was the relevance of EDUCO's profiling info to you when you were seeking for work mate(s) to carry out collaborative tasks?

Preliminary results of the post testing show that the EDUCO was found to be a useful tool in the matters like adaptation to respondents learning, cognitive and motivational strategies, and means to implement collaborative actions.

> *"It was very useful to see what documents other users were reading ... it gave me many hints and saved time."*
>
> *"It was truly nice to be able to see what is the most interesting document at the moment and who is reading it."*
>
> *"Actually, in several cases I wanted to start a chat conversation with someone reading same hyperdocument with me ...I guess this is social navigation?"*

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Presence of EDUCO increased task-related participation and was valued tool for those who had difficulties to participate in face-to-face meetings:

> *"Learning material was easy to access."*
> *"EDUCO gives more flexibility to studying process."*
> *"It was possible for me to participate to this course and carry out all those tasks regardless of my domicile."*
> Real time interaction of EDUCO also elicited negative comments:
> *"EDUCO hindered formation of REAL social contacts!"*
> *"Chat never beats traditional face to face meetings."*

EDUCO's tools for seeking work mates (group membership, search function) were truly useful for most of the respondents:

> *"I was in a blue group, and when another blue was looking for a mate, I replied instantly. He had already chosen an article, I glanced at it and found that it was suitable for me too."*
> *"I had a group proposal via email message. As my forthcoming work mate had the same colour than I did, it was easy to make the decision to start collaboration. Afterwards I thought that I agreed so quickly because of the same motivational group, normally it takes more consideration. But to be honest, the topic was the most important factor."*

Conclusions

The paper has described the design and implementation of a real time on-line collaboration tool. EDUCO was build to seek solutions to some unsolved problems concerning real time collaboration between live users in both traditional and modern web-based education platforms. The main focus of the study was to demonstrate how EDUCO was applied to a real life on-line distance-education "Web-based learning" course. The preliminary research findings of small-scale qualitative empirical study indicated that some of the features used in this restricted evaluation task, namely "motivational group membership information", "graphical view to the hyperdocument space", "hyperdocuments that change their colour depending on the popularity", can be directly applied to a wider context of modern computer-based learning environments (see e.g. Dillenbourg 1999).

References

Dieberger, A. (1999). Social Navigation in Populated Information Spaces. In A. Munro, K. Höök & D. Benyon (Eds.), *Social Navigation of Information Space*, (pp.35-54). London: Springer.

Dillenbourg, P. (Ed). (1999). *Collaborative-learning: Cognitive and Computational Approaches*. Oxford: Elsevier.

Garcia, T. & Pintrich, P. (1994). Regulating Motivation and Cognition in the Classroom: The Role of Self-Schemas and Self-Regulatory Strategies. In D. Schunk & B. Zimmerman (Eds.), *Self-Regulation of Learning and Performance: Issues and Educational Applications*. Hillsdale, N. J.: Erlbaum.

Hoppe, U. & Ploezner, R. (1999). Can Analytic Models Support Learning in Groups? In P. Dillenbourg (Ed.), *Collaborative-learning: Cognitive and Computational Approaches*, (pp.147-168). Oxford: Elsevier.

Kurhila, J., Miettinen, M., Niemivirta, M., Nokelainen, P., Silander, T. & Tirri, H. (2001). Bayesian Modeling in an Adaptive On-Line Questionnaire for Education and Educational Research. In H. Ruokamo, O. Nykänen, S. Pohjolainen, & P. Hietala (Eds.), *Proceedings of The 10th International "Intelligent Computer and Communications Technology – Learning in On-Line Communities" Conference (PEG)*, (pp.194-201). Tampere, Finland.

Landon, B. (2001). *On-line educational delivery applications: a web tool for comparative analysis* [Online reference, see <http://www.ctt.bc.ca/landonline/>, referred 10.04.2002]

Munro, A., Höök, K. & Benyon, D. (1999). Footprints in the Snow. In A. Munro, K. Höök & D. Benyon (Eds.), *Social Navigation of Information Space*, (pp.1-14). London: Springer.

Pintrich, P. (2000). The Role of Motivation in Self-Regulated Learning. In P. Pintrich and P. Ruohotie (Eds.), *Conative Constructs and Self-Regulated Learning*, (pp.31-50). Saarijärvi: Learning and Change Series of Publications.

Ruohotie, P. (2000). Conative Constructs in Learning. In P. Pintrich & P. Ruohotie (Eds.) *Conative Constructs and Self-Regulated Learning*, (pp.1-30). Saarijärvi: Learning and Change Series of Publications.

Scardamalia, M. & Bereiter, C. (1994). Computer Support for Knowledge-Building Communities. *The Journal of the Learning Sciences*, 3(3), (pp.265-283).

A Study of Changes in Attitude Towards Science in a Technology Based K-8 Preservice Preparation Science Classroom

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The purpose of this study was to identify and analyze changes in attitudes towards science in a technology based science content course for K-8 pre-service teachers. Given a science classroom where Internet research, hands-on science activities, cooperative group work and a constructivist learning environment is promoted, research can identify how students' attitudes towards science change before and after taking a technology integrated class. Technology is required in standards based teaching, and the science teacher needs guidance in integrating technology into her teaching while continuing learning experiences that work in her classroom. A positive attitude towards different components of science in pre-service teachers can facilitate more effective learning in science in K-8 classes.

Attitudes associated with science appear to be affecting student participation in science as a subject (Koballa et. al., 1990)[1] and impacting performance in science (IAEP, 1992)[2]. An international assessment of nine-and-thirteen-year-old students in twenty countries (IAEP, 1992)[2] revealed that positive attitudes toward science were related to higher student performance.

Science teachers in grades K-12 have developed hands-on, experiential methods that have been effective without adding in the mix of technology. Teacher accreditation agencies are requiring technology literacy for teachers, but the connection to improving attitudes towards science, perception of the science teacher, and the value of science in society, had not yet to be analyzed. The hands-on science teacher has some real questions about the value of replacing class time spent in practicing the processes of science with computer and other technology based experiences.

For this study twenty-nine students in a one semester four hour class took the "Test Of Attitude Towards Science"[3] on the first day of the Earth and Physical Science for K-8 Teachers at Black Hills State University. These students spent 4 hours per week for 15 weeks in a university computer lab that provided Internet access, and use of standards software packages. Students studied a science textbook outside of class, and completed project based activities in earth and physical sciences during class. They used the Internet to research science content, lesson plans for K-8 teachers, and to access state and national science standards, including STS standards. The students took the same survey as a post assessment in the last week of the class.

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[1] Koballa, Jr., T. R., Crawley, F. E., & Shrigley, R. L. (1990). A summary of science education-1988. Science Education, 74 (3), 369-381.

[2] IAEP. (1992) International Assessment of Educational Progress.(1992). Learning Science. Princeton, NJ: Educational Testing Service.

[3] Weinberg, M. (1998). Assessing student attitudes towards science in an urban elementary classroom. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, San Diego, CA.

The pre and post responses were analyzed using nonparametric statistics. The perception of the science teacher was the variable that showed the smallest increase between pre and posttest. Other subscales on the instrument showed decrease in anxiety towards science, and increases in motivation and enjoyment of science. More than 80% of the students indicated that their overall attitude toward science had increased appreciably since the beginning of the course.

The students were pre-service teachers so it would be expected that they already had a fairly positive perception of science teachers. On a formative assessment that asked the students about their most positive experience in science learning, almost all of the individuals who responded to this question described hands-on activities and an enthusiastic science teacher. Adding in the use of technology in this class appears to have been the cause of a significant increase in feelings of motivation and enthusiasm about science, since so many pre-service teachers are uncomfortable with the requirement that they teach science after obtaining employment.[4] Further research with similar classrooms that are taught without the presence of extensive access to technology could make an even stronger case for integration of technology into science teaching.

In this study, hands-on, learner-centered classroom activities as well as the use of technology, provided interesting and motivating experiences for the students at the same time that their attitudes towards science improved. Results of this research can be generalized and validated for larger populations and can encourage science teachers to use technology and Internet access in their classrooms for other purposes than record keeping and word processing.

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[4] Canterna, Ron. (1994). University of Wyoming. Personal Communication.

A Framework for Online Professional Development

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A Framework for Online Professional Development

Online professional development serves the needs of individuals as well as organizations. Professional development can be viewed from these two perspectives: the individual who plans to participate in additional education and training opportunities and a system that provides those opportunities to its workforce (Bellanca, 1995). Adding an online perspective to professional development activities provides an individual with the chance toparticipate in education and training opportunities at times and places that are convenient. Systems benefit from online professional development by reducing travel and absent employees (McCampbell, 2000). This proposal explores a framework of designing, developing, maintaining, and implementing an online professional development program for educators who are challenged by national and state reform and accountability initiatives. The example OPD workshops described in this paper have been developed and implemented. As part of the framework for OPD, issues related to Accountability and Reform Initiatives are addressed. In addition, a set of guiding questions that focus on High Quality Course Design, Course Management, and Learner Support/Course Facilitation are used to design, develop and implement the OPD. Before these questions are addressed, however, let us begin by definingOPD.

The Challenge of School Reform and Accountability

During the past decade, many states across the country have engaged in rigorous school reform and accountability efforts, most in direct response to the national Goals 2000 initiative. In some states, high-stakes testing accompany rigorous standards, all with the hope of transforming education and improving student performance.

Ultimately, the improvement of performance comes down to how well teachers understand the reform efforts, the standards, and the content for which they are being held accountable (Sparks & Hirsch, 1997). Teachers must have the tools, support, and training to radically change teaching and to infuse change at the school level (Darling-Hammond & McLaughlin, 1995; Sparks & Hirsch, 2000). Schools trying to improve must consider professional development as a cornerstone to success (Fullan, 1999) with strong linkages between professional development and the reform agenda (Darling-Hammond & McLaughlin, 1995). In the past, fragmented approaches to professional development have yielded minimal progression toward a clear, compelling vision for the future (Fullan, 1991). This vision, apparent in most school reform agendas, should be considered when linking professional development with reform. By linking professional development with participants' ongoing professional practice, the effects may begin to visibly move the reform agenda in a positive direction, thus promoting change within the educational system as a whole (Sparks & Hirsch, 1997).

Lieberman (1995) suggests that a radical re-thinking of professional development must occur. Given that learning occurs through active engagement, it is time to consider alternatives to more traditional direct-instruction approaches. With a national average of only 1% of the budget slated for staff development, with less than 50% of teachers receiving release time for professional development, and with nearly 25% of teachers given no time, credit or support (NCES, July 98), rethinking the practice of professional development, as well as the mechanism for delivery, is critical. It is no surprise that teachers report increased use of strategies and change in their teaching practice with increased professional development (NCES, July 98). Thus, support for professional development is a most important variable in school reform.

Defining Online Professional Development

Online Professional Development (OPD) is the delivery of professional development where participants and instructors are separated by time and usually by distance, using the World Wide Web as the tool for instruction, communication, and collaboration. As with all forms of distributed learning, there are a variety of learning goals and approaches used within various OPD settings. Based on the learning goals, the available technologies, and the level of interaction that is deemed necessary, an appropriate model or combination of models may be selected. With interaction being a significant contributor to the success of online learning, it is important to consider the levels of interaction being used. Both social and instructional interactions contribute to the success of online learning. Social interaction promotes communications and collaboration, while instructional interaction promotes interaction with the content. Three levels of instructional interaction are commonly discussed for distributed learning, to include: (1) interaction with the content, (2) interaction with the instructor, and (3) interaction with peers (Moore, 1989; Northrup, 2001; Rasmussen & Northrup, 2000). Models of Online Professional Development will vary in their type and amount of social and instructional interaction. Models for OPD that encourage various levels of interaction include: (1) Self-Paced, Individual Study, (2) Lecture-Discussion, and (3) Learning Community.

Self-Paced, Individual Study

This model of OPD has low levels of interaction and closely resembles a correspondence course. Interaction would most likely occur between the student and instructor and between the student and the course materials. This self-paced model may be "open-entry, open-exit" where participants log on and complete their course using their own time table rather than a specific beginning and ending date for the course. For participants who are very motivated and self-directed, this model may yield successful results. For most, this is a difficult approach. In addition to being difficult for students, instructors/facilitators have no boundaries and find it hard to communicate, assess assignments or to establish a relationship with students.

Lecture-Discussion Model

Typical lecture-discussion models provide online lectures via PowerPoint, streamed video, or even through videotapes delivered via surface mail. This approach, if deemed appropriate, may provide the typical lecture discussion approach where students are encouraged to read materials, view lectures, and respond accordingly through listservs, chat rooms, or via threaded discussions. The levels of interaction in this model would include instructor-to-student interaction, student-to-materials, and student-to-student interactions most closely aligned to discussion of given content. Less social interaction would occur in this model.

Learning Community Model

This model places its emphasis on interactions among participants, instructors, and facilitators. Many learning community models rely on activities to spark ideas and generate collaboration and sharing. This many-to-many model makes use of listservs, threaded discussion, and chats, with a focus on collaboration and communications. Success with this approach requires embedded scaffolding of expectations, guidelines for setting up teams, and some general rules of dialog. Interaction in this model heavily emphasizes social interaction as well as student-to-student and student-to-instructor instructional interactions. What's missing in this approach is the tutorial-focused instructional component of instruction, as most assignments are centered around activities. Depending on the instructional content, this may or may not suffice as the sole vehicle for instructional delivery.

Guiding Questions for Online Professional Development

As a result of the need for radical rethinking of professional development, this paper documents how Online

Professional Development (OPD) can be used as one of many professional development strategies within a school district. This paper advocates OPD as one solution; however, there are several other learner-centered approaches that should be considered when developing a school or district-wide professional development plan. The guiding questions addressed in this paper center around the elements of professional development, whatever the medium (EDC Center for Online Professional Development, 2000). The following guiding questions form the basis for High Quality Design, Course Management, and Learner Support/Course Facilitation of OPD:

- How do we provide equal professional development opportunities for all teachers at a time and place
- convenient for them?
- How do we provide opportunities for collaboration and sharing among faculty?
- How can we provide a forum for inquiry, reflection, and mentoring?
- How do we model successful practice?
- How can professional development translate into professional practice?
- How can we promote ongoing communication and conversation among educators?
- How can we foster "deep" understanding of the subject matter and its relation to the school reform and accountability agenda?
- How can we instill confidence in participants who are not familiar with online learning?
- How can we scaffold strategies for time management and for embedded support throughout the professional development experience?

Using the Framework for OPD Development

Information Engagement: Reading in the Content Area and *The Making of a Technology-Rich Classroom* are two Online Professional Development (OPD) workshops designed and field tested through grants in collaboration with The University of West Florida's Division of Technology, Research and Development and partnering Florida school districts. In response to standards-driven reform, these OPDs provide opportunities in continuous improvement of professional skills as teachers participate in an active, engaging learning community. The OPDs are highly interactive, activity-focused, and rich in collaboration and discussion among participants, instructors, and facilitators.

Each of these OPDs are four-week, 10-hour workshops (approximately 2.5 hours per week) designed to guide teachers through related processes and content. In the *Making of a Technology-Rich Classroom*, (http://mentor.coe.uwf.edu/onlinepd/) the goal of the workshop is to provide teachers with knowledge, skills, and abilities that are needed to successfully integrate technology into the teaching and learning environment which, in turn, will enhance the overall learning environment and, ultimately, increase student performance. Similarly, *Information Engagement: Reading in the Content Area* (http://dev.ibinder.uwf.edu/cybersphere/profdev/onlineindex.cfm) is designed to provide middle and high school teachers with the skills they need to effectively integrate reading techniques and strategies into content area classes with the objective of increasing reading scores.

The OPDs combine elements of the lecture-discussion model (i.e., information acquisition) and the learning community model (i.e., discussion-based, sharing of experiences, both prior and current). The OPDs were systematically designed to promote exploration and discovery, encourage experimentation, and to provide rich examples and opportunities for practice. In addition, the OPDs are designed to be highly interactive and visually rich, taking teachers into others' classrooms via online video examples.

Information is presented over the four-week period (see Figure 1 for the main site of *The Making of a Technology-Rich Classroom*) to the teachers in manageable, small chunks that focus on specific objectives through several delivery methods: text, graphics, and video. Teachers are guided through the workshop by a facilitator. The facilitator promotes interaction in threaded discussions and through the listserve, and serves as an expert for individual questions, offering advice and best practices.

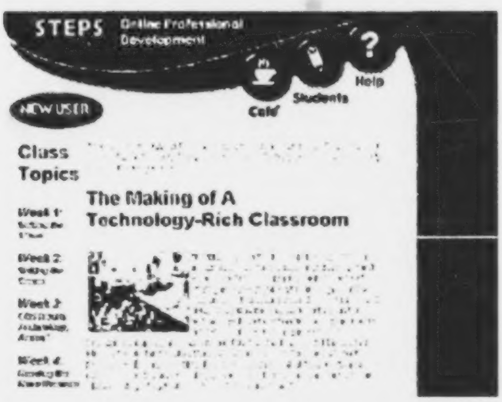
STEPS
Online Professional Development
Help
Students
Café
NEW USER
Class Topics
The Making of A Technology-Rich Classroom
Week 1
Week 2
Week 3
Week 4

Figure 1.
The Making of a Technology-Rich Classroom main site with weekly topics.

Research on traditional teacher staff development suggests that typical in-service activities for teachers is faulty – teachers spend isolated time, away from their classroom, learning the topic and never fully implement, either by choice or by situation, the changes into their classroom. These examples of OPD combat these issues by enabling teachers to participate in the workshop at times that are convenient for them and by, more importantly, guiding the teachers in a step-by-step processes that are immediately implemented. In other words, teachers field test techniques and strategies suggested by the OPD and other teachers in their own classroom laboratory. This integration of implementation into the workshop environment provides teachers with the motivation to start to implement and then, hopefully, to provide them with enough support so that they may continue the implementation after the workshop is completed. Teachers then reflect with other learners and facilitators as to what worked through communication activities (chats, listserves, and threaded discussions [see Figure 2]) which also permits them to learn about challenges and successes experienced by their colleagues. The structure of the OPDs, over an extended period, require that sharing and reflection take place – giving teachers the time that they need to actually try out innovations in their classrooms and evaluate the success of that innovation.

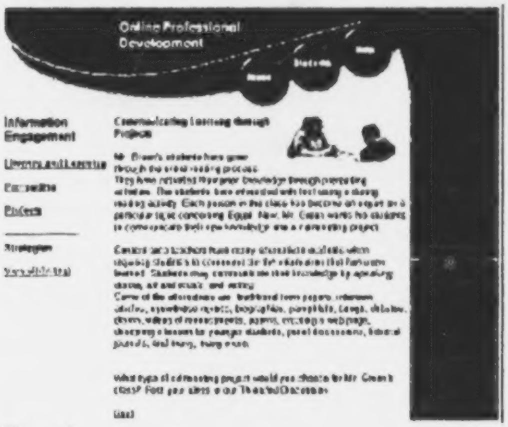
Online Professional Development
Information Engagement

Figure 2.
Information Engagement: Reading in the Content Area weekly lesson example.

Field Testing the OPDs

Information Engagement: Reading in the Content Area and *The Making of a Technology-Rich Classroom* have been developed and implemented with teachers. An evaluation was conducted after each field test. Both evaluations yielded

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positive results, with teachers focusing on the convenience of the OPD and applicability of the strategies to the classroom. Teachers were able to integrate innovative strategies into their classrooms with little disruption or interference in the day-to-day operation of the class. Using anecdotal data from the four-week period, teachers believed that student performance would be improved with continued use of the new strategies.

Addressing the Guiding Framework Questions

The questions outlined earlier relating to High Quality Course Design, Course Management, and Learner Support/Course Facilitation are extremely important in the ultimate success of the OPD participant. The first area of concern that needs to be evaluated is the *course quality*. Without a strong foundation of quality, the professional development will not meet the needs of the participants. Learning outcomes are aligned to relevant standards (e.g., NETS, NCTE/IRA). In addition, throughout the OPDs, teachers align their own revised curriculum, using suggested strategies that focus on improving student performance. Materials, including web pages, activities, supporting resources, have been created by professional instructional designers in consultation with subject matter experts who are experts in their fields. The instructional materials contain web links, readings, and assignments that are aligned to standards and workshop goals and objectives. Information is presented and activities are incorporated in a variety of fashions to meet a variety of learning styles. All activities are designed to be able to be immediately used in the classroom with a minimum of disruption. The weekly activities are designed to take no more than the allocated time of 2.5 hours, which includes the time set aside for chat sessions, threaded discussion responses, and listserve communication. All elements of the OPD are designed to promote effective and efficient learning that meets the needs of the teachers and the goals of the workshop.

Expectations for teacher performance are clearly outlined in the first week – the final outcomes are outlined and teachers immediately begin to work on their final projects, which are based upon implementing topic strategies by the end of the OPD. Facilitators communicate with teachers at least twice a week to make sure that they remain motivated and on track.

Course management issues revolve around two major categories: Administrative (for the providers of the OPD as well as for those who supervise professional development activities at the district- and school-level) and the Participant. Concerns of registration, recognition and notification, cost, and alignment of the OPD to the district schools' accountability and improvement initiatives must be addressed. Districts handle these issues differently. In some cases, teachers register through their home districts. At other times, participants will register through the OPD web site. At the completion of the workshop, teachers are provided with a certificate and the district staff development office is notified via e-mail that the teacher has successfully completed the OPD. Costs are negotiated with the district for district-sponsored workshops. Some districts may choose to negotiate to implement the OPD and assume the responsibilities for access and facilitation.

OPD can, in many cases, be overwhelming to participant on several levels. Even expert technology users must become comfortable with the delivery system and the demands of learning at a distance. Novice users face the challenges of learning both to learn at a distance as well as being able to efficiently and effectively use new technologies. Teachers should have a basic level of technology literacy, including the ability to use the Internet, email, and use basic application software. An online orientation assists teachers in developing the skills they need to be distance learners. In addition, the first week serves as an orientation to the content of the OPD. When districts participate in the OPD, face-to-face orientation meetings can be held. For teachers who may not possess all of the technology skills, tutorials are available to provide them with additional support (which may require additional time on the teacher's part).

Before a teacher participates in OPD, they must commit to the time required for the workshop and have access to the minimum technology resources needed. They should also accept the philosophy of the OPD in terms of interaction and relationship development. In the example OPDs, teachers commit to accessing the site at least two to three times a week as they actively share their experiences and implement technology-rich activities in their own classrooms. Teachers work in groups and must be able and willing to participate in group activities. The final area of concern when considering OPD involves *learner support and course facilitation*. First, teachers should evaluate the level and amount of support and determine whether it fits their style and needs. The accessibility of the facilitator and experts should be evident – both facilitators and experts should be available at various times throughout the OPD to offer support and guidance. Responses to questions should be returned to the teacher within 24 hours at most. Online support, such as tutorials, coaching, embedded assistance, and other resources, should be available to supplement needs of the distance learner. Student-to-student interaction should be encouraged to promote and develop an active learning community that will continue beyond the OPD experience. The learning environment should be non-threatening and supportive to permit teachers to explore and discover strategies that are meaningful to their own instructional situation. Finally, the site, or resources from the site, should be available so that teachers can revisit resources as they follow-up and continue to implement strategies from the OPD.

Support and facilitation are of utmost importance. In the example OPDs, extensive web resources including tutorials, web resources, activity databases, standards, and previous teacher ideas are available whenever the teacher needs additional information. Teachers are encouraged to share via the listserve new sites that might also interest their peers. These new resources are captured by the facilitator who then improves the web resources by new relevant sites. Facilitators are themselves expert teacher who successfully integrate technology in their own classrooms and serve as active participants, sharing their own experiences, as they encourage and motivate the teachers. After the OPD concludes, the facilitator maintains contact with the teacher participants for a period of two months, providing follow-up information and encouraging the teacher to continue to integrate technology into his or her classroom. In addition, teachers are encouraged to keep in contact with their new peers to develop their own learning community that promotes technology integration.

Conclusion

Online Professional Development is an effective way to provide teachers with the new skills that they need to meet the challenges of state and national accountability and reform initiatives. Available at their convenience, teachers can take advantage of OPD workshops that meet their needs. The appropriate design and development of a workshop, in conjunction with learner support of the OPD, facilitates participant success. Following the framework for online professional development ensures a successful OPD experience.

References

Bellanca, J. (1995). Designing Professional Development for Change. Arlington Heights, IL: SkyLight. Darling-Hammond, L. & McLaughlin, M. (1995). Policies that support professional development in an era of reform. Phi Delta Kappan, 76(8), 597-604.

EDC Center for Online Professional Education (2000). Designing and implementing online professional development workshops. [online: http://www.edtechleaders.org/Resources/opd_report/intro.htm.

Fullan, M. (1999). Change forces: The sequel. Bristol, PA: Falmer Press.

Lieberman, A. (1995). Practices that support teacher development. Phi Delta Kappan, 76(8), 591-596.

McCampbell, B. (2000). Online courses: meals or snacks. Principal Leadership (High School Ed.), 1(4), 72-5.

Moore, M.G. (1989). Three types of interaction. The American Journal of Distance Education, 3(2), 1-6.

Northrup, P. T. (2001). A framework for designing interactivity into web-based instruction, Educational Technology, *41*(2), 31-39.

Rasmussen, K.L. & Northrup, P.T. (2000). Interaction on the web: A framework for building learning communities. Paper presented at the annual meeting of the Association for Educational Communications and Technology, February 2000. Long Beach, CA.

Sparks, D. & Hirsh, S. (1997). A new vision for staff development. Alexandria, VA: Association for Supervision and Curriculum Development.

Sparks, D. & Hirsh, S. (2000). A national plan for improving professional development. [online: http://www.nsdc.org/library/NSDCPlan.html].

U.S. Department of Education. National Center for Educational Statistics. (1998). Toward better teaching: Professional development in 1993-94, NCES 98-230, by Susan P. Choy and Xianglei Chen. Project Officer: Michael Ross. (Washington, DC: U.S. Government Printing Office).

Learner Perceptions of Online Interaction

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Interaction has been defined from many perspectives. Most simply stated *interaction is engagement in learning* (Hillman, Willis & Gunawardena, 1994). It is agreed that interaction must be designed into an instructional program and that it is an important variable for online learning. Berge (1999) suggests that interaction is important to learner satisfaction and that it assists in maintaining student persistence in courses. With retention in online learning programs being as low as 50% in some cases and course completion rates in traditional courses at 10-20 percentage points higher than in online courses (Carr, 2000), learner satisfaction is a key variable. With interaction being a component of overall student satisfaction, interaction should be considered when trying to increase retention in online courses. However, from the online learners point of view, too much interaction may be perceived as busywork and lead to frustration, boredom, and overload (Berge, 1999); while too little interaction may result in student isolation. Both are considered frustrating and a balance has to be found.

Several interaction frameworks and taxonomies are available as guidelines for designing for online interaction. Moore (1989) identifies three types of interactions: (1) interaction with the content, (2) interaction with peers, and (3) interaction with the instructor. Gilbert and Moore (1998) view the process from a different perspective indicating that interactions encompass both instructional and social situations.

Sorting through interaction frameworks to determine the most appropriate interactions for given learning outcomes is difficult at best. Northrup (2001a) provides a set of interaction attributes that can be used to select strategies and tactics to facilitate online interaction. The attributes encompass levels of content interaction, types of dialog through communications and collaboration, levels of student self-directedness, and types of support for the learner anytime, anyplace.

With most research on interaction focused on classifying the types of interactions or building frameworks from which designers would select appropriate interactions for given learning outcomes, it seemed apparent that there should be an upper and lower limit to the types of interactions used for a given set of instruction. Additionally, with *student perception of interaction being complete* as such an important variable for ongoing participation in the course (Zhang & Fulford, 1994), the relationships of student perception to the attributes of interaction should be considered.

Purpose of the Study

The purpose of this study was to investigate the types of interactions that students perceived to be important for online learning. The interaction attributes investigated included content interaction, conversation and collaboration, intrapersonal/metacognitive skills, and need for support. Also investigated were reasons why learners were taking online courses. It was presumed that students taking courses for convenience, flexibility, or preference would likely be more pleased with interaction in online course than those required to take an online course because it wasn't offered on campus.

Method

Introduction

The purpose of this study was to investigate the types of interactions that students perceived to be important for online learning. Interaction attributes studied in this investigation included content interaction, conversation and collaboration, intrapersonal/metacognitive skills, and need for support. This study was an initial investigation of learner perceptions of online interaction. Data were collected through the administration of the Online Learning Interaction Inventory (OLLI) (Northrup, 2001b).

Participants

This study consisted of 52 graduate students in an online masters program in instructional technology. Thirty-four of the students were female and 18 were male. Students were selected to participate in this study based on where they were in the program of study. Intact classes of students were selected from two courses at the beginning of their online learning sequence and two courses at the end of their online learning sequence.

Instrumentation

The instrument used for this study was the Online Learning Interaction Inventory (OLLI), with a reliability coefficient of .95. The OLLI focused on the four interaction attributes of content interaction, conversation and collaboration, intrapersonal/metacognitive skills, and need for support.

The OLLI was divided into six sections with a total of 50 items. Section 1 dealt with demographic information. Section 2 included five questions on reasons why students selected to take an online course. Section 3-6 addressed each of the interaction attributes and were rated on a five point Likert scale with 1 representing strongly disagree to 5 representing strongly agree. Section 3 dealt with *Content Interaction*. There were 13 items relating to the indicators of content interaction. Section 4 addressed *Conversation and Collaboration* with 14 items relating to the indicators of interaction. Section 5 addressed *Intrapersonal/Metacognitive Skills* with 7 items relating to the indicators of interaction. Section 6 addressed *Support* with 7 items relating to the indicators of interaction.

Procedure

In the current study, students from four online classes were sent a detailed email stating that the purpose of the Online Learning Interaction Inventory (OLLI) was to gather information to continue to make the online courses and the program more appropriately interactive. The email indicated that data would be reported and used as research as well as be used for formative evaluation purposes. Students were provided with the url to take the OLLI online. In two of the four courses, the OLLI was posted as a weekly assignment. In the other two courses taking the OLLI was optional. Students were provided with one week to complete the 50-item instrument.

Data Analysis

Data were analyzed by item using frequency, means, and standard deviations to report areas of interaction that are perceived to be valuable or a hindrance to success for online learning. Research questions for the study are as follows:

Question 1: Why do students learn online? Question 2: What interaction attributes do students perceive as important for online learning?

Results and Discussion

Data collected from the OLLI were analyzed by attribute, with frequency, means and standard deviations reported. Reported first will be responses from the first research question related to students learning online. The second research question related to the interaction attributes will be reported by each of the four interaction attributes.

Learning Online

Learning online is related to the first research question, *Why do students learn online?* The majority of students selected to take online courses for convenience (M=4.13, SD=1.14) and flexibility (M=4.65, SD=1.33). Most of the students reported that they could attend school even if the course was campus-based (M=3.58, SD=1.58), indicating that many of the students lived close enough to the campus to take campus-based courses. Only 12 students (23%) reported that it would be impossible to take the course if it were not offered online.

Interaction Attributes

There are four interaction attributes related to the second research question. Attributes included: (1) content interaction, (2) collaboration and conversation, (3) intrapersonal/metacognitive strategies, and (4) support. Responses are included by attribute for the following research question: *What interaction attributes do students perceive as important for online learning?*

Content Interaction. In general, it appears that students agree that interacting with the content is important to their online learning experiences. Overall, they report that they like partially individualized courses with some instructor direction (M=3.77, SD=.85). Participants also reported a desire to interact with content delivered via audio-narrated online presentations (M=3.65, SD=1.22). Interacting with innovative instructional strategies also was reported to be important to their online experience. Strategies such as case studies (M=2.83, SD=.92); structured games (M=3.10, SD=1.11); and readings followed by online discussion (M=4.56, SD=1.09) were all rated popular with participants. Interestingly, participants expressed strong frustrations about being required to participate in too many interactive assignments in a weekly segment of the course (M=4.08, SD=1.06).

Interacting with the content is a major component of an online course and the primary location where new knowledge, skills, and abilities are presented. Typically instruction online is presented as instructor-centered or student-centered. Both are appropriate given the learning outcome and topics of the course content. Students in this study seem to prefer a variety of techniques, yet seem to feel most comfortable with the "feeling" of a traditional class. With the highest reported perceptions of positive interaction in the areas of audio-narrated presentations and readings text followed by discussion. The lecture itself (the audio-narrated presentations) can provide a foundation for other attributes of interaction including conversation, collaboration and informal discussion.

Conversation and Collaboration. Results of the interaction attribute of conversation and collaboration indicated that participants rely on their peers and their instructor in forming and maintaining the online learning community. The majority of participants (M=4.94, SD=1.06) reported that it is essential to build a community of learners in the online environment. Participants reported liking to discuss ideas and concepts with peers (M=4.00, SD=. 71) and also perceive that sharing information with peers is important (M=3.83, SD=. 71). In relationship to teaming, participants reported that working in teams was difficult for them (M=3.08, SD=1.19) and that once a team is formed; they prefer to maintain the same team for the entire semester (M=3.62, SD=1.05). In terms of innovative instructional strategies for interacting online, participants reported liking online debates (M=3.04, SD=1.12) and posing questions to experts (M=4.02, SD=1.02). Students weren't as receptive to the idea of posing as the guest presenter in class (M=2.71, SD=1.18). Finally, in terms of feedback from the instructor, participants reported that it is important to them (M=4.35, SD=.76) and that the instructor should make every attempt to provide some kind of feedback to them at least two times per week (M=3.77, SD=.85). Interestingly, participants reported that it was unnecessary for instructors to provide feedback on a daily basis (M=4.25, SD=.84).

Promoting collaboration and conversation online is an attribute of online learning that participants considered important. Overall, forming the community of learners, collaborating with peers, and getting feedback from the instructor were the most highly rated indicators of this attribute. Given that groups of students do not just become collaborative because they are assigned together (Johnson & Johnson, 1994) means that designers and instructors should provide clear expectations for collaboration online.

Interestingly, note the positive responses on innovative instructional strategies. The variety of strategies presented within the confines of a course appears to yield positive perceptions among students. Providing both synchronous and asynchronous conversation and communication online can extend learning and at the same time motivate the learner (Sherry, 2000).

Intrapersonal/Metacognitive Skills. Analysis of items related to intrapersonal/metacognitive skills suggest that self-directedness and embedded cognitive strategies designed into the online learning environment are perceived to be important to participants. Participants reported that it is important to monitor their own progress each week (M=4.58, SD=.72). With regard to embedded cognitive strategies, participants reported that it is important to have structured times that assignments are due (M=4.33, SD=.83), to have an advance organizer to assist them through the assignments each week (M=4.10, SD=1.00), to provide graphical representations of the steps that should be taken to complete assignments (M=3.96, SD=1.31), and to have notetaking guides to accompany audio-narrated presentations (M=4.04, SD=1.12).

Overall, self-regulating one's own learning is an important aspect of online learning. Not only do students need to monitor their progress in an ongoing fashion and adjust their strategies for learning based on their progress, they also need to maintain a time management schedule in order to complete online learning activities in the allotted timeframes. To assist and guide learners through online learning, strategies like advance organizers and graphical representations are used to guide the learner through assignments, while notetaking guides and posted times for assignment due dates are also included.

Support. Results indicate that support is also a key attribute in the success of online learning. Designing online learning with a solid support system in place enables timely responses to questions, mentoring, tutorials, and tips from peers. This support system may very well provide a foundation for successful learning. Participants report that timeliness of response (M=4.48, SD=.64) is a major indicator of support. Most participants reported also that having a mentor in place to provide assistance is also important (M=3.52, SD=1.35). Participants also reported that having tutorials available as needed (M=3.12, SD=1.55) will assist them in performing tasks such as being in a chat room, posting to a threaded discussion, etc. And no surprise, participants report that when the technology doesn't perform as intended, they are extremely frustrated (M=4.17, SD=1.15).

Overall Perceptions of Interaction

Overall, participants provided the reasons why they chose to take courses online. They also rated items in each attribute of online interaction as important to their success as online learners. The top reason for taking a course online was the flexibility (M=4.65, SD=.74) followed closely by convenience (M=4.13, SD=1.14) With regard to the interaction attributes, Intrapersonal/Metacognitive had the most highly rated indicators with self-monitoring of individual progress (M=4.58, SD=.72) rated at the highest frequency. The support attribute also rated at the top with timely responses by the instructor (M=4.48, SD=.64) rated as the number two indicator of an interactive online course. Although indicators exist in each of the interaction areas, the idea of self-regulating learning and having timely feedback from the instructor was reported as most valued by participants.

Conclusion

In conclusion, it is agreed that interaction should be designed into online instruction. It is also agreed that interaction is an important variable for learning, primarily because it is important to learner satisfaction and motivation (Berge, 1999). In this study, online learners echo the importance of interaction by requesting interactive elements in their online experiences. Participants in this study are still most comfortable with the idea of simulating a campus-based class online, as reflected in their statements regarding the desire for instructors to use online audio-narrated lectures, provide notetaking guides, and discuss learned experiences in some type of online conversation. Although their comfort is with the "known" they still favorably rated using more innovative strategies in the online environment including case studies, debates, role-plays, and gaming. The foundation of the online learning environment however, included the notion of solid student support and self-directedness. Participants strongly stated that the need for timely responses from peers and from their instructor was of utmost importance. They also indicated that it was essential for students to self-monitor their progress for survival in the online course.

This study was an initial investigation into the perceptions of online learners' interaction needs. Future studies should consider other variables that may affect the individual learner, the learning environment, and instructional strategies that may be most appropriate for specific learning outcomes.

Reference

Berge, Z. (1999. January/February). Interaction in post-secondary web-based learning. *Educational Technology, 39*(1), 5-11.

Carr, S. (2000, February 11). As distance education comes of age, the challenge is keeping the student. *Chronicle of Higher Education.*

Gilbert, L. & Moore, D. L. (1998, May/June). Building interactivity into web courses: Tools for social and instructional interaction. *Educational Technology, 38*(3), 29-35.

Hillman, D. C., Willis, D. J. & Gunawardena, C. N. (1994). Learner-interface interaction in distance education. An extension of contemporary models and strategies for practitioners. *The American Journal of Distance Education, 8*(2), 30-42.

Johnson, D. W. & Johnson, R. T. (1994). *Learning together and alone: Cooperative, competitive and individualistic learning* (4th ed.). Boston: Allyn and Bacon.

Liaw, S. & Huang, H. (2000, January/February). Enhancing interactivity in web-based instruction: A review of the literature. *Educational Technology, 39*(1), 41-51.

Moore, M. G. (1989). Three types of interaction. *The American Journal of Distance Education, 3*(2), 1-6.

Northrup, P. T. (2001a). A framework for designing interactivity into web-based instruction, *Educational Technology, 41*(2), 31-39.

Northrup, P. T. (2001b). The online learning interaction inventory (OLLI). Unpublished document, University of West Florida.

Sherry, L. (2000). The nature and purpose of online discourse: A brief synthesis of current research as related to the WEB project. *International Journal of Educational Telecommunications, 6*(1), 19-51.

Zhang, S., & Fulford, C. P. (1994). Are interaction time and psychological interactivity the same thing in the distance learning classroom? *Educational Technology, 34*(6), 58-64.

Beyond Animation and Simulation: Teaching Mechanics with Explorations

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Abstract: The groundwork for interactive learning applications at the Laboratory for Technical Mechanics, begun ten years ago, has led to a new type of highly interactive application called an Exploration. Explorations combine aspects of construction, modeling, and simulation; they allow students to graphically create their own constructions, and supply the corresponding mathematical description. The program executes the necessary calculations and displays the results in graphs and as analytic equations. The idea behind Explorations was to support learning by constructions and immediate response by the system. In cooperation with the research group Computers and Society of the University of Paderborn, a number of Explorations were built for student use.

Introduction

The problem that arises in learning Technical Mechanics is finding the connection between mechanical structures and their complex mathematical and physical relations. The practice of teaching shows that especially for visual conceptualization, both of static and of dynamic mechanical processes, the use of animation and simulation programs can be a good extension to the classical method of presentation with chalk and blackboard. Even for mechanical problems covering static structures, an animation effectively shows how one can find a solution. The necessity for the visualisation of mechanical effects was the internal spark for developments of simulation programs at the Laboratory for Technical Mechanics of the University of Paderborn.

In the following paragraph is given a historical overview about our approach and our previous experience in the development of animations and simulations.

The second part of this paper will introduce a new kind of interactive learning application, the Exploration. These applications have capabilities that are in many ways more powerful than the capabilities of animations and simulations. They give students the ability to build constructions in a graphical way while construction, simulation, visualisation and analytic description of technical models are linking.

Previous works in the field of animations and simulations

In 1991, the Laboratory for Technical Mechanics procured its first PC systems, leading to the development of computer programs for instruction purposes. The first application (see Ferber et al., 1992) was a program for image processing, simulation and scientific visualisation. This program created simulations of experiments done by students in the laboratory section of a technical mechanics course. The shadow-optical images created by students during these courses are digitized and analyzed by image analysis algorithms[1], thereby allowing the unknown parameters of the experiment to be determined. With these parameters, based on the fundamental equations of optics, numeric simulations will be carried out. The pictures gained by visualization of the simulation results are compared with those pictures which are experimentally obtained, and students discuss the variations. Even the testing of parameter combinations before carrying out time-consuming experiments is thus made simple. In hindsight, the longevity of this application is remarkable. Function libraries which were developed in the programming language FORTRAN can still be used by modern compilers to simulate complex mechanical processes. Between 1994 and 1998, several applications and non-related animations were created. The didactic goal was to offer a means beyond mere text and visuals by which students could prepare for this infrequently offered course.

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[1] In this basic experiment, a specimen of a transparent composite material containing an existing crack is illuminated with light generated by a point light source. The stress intensification in the region surrounding the crack tip leads to a reduction of both the thickness of the specimen and the refractive index of the material. As a consequence, in the transmission case, the light passing through the specimen is deflected outwards, and a dark shadow spot is formed on an image plane behind the specimen. The spot is bounded by concentration of bright light, the caustic. This caustic contour determines the properties of the material.

mechANIma

With the mechANIma project (see mechANIma, 1998 and Keil-Slawik & Nowaczyk, 2000), which began as a co-operation between the chairs of Technical Mechanics and for Computers and Society, the efforts within the area of the new media which focus on new concepts of multimedia teaching were resumed and strengthened.

The acronym mechANIma establishes a connection between "mechanics" and "animation". However, mechANIma is not only a computer program or a collection of different materials for a mechanics course, but rather a new method for teaching and understanding mechanics. Our biggest concern in the project was the inclusion of students in the production of materials. This goal led to the phrase, "Software created by students for students", which remains an objective for us today. This phrase can be realized in auxiliary worker activities or as a part of seminary- and diploma theses. It was important to us that the chosen programming language was easy to learn and use, so even students without extensive programming knowledge could obtain a quick and easy introduction to programming. The programming language should not contain pitfalls which normally lead to errors, and should be capable of calculating complex simulations. Indispensable are extensive documentation and code samples which can be understood by the non-expert programmer. It should also contain programming examples for typical problems which arise in the development processes. Therefore, the suitability of a number of popular programming languages and environments has been evaluated and tested for our special purposes. Because of its popularity as a teaching language, it is assumed that future generations of students will use Java. Therefore, following the creation of independent modules in Visual Basic and Borland Delphi, Java was finally selected as the favoured programming language for this project. Because of the availability of different development environments without license fees, Java is also well suited for usage at universities. Its extensive standard class library allows Java to be used for developing user interfaces. Another advantage is the availability of Java for all four significant operating systems (Windows, Linux, MacOS and Solaris) used in university computer labs. The desire to more clearly elucidate complex mechanical processes by suitable visualization methods was the main motivation for the creation of animations and simulations for learning purposes. The most important aspect is that all our animation systems visualize the precise effects and parameters addressed in the lectures and tutorials. Hence, by modifying these parameters in animation systems, students get a much better idea of the underlying physical and mathematical effects.

In general, the interactive capabilities of simulation programs are limited. Only particular simulation parameters may be modified but the mathematical model of an experiment is fixed by the program and cannot be changed. Normally even small changes by the user are not possible.

With the intention of building a new kind of interactive digital media, we began the creation of mechADO (Hampel, 1999), a construction environment which covers the topic of static analysis of plane trusses. With mechADO, students are able to construct a truss and apply forces to it in an interactive way. The program then automatically calculates internal and external reactive forces of the construction. Even if mechADO lacks some important aspects of current Explorations, it was an important step towards the development of the Explorations-concept. This concept comprises the core of this paper, and is further described in the following paragraphs.

The Exploration Concept

Explorations are a new kind of highly interactive learning application which combine aspects of construction, modelling and simulation. They allow students the graphical creation of their own constructions whose mathematical description and calculation are executed by the program. The results are shown graphed and as analytic equations. The basic idea was to support learning by construction and immediate response from the system. Designed as modular units, a single Exploration always covers one well-defined topic. Those modules should be usable in different contexts: e.g. lectures, tutorials, individual self-instruction, or even in an internet-based cooperative learning environment.

A piece of software comparable to the Explorations in that it links construction and simulation is Interactive Physics 2000 (IP), a commercial application produced and sold by MSC Working Knowledge (see http://www.krev.com/products/ip.html). IP is suitable for simulating a wide range of physical topics such as kinematics, kinetics and rotation dynamics. Virtual experiments covering the elastic collision of masses are especially easy to simulate with IP. It was created as a monolithic application to cover all the above topics in one program. The disadvantage of this is that it may take the user longer to discover all the features of construction and parameter in- and output.

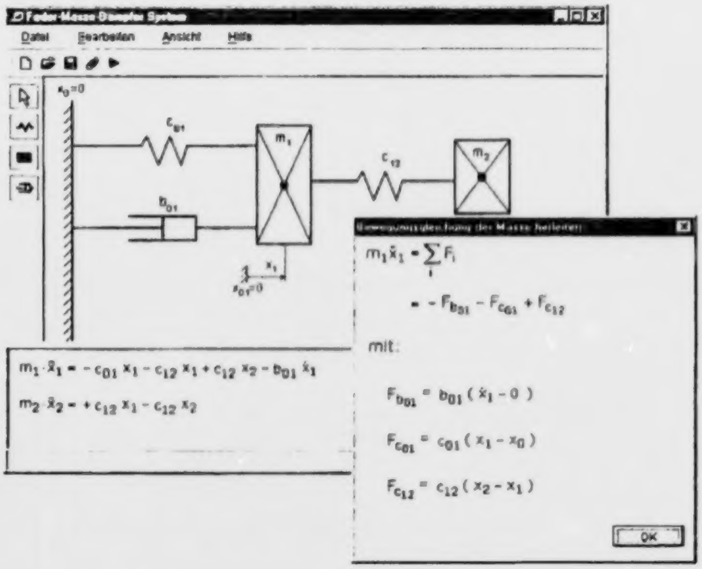
We tested IP as an authoring environment for building animations, but soon reached the limitations of the system. It was proven to be quite difficult to precisely reproduce the exercises which students had been solving for years with pencil and paper. However, the main reason for developing Explorations rather than using IP in the teaching of engineering was its approach to mechanics. In IP, a physicist's point of view is taken, whereas the Explorations view mechanics from an engineering perspective.

However, the major difference between IP and Explorations is that IP has no means of describing the constructed experiment with an analytic equation.

The ambitious goals of the Explorations were fulfilled in a two-year project. Applications which are now in use have been developed for fundamental topics in mechanics, including statics, dynamics and failure theories. It was not our aim to create an entire multimedia script, but rather a few modules which cover significant topics and are usable in a highly interactive way. That is why the Explorations are not bound to a specific learning medium, but can be used in many different environments. In an internet-based usage, such as in our prototypical environment, the Explorations can be started using Java Web Start in the browser. On a CD-ROM, the Explorations can be started immediately without any further software. Two out of eight constructed modules are presented in detail below.

Example of an Exploration: one-dimensional spring-absorber-mass system

A fundamental topic in the study of engineering are vibratory systems. In electrical engineering, they can be implemented using a combination of inductive and capacitive components, and in mechanics they can be implemented with masses and springs. For this part of a mechanics course, the Exploration Swingx should enable free construction of a vibratory mechanic system with various components.



$m_1 \cdot \ddot{x}_1 = - c_{01}\, x_1 - c_{12}\, x_1 + c_{12}\, x_2 - b_{01}\, \dot{x}_1$

$m_2 \cdot \ddot{x}_2 = + c_{12}\, x_1 - c_{12}\, x_2$

$m_1 \ddot{x}_1 = \sum_i F_i$

$= - F_{b_{01}} - F_{c_{01}} + F_{c_{12}}$

mit:

$F_{b_{01}} = b_{01} (\dot{x}_1 - 0)$

$F_{c_{01}} = c_{01} (x_1 - x_0)$

$F_{c_{12}} = c_{12} (x_2 - x_1)$

Figure 1: Exploration Swingx (one-dimensional spring-absorber-mass system)

With this Exploration, it is possible to demonstrate the element which mainly describes such a system; that is, the connection between drawing, equation of motion and the motion itself. The picture above shows one

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student's construction and how the equation of motion is deduced and presented. In this way, the student simultaneously sees the graphical and mathematical representation of the mechanical system. The following paragraph deals with this specific feature of the instructional program, which is called multi-level representation.

Multi-level representation in learning modules

Technical systems can be described not only with drawings, but also through mathematical notation (e.g. an equation). Because the mathematical notation can automatically be deduced from some kind of construction, it is possible to transfer this work to a computer program. Thus, the most important feature of an Exploration beside the visualisation of the numeric solution (i.e. in a graph or animation of the drawing) is the ability to depict the analytical solution. These two ways of representing a mechanical system can be viewed simultaneously in order to help the student comprehend the complex structures.

The multi-level representation and the ability of the student to change the construction with its components and connections demonstrate the correlations that describe the system. Thus, different points of view can be developed for a single task and set in correlation to one other. This will help the student to gain a deeper understanding of the topic.

In a nutshell, the main task of an Exploration is to simulate and animate systems constructed by students and to ensure consistency between the different ways of describing this mechanic system.

Example of an Exploration: Calculation of internal forces for straight beams

A comprehensive topic in technical mechanics is the static analysis of plane trusses. An introduction to this topic generally uses the example of straight beams. Therefore the Exploration Beamex is a learning tool in which students design the load and bearing of beams. Afterwards the resulting internal forces are visualised.

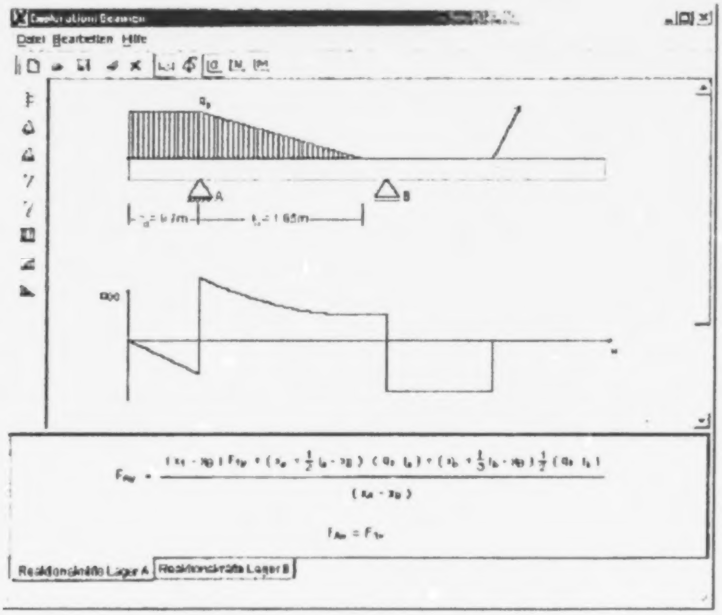

Figure 2: Exploration Beamax (internal forces in a beam) with an example construction

A selection of bearings is given, and the correct combination placed under the beam allow the calculation of the internal forces. Such an example is shown in the picture above. Distributed forces can be combined and superposed in various ways on the beam, leading to different internal forces. In a frame beneath the designed structure it is possible to visualise different internal force diagrams. Particular to the Exploration

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is not only the depiction of reactive forces in the schematic as force vectors, but also a corresponding calculation formula.

It is possible to change the construction even after the calculation. As a result, the student can continuously vary the loads and simultaneously observe the new diagram.

To summarize, Explorations have capabilities which surpass those of previous tools in several ways. They allow students to design on their own, with error-checking by the system to prevent impossible constructions. They enable the student to observe and link both the visual and mathematical descriptions of mechanical systems. Furthermore, they can be integrated into different learning environments.

Conclusion

With the Explorations, a new kind of highly interactive learning application was developed for engineering science which allows the construction and simulation of virtual experiments by the students themselves. What is more, the Explorations represent a new quality of learning program; they combine the graphical representation of technical systems with their corresponding mathematical equations and numerical simulations.

Future Work

The discoveries made during this two-year project are entering a new stage of development, forming the basis for cooperative Explorations. After implementing a communication interface, these Explorations will become a part of the cooperative learning environment sTeam (see Open sTeam 2001 and Hampel & Keil-Slawik 2001). Explorations which implement the so called sTeam module framework could use components for synchronous and asynchronous communication as well as awareness components directly from the sTeam environment.

With cooperative Explorations, distributed teams of engineering students can be formed, allowing them to receive feedback from each other, as well as from the simulation system.

References

Ferber, F., Hinz, O., Herrmann, K.P. (1993). Determination of fracture mechanical parameters by using digital image analysis and photoelasticity. *International Conference Photoelasticity: New Instrumentation and Data Processing Techniques*, London, 24.-25. November 1993, Short-Form Papers, Sira Communications Ltd, South Hill, Chislehurst, U.K., p. 4-30 - 4-37.

Hampel, Th., Keil-Slawik, R. Ferber, F. (1998). mechANImat each – A New Approach to the Teaching of Mechanics. In: Ottmann, Th., Tomek, I. (eds.): *Proc. of ED-MEDIA/ED-TELECOM 98*, Charlottesville (Va.): AACE, 1998 (Vol.I), p. 458–465.

Hampel, Th., Keil-Slawik, R., Ferber, F. (1999). Explorations – A New Form of Highly Interactive Learning Materials. In: de Bra, P., Leggett, J. (eds.): *Proceedings of WebNet'99*, p. 463–468.

Hampel, T., Keil-Slawik, R. (2001). sTeam – Designing an Integrative Infrastructure for Web-Based Computer Supported Cooperative Work. *Proceedings of the Tenth International World Wide Web Conference*, Hong Kong, May 1-5, 2001, p. 76-85.

Keil-Slawik, R., Nowaczyk, O. (2000). Von der geschlossenen Multimediaproduktion zur offenen Lernumgebung. In: F. Scheuermann (eds.): *Campus 2000: Lernen in neuen Organisationsformen*, Waxmann Verlag, p. 265-277.

mechANIma (1998). http://wwwfb10.uni-paderborn.de/LTM/mechANIma/mechanima.htm (in german)

Sun Microsystems (2001). http://java.sun.com/products/javawebstart/

Open sTeam (2001). http://www.open-steam.org/

Collaborative Learning with Dynamic Business Game Simulation – Innovative Learning Environment for Business Education

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Abstract *Business organizations and their employees face ever-increasing complexity and accelerating changes in their everyday work. This brings along the need for training models able to facilitate the development of knowledge and skills needed in this kind of environment. This paper introduces a certain computer-based, continuously processed business simulation. The purpose of the described learning environment, created with the use of highly interactive simulation is to represent a realistic view of business processes to the students and enhance students' perception of business processes as a whole. We introduce some pedagogical and theoretical guidelines for designing of this business game, and describe also an example of a learning environment based on the use of this game. Some preliminary results from the research based on an example course are also presented.*

Introduction

Modern, so-called knowledge society induces many new challenges to human competence and skills required for learning and working. As a result the ways of working, studying, and collaborating are changing dramatically. Work is increasingly becoming organized in teams and groups, and often supported by technology. Other main characters of the modern work are the distribution of expertise and working in networks, both of which require social and collaborative skills to share and construct together knowledge, ideas, symbolic artifacts etc. (Lehtinen, 2000). From the pedagogical perspective, students need to learn to learn, develop metacognitive capabilities and construct meaningful knowledge in interaction with others and with tools afforded by activity environments. This is true especially in the fields of science, but also in businessworld.

Our rationale for using a dynamic simulation in teaching within the domain of business comes from the alarming findings from previous studies. Namely, the biggest challenges and obstacles in business education as well as in other subject domains are difficulties in applying theoretical subject knowledge in real life settings, inabilities to handle complex and ill-defined problems, and lack of consistent and holistic conception of business processes. All of these problems are more or less connected to the question of contextualizing the content being learned. It's been found that graduate students of business management are not well prepared for the complex problems and situations they will face in real-life working contexts. That's partly due to the traditional teaching methods, which don't help students to face the complexity and cope with ambiguity and uncertainty of real business world they will inevitably face when taking positions in working organizations (Aram & Noble, 1999). These traditional forms of instruction (e.g. lectures) are often found to produce inert knowledge, which cannot be applied in complex situations (Bransford et al., 1991), and even intermediate experts of economics may have enormous difficulties in applying their knowledge and skills in realistic problem-solving situations (Mandl et al., 1994). One of the main reasons for the inabilities of traditional teaching methods to facilitate the development of flexible and useful knowledge and skills is the lack of contextualizing or anchoring the content being learned. If content is separated from its authentic context were content knowledge and skills are used in real life, it will produce inert or impoverished knowledge. In such impoverished environments, learning becomes the memorization of seemingly abstract, self-contained entities, not useful tools for understanding and interacting with the world (Barab et al., 2000). Furthermore, there exists a lack of integration between different functional areas of business studies (e.g. accounting, marketing, management), which makes it very difficult for students to

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develop coherent mental models about the business world and strategies in whole (Selen, 2001). This is a clear example of stripping content out of context and conditions in which it is used; separating different domain areas from each others and from their realistic intertwined existence. Walter and Black (2000) have recognized similar problem: what is needed in business education is a process approach. They state that the flexible and organizational understanding of the business world can only be accomplished by presenting the study of business as a series of integrated activities (c.f. connecting the areas together in realistic way). However, all of this embedding of learning experiences in practical situations or contexts must not neglect the learning of formal knowledge and construction of abstract ideas (Lehtinen, 2002). On the basis of the issues discussed above changes are definitely needed in the teaching methods in the domain of business studies, and one possible answer for these problems might be the use of a dynamic computer simulation. The main reason for this simulation use is to create an authentic and collaborative learning environment, where computer simulation is used as a tool for situating the business content being learned in its authentic contexts in challenging way.

The Case of Dynamic Business Game

We assume that the potential of simulations and games in business education is not fully exploited. One of the reasons for this is that present, traditional batch-processed business games neither realistically represent the actual processes occurring inside and outside organizations, nor correspond to the real-world decision-making situations. However, there are no technical obstacles for constructing continuously processed business simulations that differ from the main stream of business games by how the participants experience the subject matter of the learning session. So far the computer based business games have worked in batch-process mode. Whicker and Sigelman (1991) describe how 'business strategy games' are processed: "Typically, the player feeds information into a computer program and receives back a series of optional or additional data that are conditional upon the player's initial choices. The game proceeds through several series of these interactive, iterative steps." The problem with the batch-processing method is that world very rarely works in such a pure sequential order. There are hardly any business areas where the decision makers first enter all their decisions for the next budgeting term, then rest during all the actual term, and enter again the business in the end of the term to analyze the term results executed and to prepare the next budget.

The simulation, Dynamic Business Game (DBG), we are introducing in this paper is in several ways a typical business game, and the aim of the new construction is the same as with the conventional business games: to increase business perception of the participants. However, as the new construction is operated in a different way compared to conventional games, it brings along some advantages not met in conventional games. What is suggested here is a real-time processed business simulation. Decision-making and having results from the decisions made should be in interactive real-time mode as they are in the real-world environment. Interactive mode means that decisions are made continuously when in the game model and game market situations occur which need to be reacting to by the participants. In the interactive model decisions are made as soon as they are needed or at least as soon as the decision-maker notices that the market situation needs actions from him.

DBG is a computer-based simulation, which creates a complex and authentic-like environment for learning of business studies. It's developed by one of the authors of this paper. DBG models the managing of a manufacturing company with main decision-making functions, and a market engine creating demand and supply. This is done by a computer model representing realistic contexts, in which students are required to perform complex problem solving and discover functional market strategies when running their virtual company. Therefore DBG can be defined as certain kind of a hybrid form of simulation between typical types of conceptual model and operational model simulation as classified by de Jong and van Joolingen (1998). On one hand DBG requires discovery inferring the simulation model as a way to achieve functional business strategy (conceptual model), and on the other hand it urges an active functioning and responding to that model (operational model). DBG can also be seen as a combination of educational games, experiential and conceptual simulations as divided by Gredler (1996), because DBG environment contains competition between participants, it places students into responsible roles in complex situation, and requires discovering, predicting and developing of mental models about business functions. What makes DBG very special is the changing nature of its business model as a result of all participating companies' actions. That's why this game is called as dynamic.

Theoretical Principles of Dynamic Business Game Simulation

The most important theoretical principles hat have guided our efforts to design DBG can be described as follows:

- *PROVIDE REALISTIC AND COMPLEX MODEL OF BUSINESS FUNCTIONS.* DBG provides dynamically changing, rich information about the current situation of companies and market trends in whole as a reaction to the students' actions and decisions made in the managing of their firms in an interaction with other companies' inputs. The main idea is to embed learning in realistic and relevant contexts.
- *USE AUTHENTIC TOOLS AND MULTIPLE REPRESENTATIONS.* There are realistic tools to examine this rich information provided by the simulation (e.g. different market and cash flow reports), which might support the understanding of the business functions more deeply and facilitate interaction between students (DBG is functioning as a shared frame of reference)
- *FACILITATE CONTINUOUS PROBLEM SOLVING.* DBG is functioning in real-time –based virtual market in LAN network. Therefore the time to react and make decisions is an essential element of successful business functioning, and the students need to continuously watch the market, interpret available information and if necessary change their strategies.
- *EMBED LEARNING IN SOCIAL EXPERIENCE.* DBG is designed to be used in small groups, because learning by its very nature is a social and collaborative process. DBG tries to facilitate task oriented interaction, social negotiation and collaborative meaning making by demanding the students to discuss about their decisions in the management of their company.
- *SUPPORT STUDENTS' LEARNING BY TAILORING THE GAME.* There are opportunities to adjust the simulation to support the needs of learners (e.g. the speed of game clock can be changed or stopped, the model can be made more complex during the gaming, the company context with all of its variables can be modified, the supply and demand of the market can be changed, economical depression is possible to model etc.) (c.f. de Jong, 2001)

The objectives of using DBG can be very diverse and versatile. For example the students can learn substance knowledge and skills of business studies, enhance their collaboration and interaction skills, learn to face and master the complexity of real economical world, and acquire flexible and robust competence which is transferable to other contexts and real-life situations. In short, the working with simulation aims to facilitate both formal and informal knowledge. The main pedagogical basis behind this kind of a learning environment is the idea of "learning with technology" (Jonassen et al., 1999), which is congruent with constructivist perspective as seeing learning as an active meaning making and knowledge building in an interaction between learner, available tools and his/her social and physical environment. In this view the role of computer technology is to encourage the thinking of the learners, facilitate the mindful engagement with a deeper level of learning, support the collaboration between participants, and function as a cognitive partner of learners. The essential feature of this learning environment is the use of simulation in small groups (or teams), in such a way that every small group manages their own company. Collaborative action becomes very important, because every decision has to be discussed and processed in small groups the same way as in real business contexts.

DBG is highly interactive in several ways (see Fig. 1). First, there is collaboration between the participating students within each team around the same computer. Secondly, the participants enter their decisions to the game decision-making application (computer model of manufacturing company) in their computer. Thirdly, each company application is in continuous interaction with the market server. Actually simulation does not operate in true real-time processing. However, the processing is continuous in the sense that the game time is clock-driven, smallest increment of time being one hour, and the participants are not tight to make decisions in specified points of time but can make decisions whenever during the game they choose. Fourth, all the companies are indirectly in connection to each other through the market server. So, the market server with the contributions and actions made by each participating company form a kind of a virtual market. This virtual market with its human component is much richer and more authentic than a pure computer-based model of the functioning of the business world alone. DBG includes all the major business decision functions which correspond to the realistic contexts found in business world. The idea is that students can use any of the tools and information resources available at any time. Also multiple tools can be used simultaneously. In a way the working with DBG resembles continuous problem solving. Figure 2 represents the game user interface (company decision-making application).

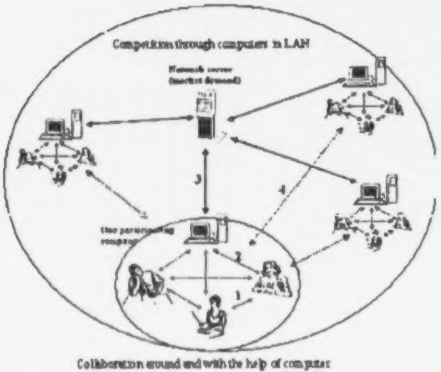
Competition through computers in LAN
Network server (market demand)
One participating company
3
4
2
1
Collaboration around and with the help of computer

Figure 1: Interactivity in DBG

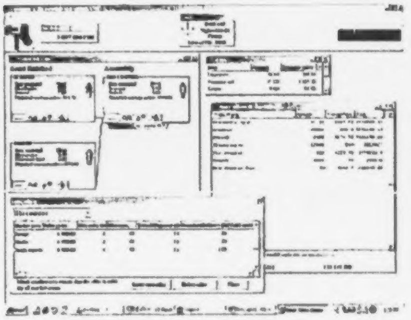

Figure 2: Interface of the decision-making application

However, to overcome the difficulties in simulation environments found in previous studies (e.g. de Jong & van Joolingen, 1998) it is also possible to arrange other instructional supporting activities besides mere simulation working. Our own approach was home assignments, which supported and focused student processing towards the relevant contents and variables in business simulation. A typical assignment was, e.g., to carry out different business analysis and designing future business strategies for their virtual firm, and then to apply these in the next simulation session. We also assigned them to create an Excel spreadsheet (which they could use afterwards during working) for calculating profit and other key figures. These additional arrangements were to engage the students in a deeper processing of the substance area. Other supporting feature which was build in this simulation was so called model progression (e.g. White & Frederiksen, 1990) method, which means that the complexity of simulation is gradually increased. This was done by accelerating the game clock speed and adding more market areas into the game during the course. We hypothesize that this would help students in the beginning to get used to the simulation and to decrease their cognitive load. In all, we assume that with DBG it is possible to create a learning environment, which supports constructive, situated and social processes of learning (Nurmi & Jaakkola, in press).

Overview of the Research

Our first research of a DBG based learning environment was conducted in autumn 2001. The study course was arranged in higher education level, and 19 students of information systems and computer science participated in the course. The course consisted of 24 hours of working with DBG (6 sessions of 4 hours) and in addition to several home assignments. The DBG was used in the groups of three students, so there were seven companies in virtual market competition. We have collected large amount of both quantitative (financial figures, attitudes towards ICT, teamwork and business studies, feedback from the course, log data from simulation, and scores of pre- and post-tests of substance knowledge) and qualitative data (observation data of group working, reflecting the roles of group members). The purpose of our research was to understand the actual collaborative learning and working processes with simulation, and to find out what are the effects of simulation course on students substance knowledge and attitudes towards ICT, team work and business studies.

Preliminary Results and Discussion

At the moment only part of the data is analyzed. Qualitative process data from the observation of small groups will be analyzed in the near future, as well as companies' log data and financial progress in the game. These preliminary results are based only on the effects of simulation working and feedback and experiences from the students. When reviewing students' scores on pre- and posttest questions, it can be seen that simulation course had statistically significant (T-test $p < .01$; Wilcoxon test, value of $z = -2.672$, $p < .01$) effects on scores of substance knowledge (see table 1). The effects of playing to scores were significant, but the overall increase in score was quite modest, average scores increased only from 12.7 to 13.9 points (max 21).

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Repeated measures T-Test

test scores	mean	N	st. dev.	t-value	df.	sig. (p-value)
pretest score	12.69	16	3.301			
posttest score	13.88	16	3.243	-3.230	15	0.006**

** p<.01

Table 1: Effects of simulation course to the scores on pre- and posttest of substance knowledge.

We were not quite satisfied with our test questions, which were concentrating too much on fact knowledge, and the content of our problem solving tasks didn't match too well with the issues students had to face during simulation working. It seems to be the case that by its very nature the results of simulation working are so qualitatively different from just acquisition of new factual knowledge that those effects cannot be detected by traditional knowledge tests (c.f. Swaak & de Jong, 1996). Swaak et al. (1998) concluded that it is not clear how the effects of learning from simulation are to be measured. Further they inferred that simulation working produces intuitive (or implicit or tacit) knowledge, which tends to be difficult to verbalize and to measure. As a consequence in following studies we have changed our test questions much more towards problem solving and knowledge applying tasks as well as concept mapping assignments, because simulations are more valuable in facilitating deeper understanding and complex problem solving skills than in teaching factual knowledge. In future it would also be interesting to compare DBG with more traditional batch-processed business game.

We also ask participating students to reflect their experiences and give feedback from simulation course and especially from the simulation itself. According to these comments several conclusion can be made. First of all, all the respondents regarded DBG as authentic. They thought that the questions and problems they were dealing with during the game can also be faced in real working-life context of any manufacturing company. Participating students evaluated that DBG represent authentic and complex business processes rather realistic way. For example one claims that *"Situations and problems faced while playing felt very realistic. Also game business model looked like real, but someway it's little simplified (e.g. customers are not always so rational etc.). However, I think that it is impossible to model all the factors in business world in computer game"*. The complexity of business world was also seem to transmitted to students , which can be seen from these comments: *"What made this playing to felt so real, was that you had to take care so many things simultaneously to get the firm do well"* and *"I realized that enterprise is always a risk. You can't be sure that even considered decisions will lead to anything but a loss."*

Secondly, the simulation was valued as very engaging (or immersive) and the working with it was experienced as meaningful and interesting. Once the game started some of the students didn't want to stop playing when the course ended. *"I could say that I was little addicted to game, it would be fun to keep on playing longer"* said one participant. Especially real time element of the game was seen as very important feature which affects on authenticity and engagement, because real timing *"makes it possible to see the consequences of own decisions and actions"*, *"...shows how important it is to make your decisions as quick as possible and before your competitors"*, and *"...forces to observe the market situation, analyze the actions of other companies and revise your strategy"*.

Thirdly, especially participants assessed the collaboration around simulation as very fruitful and useful. They said that simulation can function as a shared frame of reference which allows talking about difficult issues even without correct concepts. This can be seen e.g. from this response: *"Our team work succeeded well, and we were all aiming to get our company to show a profit. I could say that the working was very intensive during the whole course and the game inspired our discussion"*. Basically one can claim that the collaboration in small groups brought additional value to wholeness of simulation working. Collaborative processes seems to be much more than just a sum of its parts (the characteristics and abilities of group members), because none of the background variables (attitudes to ICT and team work, learning orientations, scores of pretest) couldn't clearly explain the successfulness of small groups in the virtual market of game. It clearly seems that in order to understand learning with simulation, we have to concentrate on analyzing the collaborative processes around computer occurring in small groups.

Students also saw DBG as very motivating teaching and learning method for business education – especially compared to more traditional instructional methods, and based on their opinions it can be said that simulation could maintain task related orientation during the whole course. For instance one student said that *"...maybe the* *most motivating aspect of the game was the competition against other companies* ", while some other regarded the meaningful problems and situations as the real source of motivation. However students also saw the importance of traditional teaching methods: "*Although playing is fun and it gives the big picture of business processes, it's not enough. It would be good to combine theoretical lectures and concrete playing in the same course*". One suggested mode to use this simulation was the knowledge applying approach: "*...game is a perfect opportunity of testing what you know before in a safe environment. It lets you simulate different approaches and their effects*". When asking students to reflect, what the most important thing they have learned during the simulation course was, majority stated that it was acquiring the consistent conception of business processes as whole. They said that they could now understand how many different factors are affecting to successfulness of business company. For example one stated that "*...the most important thing that I have learned is how different parts of a company interact and what kind of things you have to take in considerations in such a company as this*" which he explained, was because "*...you could see the flow of the whole process of the product from the raw materials to the end product and the different procedures in between*". Unfortunately this development of holistic picture about business processes could not be catch in our test questions. In all, the overall responses about the whole course were very positive without exception.

In conclusion, on the basis of this research, we state that simulation working can be regarded as authentic and very engaging as well as meaningful and motivating for students, and it could facilitate the development of deeper understanding about realistic business processes as whole. However, our qualitative analyses about small groups' working processes are not done yet, and they will shed new light on many of our research questions and conclusions in future.

At the moment we have conducted a follow-up research where students with different levels of expertise have been compared. We examined how novices and intermediate experts are working with simulation. The research focus is on the questions such as: does the students with different level of substance knowledge and expertise in economics work and use DBG differently, does they use various business strategies (e.g. trial-and-error experiments or planned theoretical strategies based on the theories of economics) during the game, does they succeed differently in the competition of virtual market, and does they benefit equally in tests as an effect of playing? The results of this study are reported in future.

References

Aram, E. and Noble, D. (1999). Educating prospective managers in the complexity of organizational life. *Management Learning, 30(3)*, 321-342.

Barab, S., Hay K. & Duffy, T. (2000). *Grounded constructions and how technology can help*. CRLT Technical report.

Bransford, J., Goldman, S. & Vye, N. (1991). Making a difference in people's ability to think: Reflections on a decade of work and some hopes for the future. In R. Stenberg & L. Okagaki (eds.) *Influences on children*. Hillsdale, NJ: Lawrence Erlbaum.

de Jong, T. (2001). *Highly interactive learning environments: Simulations, games, and adventures*. Abstracts of the 9th European conference for research on learning and instruction (EARLI). Fribourg, Switzerland. Aachen: Verlag Mainz.

de Jong, T. & van Joolingen, W. R. (1998). Scientific discovery learning with computer simulations of conceptual domains. *Review of educational research, 68(2)*, 179-201.

Gredler, M. (1996). Educational games and simulations: A technology in search of a (research) paradigm. In D. Jonassen (ed.) *Handbook of research for educational communications and technology*. New York: Macmillan.

Jonassen, D., Peck, K. & Wilson, B. (1999). *Learning with technology. A constructivist perspective*. New Jersey: Prentice Hall.

Lehtinen, E. (2000). Information and communication technology in education: Desires, promises, and obstacles. In D. Watson & T. Downes (eds.) *Communications and networking in education: Learning in a networked society* London: Kluwer Academic Press.

Lehtinen, E. (2002). Developing models for distributed problem-based learning: Theoretical and methodological reflection. *Distance Education, 23(1)*, 109-117.

Mandl, H., Gruber, H. & Renkl, A. (1994). Knowledge application in complex systems. In S. Vosniadou, E. De Corte & H. Mandl (eds.) *Technology-based learning environments. Psychological and educational foundations.* Berlin: Springer.

Nurmi, S. & Jaakkola, T. (in press). Teknologiset oppimisympäristöt ja oppiminen (Technology-supported learning environments and learning). In E. Lehtinen & T. Hiltunen (eds.) *Opettajuus ja oppiminen.* The department of teacher training, University of Turku.

Selen, W. (2001). Learning in the new business school setting: A collaborative model. *The Learning Organization, 8(3)*, 106-113.

Swaak, J. & de Jong, T. (1996). Measuring intuitive knowledge in science: The development of the what-if test. *Studies in Educational Evaluation, 22(4)*, 341-362.

Swaak, J., van Joolingen, W. R. & de Jong, T. (1998). Supporting simulation-based learning; The effects of model progression and assignments on definitional and intuitive knowledge. *Learning and instruction, 8(3)*, 235-252.

Walker, K. & Black, L. (2000). Reengineering the undergraduate business core curriculum: Aligning business schools with business for improved performance. *Business Process Management Journal, 6(3)*, 194-213.

Whicker, M. L. & Sigelman, L. (1991). *Computer Simulation Applications, an Introduction.* Sage Publications.

White, B. & Frederiksen, J. (1990). Causal model progressions as a foundation for intelligent learning environments. *Artificial Intelligence, 42*, 99-157.

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Online Student Retention: Can It Be Done?

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Abstract: Retention has been indicated as one of the greatest weaknesses in online instruction. While a preponderance of literature about online instruction is available, concrete ideas about how to retain students are lacking. A DHHS grant for over $1 million dollars has made it possible for us to provide an Internet option enabling registered nurses to obtain a bachelor's degree. Now in the third year of the program, we have maintained an excellent retention rate ranging from 85 to 93%. Factors found to positively influence retention included: enhancing the comfort level of students with the technology, creating a sensitive online faculty persona generating trust in the environment, and addressing safety and security needs to support highly interactive experiences. These strategies promoted the development of relationships with "classroom" colleagues and fostered linkages necessary for students to remain connected to the learning experiences and continue to degree completion.

Student Retention in the Web Environment

Despite great attention to appropriate design for online courses, high student attrition and/or lack of re-enrollment continues to be the dominant concern about web-based learning. The literature addressing web-based learning contains few practical suggestions for connecting with students online to retain the high-touch in a high-tech environment. A study conducted at one small liberal arts university (Lynch, 2001), reported student dropout rates from Internet courses were as high as 35-50%, compared to 14% for traditional classes. Lack of feeling connected to other students has been cited as a major reason for students dropping out of online education. "This feeling of isolation is credited for the high attrition rates of this type of instruction." (Link & Scholtz, 2000, p. 275) Obviously, poor retention would preclude the viability of online learning unless strategies to increase student success and control costs related to student attrition can be reversed. How good can the method be if students do not to continue in the environment?

A DHHS grant for over $1 million dollars provided the opportunity to develop an Internet option enabling registered nurses to obtain a bachelor's degree in nursing. Analysis over three years of program delivery has demonstrated a remarkable retention rate of 85 to 93%. What factors affect student retention? We need to attend to preparing students for this brave new world of learning. Greater attention needs to be paid to directing the students' earliest online experiences. In redesigning this program for web-based delivery, it was rapidly discovered that student comfort levels and faculty persona made a tremendous difference in the student's perception of their potential for success. Students must feel safe and secure in the environment before they can develop the level of trust needed for positive learning and growth to occur. Trust is more difficult, but not impossible, to achieve when the learner is virtual. Trust is also essential for engaging students in highly interactive learning experiences. Students must feel free to take risks and challenge assumptions. Without this level of comfort between the student and faculty, they will be reticent to dispute ideas and stretch their thinking.

They will also find the learning experience very isolating and many will retreat to the comforts of a classroom setting or be lost to continuing education entirely. This presentation will describe the strategies found useful in establishing trust and comfort that is essential for student retention.

Comfort Level with Technology

One challenge of online learning is the lack of learner familiarity with the delivery system. Therefore, it is important to remember that transitioning courses for online learning requires far more than a simple conversion to a web-based format. Lack of face-to-face contact with the learner requires new ways of thinking about how to connect with students. One of the first priorities for faculty is to assure that the technology does not get in the way of establishing this connection. "Comfort with technology is key to whether collaboration takes place." (Boettcher & Conrad, 1999, p.90) Students need to focus on the learning and not be distracted by the underlying technology. Therefore, faculty need to generate ways of assisting students to become comfortable with the delivery system. An important and useful method for achieving this goal was the development of a technical training manual. This manual contained step-by-step instructions for activities that students would perform in the online courses. These activities, or "boot camp challenges", gave students practice taking online quizzes, using the e-mail system to introduce themselves to their classmates, posting messages on a discussion board, discussing group assignments in the chat room, and uploading assignments to the course faculty, etc. These exercises enabled students to become familiar with and reasonably comfortable in the learning environment. A second method was the early inclusion of an informatics course that incorporated the essential computer skills that students would need to be successful throughout the program. Students acquired basic skills in computer application software (Word, Excel, PowerPoint, and Access) and information literacy skills (use of electronic resources available through the library and the World Wide Web). To provide relevance and to help students more easily acquire these skills, exercises using technology were designed especially to give students the opportunity to apply their newly acquired skills to their discipline. Facilitating the use of the technology will prevent frustrating technical dilemmas that interfere with learning.

Course Design and Instruction

Many factors related to good online course design and instruction apply when addressing the issue of student retention. A well-designed course is satisfying to the learner and will encourage return. Some factors not commonly published include the fact that not all faculty are well suited for the online instruction. Students will not hesitate to drop a traditional course when a favorable impression of the faculty is lacking. Online students look for several factors in their virtual faculty including flexibility, personal credibility, and the willingness to consider other perspectives without injury to the contributor. Nowhere is an instructor more vulnerable with this type of student critique than in the online environment. As such, instructors must be carefully selected for online teaching assignments. Faculty must be able to view their teaching from the student's perspective. The ability of the faculty to effectively communicate in the written format quickly becomes transparent to all. Attention to clarity, grammar, spelling, and punctuation are essential. Therefore, faculty who harshly criticize students' written work, when their own skills demand attention, may unwittingly establish an adversarial relationship with students. In addition, the communication of complex concepts necessary for critical thinking requires clear, concise, yet innovative teaching strategies because faculty are not able to evaluate non-verbal clues to comprehension online. Those who consider teaching online an easy contrast to the drudgery of the classroom, should carefully be evaluated. Simply posting PowerPoint content outlines used in traditional classroom presentations has little meaning in the online environment. Conversely, posting extensive lectures notes that do not contain material significantly different from the textbook is a time-consuming, boring approach. "A well designed distance course that has a focus on interactivity includes many topics for discussion, feedback from students as well as experts, and finally links to sources of pertinent information. Literature citations, journal articles and URLs are a few of the possibilities" (Parker, 1999, p.16). Developing content to foster interactivity is essential. Strategies for effective interaction online are varied but not limited. Most adult students desire interactive learning. We are reminded that "The web may be a great medium for discovery learning, but there has to be substance for the student to discover!" (Carlson & Repman, WebNet Journal, 2000, p.11). Without the credible faculty, retention will be a moot point.

Many factors influence the initiation and maintenance of trust in this environment. Assigning "busy work" is inappropriate in any learning environment, but it is particularly destructive in online education. The product of online learning is written. Students submit their work in the time intensive and laborious manner of a written format. When that product is perceived as "busy work", trust in the faculty member's expertise is quickly eroded. Students are less likely to become disgruntled with time spent in high-level, interactive activities that challenge their comprehension of materials through analysis, application, or synthesis strategies than with activities that require them to regurgitate what they have read. Therefore, online faculty must become designers or managers of learning experiences, shifting the work of learning to the student. "The students become the center as interactive collaborative learners." (O'Leary, 2000, p. 28) Students must feel confident that the faculty will not humiliate them by diminishing their contributions in the face of their peers. This degradation is preventable, but is devastating to continued progress once the student has experienced it.

Both boredom and extraordinary demands (far beyond the expectations for traditional education) are primary concerns for students considering continuation in the online learning environment. Flexibility should be considered the hallmark of effective, interpersonal communication. Rigidity becomes very evident in online education. Faculty who are insensitive to subtle cues about student needs will struggle to establish a trusting relationship with their students. Awareness of students' work at the beginning of a course can provide clues to changes in behavior later on. These behavior changes can include decreased activity level, diminished quality, and delayed responses. Theses are critical cues. They should alert the faculty member to solicit student responses regarding the meaning of the new online behavior pattern. However, when students provide feedback about the instructional methods, faculty must be flexible and willing to evaluate the validity of that input so that they can make meaningful adjustments in the course. Results of a study conducted by Indiana University Bloomington to profile the innovative teacher using technology concluded that all of the teachers who had changed their teaching with technology shared what one might call an "innovative personality". "They were willing to remain flexible and to modify their innovations as they received feedback from their students." In addition, they found that innovative teachers "liked changing things mid-stream to make them work better, not having to wait for the next time they teach the course." (Energizing the Innovative Teacher: Technology's Role, http://www.indiana.edu/~tltl/energy.html) One must also keep in mind that it is easy to become so enthusiastic about the endless possibilities of activities for online instruction that one creates an overwhelming workload for the students. Identification of this factor demands the flexibility to adjust the assignments appropriately. Teaching online can be far more demanding than classroom instruction. It is expected that the faculty will gain a close association with each student and must be responsive to their individual needs or risk losing the student.

Risk Taking

Online learners are subjected to a different set of stresses than those in the classroom. Writing in the online environment creates feelings of vulnerability in both the students and faculty. Written communication is perceived as a more permanent form of self-exposure than is typical in the conversational environment of the traditional classroom. Thus, faculty need to take the lead in setting the example for risk-taking online. This is particularly true if your subject matter involves sensitive, personal expressions or examples to make a point. If faculty want students to apply learning to personal experiences as a demonstration of a concept under discussion, it can be invaluable for the faculty to provide the first example. Openness on the part of the faculty can facilitate honest communication from the students. Faculty leading the way in risk-taking activities enables the braver students to test the waters and others will follow. If risk-taking is an expectation, then it must be handled carefully or students will not return to the setting.

Feedback

Retention is related to the development of a connected relationship between the faculty and the student. One mechanism for linking to the student is feedback. In the traditional classroom, faculty are able to respond to students immediately. In the online environment, this response time is likely to be delayed. However, the delay should be minimized as much as possible so that each student perceives the faculty as truly committed to their learning. Timely review of materials supports student progress in a course. Long delays translate into student concerns about whether the faculty received the information or, if received, cared enough to review it. The literature suggests that the feedback time to online learners should not exceed 48 hours. A student who logs into a course on Sunday and has questions about the following week's assignments, will become very frustrated if the faculty does not respond to these questions very early in the week. The more connected the adult student feels to the learning situation and their faculty, the more likely they will be to continue in the course and to consider enrolling in future online courses.

Tone of Written Communication

Online students can be particularly sensitive to the tone of the written communication that they perceive between themselves and the faculty. Tone can be an elusive factor in written communication. However, it is a very important variable. How students interpret what faculty have written may be very different from the message that was intended. Most problems occur when faculty forget that it is imperative to be able to stand back from the message and view it from the students' perspective. This view relates not only to the content, but also, perhaps more crucially, to the nature of the message. Sensitive critiques including attention to word choice, understanding student perspectives, openness to errors in thinking, and warmth are factors that reflect the online faculty persona. For example, an authoritative style can easily be communicated to and resented by adult students online resulting in the inhibition of trust. When this occurs, students begin to produce what they believe the faculty wants rather than challenging their own thought processes. On the other hand, an investment in the creation of an overall trusting atmosphere will allow the students to perceive the safety net required to step-out-of-the-box and work to improve their critical thinking skills. The use of humor, especially, if it is self-directed and not sarcastic, can be an effective method for engendering trust. "Humor can lighten the burden of the learning curve for both the student and faculty and can generate a felling of sincerity among those in the class. (Parker, 1999, p. 16) But, any method that communicates a non-judgmental, open approach will assist the students to view the faculty as human and trustworthy. In any case, attention to the tone of each message requires additional time and effort on the part of the faculty. Lack of attention to tone, often will send learners running away from the experience.

Collaboration in Online Learning

Faculty who are successful in establishing an online learning community encourage student participation and discourage lurking behavior. Eisley (1991) and Schmier (1995) identified that learning is best accomplished when the learner is actively engaged in the process. Knowlton, Knowlton and Davis (2000) indicated that online discussions help students understand that there are real people that they are communicating with in cyberspace and that discussions facilitate the formation of an educational cyber-community of learners. Harasim (1989) pointed out the benefit of knowledge building that occurs when "students explore issues, examine one another's arguments, agree, disagree and question positions. Collaboration contributes to higher order learning through cognitive restructuring or conflict resolution, in which new ways of understanding the material emerge as a result of contact with new or different perspectives. (Harasim, 1989, p.5) This type of online teaching requires emphasis on quality rather than efficiency. A high level of interactivity allows faculty to quickly identify when students are confused or need additional information and gain a greater understanding of individual students' performance abilities. As noted in the University of Illinois Faculty Seminar Report (2000), "You get to know your students' minds, not just their faces". "Collaboration is an integral component of higher education not only because it supports active learning, but also, because it is required for the workplace for which students are prepared (Ben-Jacob, Levin, & Ben-Jacob, 2000, p. 8). It must be remembered that participation is not likely to happen unless it is deliberately planned. This format defines a learner-centered educational model where students operate in a more self-directed mode and have greater control of their own learning. It encourages student success and connectedness that in turns fosters retention. Again, these strategies are time consuming and require committed and dedicated faculty.

Conclusion

Clearly, many factors influence student retention. Initiation and maintenance of trust in the online environment is essential. Collaboration is essential for active learning and gives students valuable practice of skills that can lead to advancement in the workplace. Faculty contemplating teaching online must be cognizant of the need to prepare students for this new learning environment. Beyond technology preparation, faculty need to learn how to establish credibility with the students. Major factors that affect credibility include written communication skills, use of higher level teaching strategies, flexible approaches to learner concerns and needs, setting an example for risk-taking, timely feedback, and setting a tone that promotes open and honest interaction. These factors positively influence the development of mutual trust between the faculty and their students. Online education truly demands high-touch and requires selection of faculty who are able to demonstrate the qualities of excellence described above as well as dedication and commitment to student learning.

References

Ben-Jacob, M.G., Levin, D.S. & Ben-Jacob, T.K. (2000). The Learning Environment of the 21st Century. *International Journal of Educational Technology*, 6, 3 (Spring/Summer) 8-12.

Boettcher, J. & Conrad, R.M. (1999). Creating and sustaining online communities. *Faculty Guide for Moving Teaching and Learning to the Web*. Mission Viejo, CA: League for Innovation, 87-93.

Carlson, R.D. & Repman, J. (2000). Experience Speaks! What web instructors wish they'd known. *WebNet Journal*, 2(1), January-March, 11-13

Eisley, M.E. (1991). Guidelines for Conducting Instructional Discussions on a Computer Conference. Paper presented at the International Symposium on Computer Conferencing, The Ohio State University, Columbus, Ohio.

Harasim, L. (1989). On-line education: A new domain. Retrieved from http://www-icdl.ope.ac.uk/mindweave/chap4.html, 5.

Knowlton, D.S., Knowlton, H.M., & Davis, C. (2000). The Whys and Hows of Online Discussion. *Syllabus*. 13 (10), 54-58.

Link, D. & Scholtz, S. (2000). Educational technology and the faculty role: What you don't know can hurt you. *Nurse Educator*. 25(6), 274-276.

Lynch, M. M. (2001). Effective student preparation for online learning. Retrieved from http://www.fdong@elearningmag.com.

O'Leary, A. (2000). Get wired, go digit, build a web-based learning community. *Educational Technology Review*, 13 (Spring/Summer) 28-33.

Parker, A. (1999). Interaction in distance education: The critical conversation. *Educational Technology Review*, 12 (Autumn/Winter), 12, 13-17.

Reimers, C., Rathbun, G.A., and Goodrum, D.A., (1999). Energizing the Innovative Teacher: Technology's Role. Paper presented at 1999 Annual Convention of the Association for Educational Communications and Technology, Houston, TX. Retrieved September 1, 1999 from http://www.indiana.edu/!tltl/energy.html,1-12.

Schmier, L. (1995). Random Thoughts. The Humanity of Teaching. Madison, WI: Magna Publications.

Teaching at an Internet Distance: the Pedagogy of Online Teaching and Learning. The report of a 1998-1999 University of Illinois Seminar. (1999). Retrieved January 21, 2000 from http://www.vpaa.uillinois.edu/tid/report/tid_report.html. 24.

Teaching and Learning Activities in the Online Classroom: A Constructivist Perspective

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Abstract: To establish standards of quality in online courses developed through the *University of Hawaii's Asynchronous Learning* project funded by the Alfred P. Sloan Foundation, a preliminary study of courses from various disciplines was conducted. The aim of the study was to identify teaching activities that contributed to the creation of a high quality interactive classroom where students were actively engaged in the process of learning. The study showed that a direct relationship exists between the teaching activities and the frequency and quality of collaborative learning in the online classroom. Carefully crafted teaching activities contribute toward creating the social presence of the teacher, which directly or indirectly shapes the learning environment and thus significantly impacts the desired learning outcomes.

Introduction

A number of recent studies on the online teaching-learning process have specifically dealt with the role of the online teacher as a facilitator (Salmon, 00; Palloff et al, 01; Collison et al, 00). Such studies through their exclusive focus on the role of the teacher as a facilitator often lead to the misperception that online teaching is merely facilitation. The role of the online instructor is also to create a "teaching presence" through appropriate instructional activities which include lecture notes, teaching commentaries and individual or collective discussion responses to guide students toward critical exploration of the content (Anderson et al, 01).

Studies have shown that the constructivist model in instructional design based on active learning is capable of providing an effective theoretical framework within which to analyze the teaching-learning experience in technology mediated instruction (Bednar et al, 92; Gold, 01). Knowledge construction has been described as a social process (Dewey, 96). Learning involves construction of internal representations of knowledge which can best be accomplished in a collaborative situation where learners encounter other knowledge representations or perspectives, which allow them to review, evaluate and assess their own perspective, and revise it if the revision is more meaningful (Bednar et al, 92). In an effective learning environment, the instructional tasks are contextualized in authentic situations and students are given opportunities to construct knowledge as they test their ideas on others and evaluate other perspectives. The social negotiation of meaning is enhanced when the role of the teacher is seen as a coach and a facilitator in the learning process (Vygotsky, 78).

Current research on online learning shows that new technologies allow course participants to engage in meaningful discussions so knowledge is not transmitted from the teacher to the students, but rather discovered as individual perspectives are shared in a collaborative learning environment (Hiltz 97; Harasim, 90; Joy et al, 00). Students acquire knowledge in a social context where they are given opportunities to articulate and express their views as they construct knowledge that is personally meaningful to them. The teaching-learning process is thus seen as a shared transaction in which the learners assume responsibility for their learning and the teacher shares with students the control of the nature and content of the activities in the classroom as s/he ensures that any new knowledge created meets the shared disciplinary standards (Garrison et al, 00). As the content expert, the teacher thus guides the learners as they negotiate the exploratory learning environment. The direct and indirect teaching acts performed by the teacher in the online classroom are thus critical in shaping the collaborative learning process in the classroom to achieve the desired learning outcomes.

Research Method

In order to determine the relationship between the diverse teaching and learning activities in completely online courses offered at the University of Hawaii at Manoa, a detailed study was conducted of six courses from a variety of disciplines: information and computer sciences, music, family resource management, anthropology, political science, and interdisciplinary technology and culture. The six online courses were taught in Fall 2001. The primary aim of the study was to find the set of teaching-learning practices that were conducive to creating an active collaborative learning environment. In order to collect data on the courses, the study employed a detailed worksheet listing various teaching and learning activities possible in the online classroom. Teaching activities which were examined in each course included course overview documents, lecture notes/content overviews, interpretive teaching commentaries, discussion/ study questions, and teacher's facilitative discourse. Learning activities that were examined included weekly responses to the reading assignments or individual work assignments, online discussion, group projects, and students' leadership discourse. After collecting data on the teaching and learning activities included in each course, the relationship between the two types of activities was examined. The impact of the teaching acts on the learning acts was studied through analyzing the quality of the work produced by the students in terms of online class discussion, group discussion (if included), as well as individual work assignments submitted as weekly responses to the readings. This study did not include the work students submitted directly to the instructor in the form of short or long research papers or quizzes.

Data Gathering and Analysis

Teaching Activities

The courses included in the study were taught using a course management system, either WebCT or Blackboard which provided an almost complete transcript of course documents, course activities as well as strategies the instructor used to manage the course on a weekly basis. The course overview documents along with the weekly introduction of materials by the instructor provided a good perspective on how the course was designed. Courses studied were labeled A, B, C, D, E, and F in order to maintain the anonymity of the instructors who taught the courses.

All instructors had gone through a tutorial on online teaching, which went over the effective strategies to organize and manage an online course. With the result all courses included good course overview documents, which provided a detailed description of the syllabus, schedule, course procedures, requirements, and grading system. The courses A, B, and C included either an introductory student tutorial on online learning or detailed technology tips for students to access the course.

In courses A, B, and C the instructors rethought the traditional lecture presentation. The weekly reading assignments were introduced in a non-linear manner through lecture notes, content overviews, and web-based resources. The purpose of lecture notes or content overviews was to facilitate students' access to weekly readings and work assignments.

Whereas lecture notes served the purpose of introducing the course materials, the interpretive teaching commentaries used in the courses A, B, C, D, E, and F served to provide a platform through which the instructor as content expert responded to discussion posts and/or individual responses to the readings in the form of weekly collective postings. Different instructors used teaching commentaries for different purposes. In all cases, the teaching commentaries became for the instructor one of the ways to assert his or her presence in the electronic classroom. The commentaries served to contribute to the dynamic nature of the learning environment as these were not pre-scripted, but tailored to the particular learners and the learning environment. The instructors who provided interpretive teaching commentaries thus made their presence felt in ways other than discussion facilitators.

In order to make the course materials more meaningful to students, the instructors who taught the courses A, B, and C made use of study questions or discussion questions to guide students to think of the ideas or the subject matter covered in a broader context. They also encouraged students to apply the ideas under discussion to real life situations. The discussion questions in courses A, B and C became the basis for the instructor-led component of class discussion that also had a broader student-led discussion component. No discussion/study questions were included in the weekly activities of the courses E and F.

The success different instructors had with the efficient management of the classroom was studied through the examination of the facilitative discourse which was present in all courses to a greater or a lesser extent. The facilitative discourse included any direct or indirect teacher intervention to efficiently manage the course and make it run smoothly through enforcing deadlines and providing guidance when needed. It included the comments to generate enthusiasm or to promote self-motivation and self-direction among students. The examination of the facilitative discourse was restricted to what was revealed in the course transcripts and not to any individualized feedback that the instructors might have provided students through private e-mail.

Learning Activities

All courses included both individual as well as collaborative learning activities, which were designed differently in various courses. Students were required to submit weekly individual responses to readings in the courses A, B, D, and E, whereas in the course F, they were asked to submit a biweekly response to the readings. The courses C and F made use of weekly quizzes to assess if students had learned the material.

The instructors used various methods to collect the responses submitted by the students. In the course F, students were divided into groups and the responses were discussed in the group working area. In the course D, students were asked to post their responses on the class discussion board. In this course, the responses had to include discussion questions framed by students. In the course B, students were required to send the weekly responses privately to the instructor. After students had submitted their responses for a particular week, the instructor of this course made the responses public so they were available for everyone to read.

Online class discussion was used in all courses, but its effectiveness as a collaborative learning tool varied from course to course. In the courses A, B, C and D, the discussion served the purpose of helping students validate each other's learning. Different perspectives helped them understand ideas that they had missed or not understood in their own reading. Students in these courses responded thoughtfully to each other's comments. Such exchanges created a shared context for learning. In the courses E and F, the discussions were very superficial.

As far as the incorporation of group projects was concerned, only courses A and B incorporated group projects. The group project served as the focal point around which the group members in these two courses did research, gathered information, and jointly created a product.

Giving students a leadership role in course activities was used by most of the instructors as an effective way to get actively involved in course activities. Though all courses had this feature implicitly embedded in the course activities, only the course B had explicitly organized the groups in such a way that both the groups and the individual group members were given opportunities to engage in leadership discourse as they initiated weekly discussions and managed weekly group activities on a rotating basis.

Results

The detailed analysis of the course transcripts showed that selecting a course management system and creating the course overview documents is only half of the project of creating an effective online course; the other half is the content and organization of weekly multi-modal teaching and learning activities. The study indicated that the teacher's implicit or explicit teaching philosophy directly impacted the nature and the number of teaching acts performed on a weekly basis in the online classroom. Different instructors integrated various teaching and learning activities into the course environment to different degrees. It was obvious that the presence or absence of teaching activities shaped the learning environment in each course. There was a direct relationship between the nature of direct and indirect teaching activities and the frequency and effectiveness of collaborative learning activities.

Given below is a chart that shows the relationship between the teaching and learning activities and the resulting active or passive collaborative learning environment. Courses labeled A, B, and C showed maximum multi-modal teaching and collaborative learning activities involving discovery or active learning. Courses labeled E and F showed minimum teaching activities with very little active collaborative learning. The collaborative learning activities in these courses were merely a cosmetic addition to the class activities. The course D fit somewhere between the two as far as the effectiveness of collaborative learning activities was concerned.

Courses A, B, & C: Multiple Multi-Modal Teaching Activities

The three courses labeled A, B, and C with multi-modal teaching activities produced a learning environment where students were engaged in the construction of knowledge as they worked collaboratively. The more the teaching acts, the greater the frequency and higher the quality of collaborative learning acts performed by students.

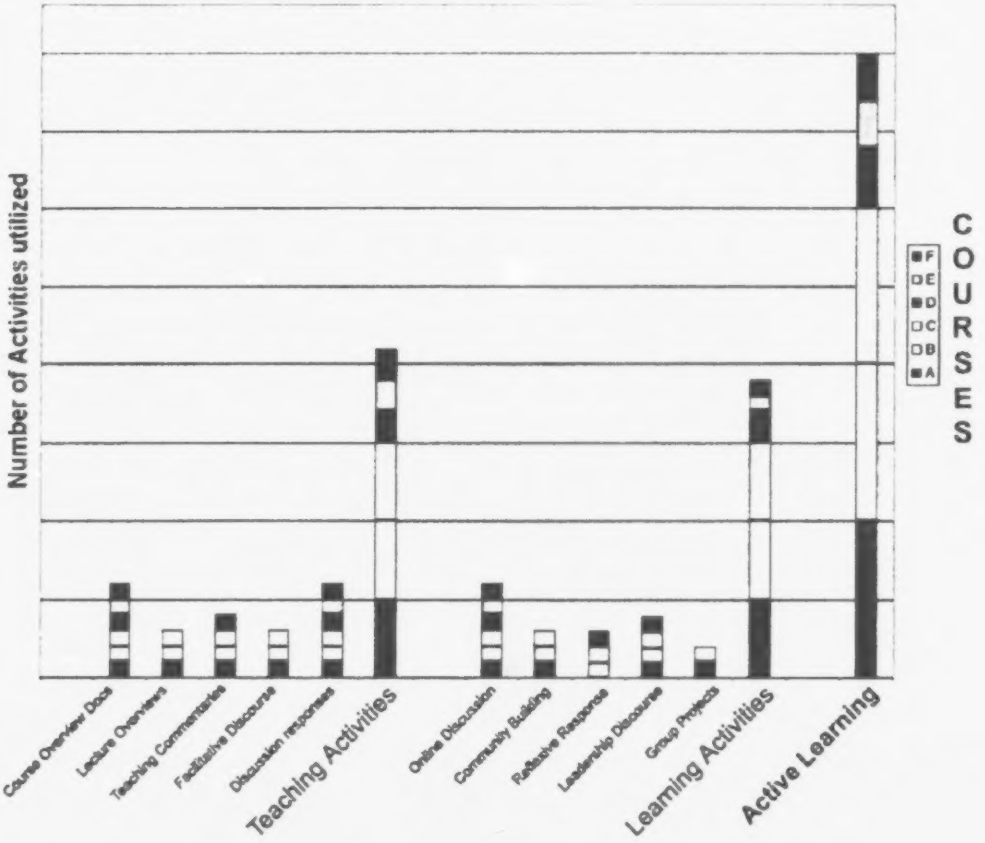

Figure 1: Relationship between Teaching and Learning Activities

Course D: (Constructivist Model) Reduced Teaching Activities

The course D occupied a position somewhere between the highest and the lowest in terms of the quality of online discussion. Students were required to write a weekly response to the readings and formulate two to three discussion questions related to the readings. Both the response and the questions were posted on the discussion board. Students then responded to each other's discussion questions as well as responses. The quality of discussion in this course was good. The instructor provided feedback primarily

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through a collective weekly discussion posting, though occasional responses to individual postings were also made. Students in this course, however, were on their own as they tackled the assigned readings on a weekly basis unlike in the other three courses A, B, and C where the instructors had provided lecture notes or content overviews on a weekly basis. Since students were more or less on their own in the course D as far as accessing the content was concerned, it is unclear if they could engage the texts as intensively as they would have done if the instructor had provided more guidance.

Courses E and F with Minimum Teaching Activities

In courses E and F with decreased teaching acts, it was obvious that the instructors implicitly based their courses on the traditional instructional model. Even though the instructors used the suggested online course design for incorporating collaborative work, it was against the background of the assigned course activities where students were primarily asked to basically read the materials, complete the assignments and send the completed assignments to the instructor. In these two courses, no specific instructions were given to students as to how they should conduct their discussion activities. In the first course, students were simply asked to discuss the readings with other group members. In the second course, each student had to complete a biweekly assignment. This assignment was in the form of a commentary on the readings, a summarization of the main points along with some comments on what transpired in the discussion amongst the group members. Group members were encouraged to discuss the work in the chat room, rather than through asynchronous discussion. Both the chat room archives and the asynchronous discussion, when examined, reflected very superficial interaction.

In the above two courses with decreased teaching presence, the teaching activity was thus confined to the minimum and appeared only in the form of the instructor's collective response to discussion postings. Students found themselves in a very open learning environment, as they had to rely on their own resources to comprehend the materials for which they were unequally prepared. The discussion transcripts of the two courses showed if the instructor is not clear about the purpose of the group work and how it can be used to encourage students in constructing knowledge or transferring new knowledge to other contexts, online discussion is bound to focus on the reproduction of ideas. In the absence of any explicit guidance from the instructor through discussion questions or well-integrated interpretive teaching commentaries or lecture notes or content overviews, students were very much on their own as they went through the course materials. They were thus more intent on merely learning the material as it was presented to them in the textbooks, without critically evaluating the ideas they encountered using their higher order thinking abilities. The only collaborative work, the online synchronous and/or asynchronous discussion, seemed to be just an "add on" activity. It seemed the "real thing" students were asked to do was the assignments (responses or quizzes) they worked on independently which they sent to the instructor. Both these courses thus retained the traditional model of instruction where students primarily wrote for their teachers and reproduced what they learned in textbooks. It was also clear that just as an exclusively teacher-centered model is not educationally effective in making knowledge meaningful to students, so is the other extreme of learner-centered model where students are expected to work in a very open learning environment with little guidance from the teacher.

Conclusion

The above study showed that diverse multi-modal teaching activities with corresponding learning activities are successful in creating an effective learning environment where students are engaged in the process of learning. The teacher's presence, generated through multi-modal teaching acts, promotes self-motivation and self-direction amongst students as they are guided to actively engage in collaborative learning activities. In establishing quality standards in the online classroom, therefore, the role of the instructor in creating an integrated teaching-learning environment must be emphasized. The electronic medium is unique in that it can be easily transformed into a dynamic electronic space that is capable of sustaining the social presence of both the teacher and the students. The instructor's expert guidance manifested through multi-modal teaching activities is indispensable in creating a shared context of learning where students are engaged in both constructing knowledge and applying it to other contexts. The diverse teaching-learning activities promote a complex mode of multi-level interaction amongst the learners, the

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instructor, and the content of the course, which creates a social context for constructing, exchanging and transforming knowledge.

References

Anderson, Terry, Liam Rourke, D. Randy Garrison, and Walter Archer (2001). Assessing Teaching Presence in a Computer Conferencing Context. *JALN*, Vol 5 (2). Accessed April 18, 2002 http://www.aln.org/alnweb/journal/jaln.htm

Bednar, Anne K., Donald Cunnigham, Thomas M. Duffy, and J. David Perry (1992). "Theory into Practice: How do We Link?" in *Constructivism and the Technology of Instruction: A Conversation*. Edited by Thomas M. Duffy & David H. Jonassen. Hillsdale, New Jersey, Lawrence Erlbausm Associates, Publishers..

Collison, George, Bonnie Elbaum, Sarah Haavind, Robert Tinker (2000). *Facilitating Online Learning: Effective Strategies for Moderators*. Atwood Publishers.

Dewey, John (1996). *Democracy and Education*. New York: The Free Press.

Gold, Sanford (2001). "A Constructivist Approach to Online Training for Online Teachers." *JALN* , Vol 5 (I). Accessed April 18, 2002. http://www.aln.org/alnweb/journal/jaln.htm

Garrison, Randy and Walter Archer (2000). *A Transactional Perspective on Teaching and Learning: A Framework for Adult and Higher Education*. Oxford, New York: Pergamon Press.

Harasim, Linda M. (1990). Online Education: An Environment for Collaboration and Intellectual Amplification." *Online Education: Perspectives on a New Environment*. Ed. Linda M. Harasim. New York: Praeger Pub.

Hiltz, Roxanne Starr (1997). Impacts of College-level Courses via Asynchronous Learning Networks: Some Preliminary Results. *JALN*, Vol I (2). Accessed April 18, 2002 http://www.aln.org/alnweb/journal/jaln.htm

Joy, Ernest H., & Federico E. Garcia (2000). "Measuring Learning effectiveness: A New Look at No Significant-Difference Findings." *JALN*. Vol 4 (I). Accessed April 18, 2000. http://www.aln.org/alnweb/journal/jaln.htm.

Palloff, Rena M., & Keith Pratt (2001). *Lessons from the Cyberspace Classroom: The Realities of Online Teaching*. Jossey-Bass.

Salmon, Gilly (2000). *E-moderating: The Key to Teaching and Learning Online*. London, Sterling (USA): Kogan Page.

Vygotsky, L.S. (1978). *Mind in Society. The Development of Higher Psychological Processes*. Eds. Michael Cole, Vera John-Steiner, Sylvia Scribner, and Ellen Souberman. Cambridge, Massachusetts: Harvard University Press.

Rethinking multimedia teaching: examining developments in multimedia course provision.

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Abstract
This paper provides an initial examination of over 614 multimedia courses now available in the UK with discussion centred on reasons for recent course expansion. Areas of specific growth and issues of course design are presented in the analysis and discussion. Changes in the application of multimedia from subject-specific to second subject contextualisation are also discussed with reasoning to support learning benefits to be derived from this approach, and implications for course designers and providers are concluded.

This paper will be of interest to multimedia and online course designers, managers and tutors, instructional designers, and those involved in institutional curriculum planning.

Introduction and motivation for this work

The motivation for this study arose early in 1999. Our study centre, CSALT[1], had successfully run an MSc in Advanced Learning Technology since 1993 and we started to give serious consideration to a course for undergraduates which married learning technology with learning theory. Our objective was not only to equip a graduate with educational knowledge and awareness, but to support this with a range of information and communication technology (ICT) and multimedia production skills in order to prepare them to make better use of educational technology already available in many educational settings.

Our first step towards this objective was to review existing course availability in this field. The University and Colleges Admissions Service (UCAS) in the UK at that time offered 53 courses related to the themes of 'educational technology', 'multimedia technology' and 'learning technology'. We also noted that approximately 250 courses were then running which included the term multimedia in their title. Given that competition between Higher Education Institutions (HEIs) in the UK can be very high, the relatively low provision of courses in the educational technology area suggested a yet-to-be exploited area for development. Consequently the authoring of course rationales and modules commenced.

The first working title for the new degree was 'Multimedia and Online Learning Technologies'. This changed to 'Multimedia Learning Technologies' within a week or so as we felt the first title to be too long and we also embraced the idea that "... the term multimedia is used to encompass both online and offline projects" (England and Finney, 1999) from one of the identified course books.

In the Spring of 2001 the degree scheme cleared the last university approval committee, though several changes had taken place by this point, not least to the title. The term *'Learning Sciences'* now replaced *Learning Technologies* in order to emphasise that theoretical aspects of learning played an equal role to those of technical production and realisation. The second title change was the removal of the word *multimedia* completely to leave a new title of 'Learning Sciences & Technology'. This latter change caused more than a little concern between the course authors and validators over what potential students - and tutors - may understand as the focus of the degree.

With this latter question in mind we decided to again examine the availability of multimedia and learning technology related courses offered through UCAS commencing in 2002. To our great surprise 614 courses were available across the UK which included the term *multimedia* in their title. This caused pause for thought and fresh questions came to mind, not least:

- What were the causes of so much expansion in multimedia course provision so quickly (around 160% increase in 2 years)?
- Had the definition of multimedia evolved to include many more new options?
- What aspects of multimedia or skills were students learning in these courses?
- Though we had removed *multimedia* from the title of our own scheme, was this perhaps the most appropriate thing to do, both for marketing and pedagogic reasons?

Multimedia course analysis

In order to understand this change it was necessary to review multimedia course availabity on a year-by-year basis. Had this change happened gradually, or was it sudden and dramatic due to improvements in access to and in the performance of technologies associated with multimedia? An analysis of this data (table 1) showed a dramatic increase in multimedia course provision between 1998-99 with 179 new courses running, compared to 95 new courses running in 1997-98 and 56 in 1996-97. The data also showed a decline in the number of multimedia courses running in for 2000-2001 (105 discontinued courses and 76 suspended from the previous year) though projections had once again picked up for 2002.

Year MM courses	1996	1997	1998	1999	2000	2001	2002
Cancelled			2	31	9	7	1
Discontinued	1	23	27	46	67	105	109

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[1] Centre for Studies in Advanced Learning Technology, Lancaster University. http://csalt.lancs.ac.uk/csalt/

Running	**121**	**177**	**272**	**451**	**560**	**547**	**617**[2]
Suspended	6		3	5	9	76	2
Grand Total	128	200	304	533	645	735	729

Table 1. Statistical data showing multimedia related courses in the UK from 1996 to 2002. Data supplied by UCAS Data and Analytical services (updated January 2002).

We then examined the courses in more detail in order to identify those courses relating to our own course which originally combined multimedia with learning and technology. This inspection highlighted a number of variations on the use of the term *multimedia* itself. Ten variations were identified including 'Creative Multimedia (MM)', 'Interactive MM', 'MM Communication', 'MM Computing', 'MM Electronic Technology', 'MM Studies', 'MM systems', 'MM Technology', 'MM Visualisation' and 'MM web production[3]. Some discussion took place as to what these terms may actually mean, what the courses which used these titles focused on, and whether students would necessarily understand differences between the various titles.

The next stage of our investigation focused on the placing of the word *multimedia* or one of its curriculum variants in the course title; some courses offered multimedia or a variant alone, some offered multimedia or a variant with a specific topic (e.g. Multimedia systems and theology), and some offered a specific topic with a multimedia or variant (e.g. Chemistry and Multimedia Technology). A classification system was drawn up to structure course titles in order to identify any development patterns (table 2). The data from this examination indicated that, in the vast majority of cases, the term multimedia or variant had been coupled with another subject study area to create a combined degree (over 478 courses from 614 making 78% MM course provision coverage).

MM term position:	**MM alone**	**Qualified MM.**	**MM 1st**	**MM 2nd**	**MM 3rd**	**unsure**	**Total**
HE offered degree incl. FE/HE[4] & FD[5]	10	42	198	235	9	7	501
HE offered HND	14	7	3	6	0	0	30
FE offered degree incl. FD.	2	0	17	2	0	0	21
FE offered HND	45	0	9	8	0	0	62
Total:	71	49	227	251	9	7	*614*

Table 2. Course titles and place of 'multimedia' i.e. 'Multimedia and topic, 'Topic and multimedia', or 'Topic, topic and multimedia'. HND courses usually cover a period of pre-university study up to and sometimes including the first year of a degree level course.

MM term position:	**MM**	**Qual MM.**	**MM 1st**	**MM 2nd**	**MM 3rd**	**unsure**	**Total**	**As %**
Applied sciences			31	56	1	1	89	14.5
Arts & humanities			77	78	1	2	158	25.7
Environment & Natural sciences			17	27	0	0	44	7.2
Management			47	50	7	2	106	17.3
Social sciences			29	21	0	0	50	8.1
Cross depts			18	7	0	0	25	4.1
Law			2	5	0	0	7	1.1
Engineering			1	3	0	0	4	0.7
Sports science/Heath care			5	4	0	0	9	1.5
Undetermined	71	49	0	0	0	2	122	19.9
Total:	71	49	227	251	9	7	*614*	*100.0*

Table 3. Multimedia course analysis against Faculty provision. The Faculty structure used was that of the authors' own university. The grey areas for MM and Qualified Multimedia degrees are left blank due to the possibility of delivery by several departments in different faculties.

As a next step we made a provisional examination of these multimedia combined courses in order to identify any specific areas of growth or development. This activity proved to be very subjective and whilst coupling multimedia with some subjects seemed to make some rational sense (e.g. Multimedia Communications & Business Studies, or Multimedia and Internet Technologies) others proved to be more taxing on our immediate understanding (e.g. Geratology and Multimedia Systems). We were particularly curious about 'Complimentary therapies and aromatherapy and Multimedia systems' insofar as whether the course utilised the sense of smell alongside text, images, audio and graphics.

In order to limit subjectivity we established a Faculty classification system. Taking the Faculty and Department structure at Lancaster University as a framework, each course was placed in the Faculty which would best provide a home for its study; for example, Mathematics and Multimedia Communication was placed in Applied Sciences due to the mathematical and possible technical components of what may be meant by Multimedia Communication. This classification system resembled the hierarchical classification systems used in phenomenographic analysis (Säljö, 1988; Marton and Säljö 1976a; 1976b). In support of this method we applied an independent co-judging technique[6] which provided 85.7% classification agreement, within Säljö 's 20% error tolerance. The resulting classifications were then tabulated (table 3) and spatially examined (diagram 1).

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[2] The figure of 617 reported here shows an increase on our earlier reported figure of 614 due to 3 new courses becoming available in the period between our initial analysis and contacting the UCAS for a statistical search.

[3] We refer to these as Multimedia offspring or Multimedia variants

[4] Further Education (FE or tertiary education) is usually the stage before Higher Education (HE or university) for many UK based .students.

[5] Foundation Degree (FD) is sometimes referred to as a Year 0 course and can be taken prior to University (HE) study.

The analysis of this data highlighted three areas of interest and discussion:

- That over a quarter of all multimedia related degree schemes and modules were related to Arts and Humanities
- That ICT and Applied Sciences (including computing and networking) accounted for less than 15% of multimedia degree and module related delivery
- That expansion of multimedia courses related to Business and Management and, in particular, the emergence of e-business and e-commerce courses, were higher than expected.

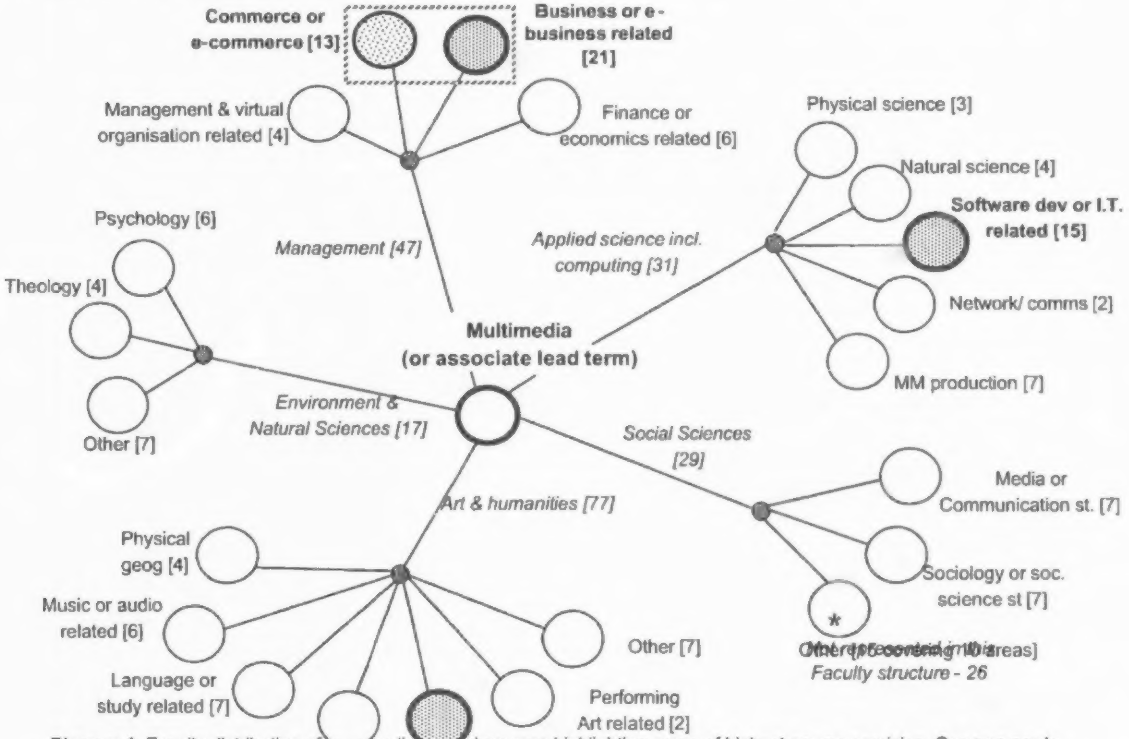
Commerce or e-commerce [13]
Business or e-business related [21]
Management & virtual organisation related [4]
Finance or economics related [6]
Management [47]
Physical science [3]
Natural science [4]
Software dev or I.T. related [15]
Applied science incl. computing [31]
Network/ comms [2]
MM production [7]
Psychology [6]
Theology [4]
Other [7]
Environment & Natural Sciences [17]
Multimedia (or associate lead term)
Social Sciences [29]
Media or Communication st. [7]
Sociology or soc. science st [7]
*
Other [26 covering 10 areas]
Not represented in this Faculty structure - 26
Art & humanities [77]
Physical geog [4]
Music or audio related [6]
Language or study related [7]
Photography or video related [9]
Art, Design or Related [42]
Performing Art related [2]
Other [7]

Diagram 1. Faculty distribution of multimedia related courses highlighting areas of highest course provision. Our own newly developed course, Learning Science & Technology, was not included in the statistical analysis but would be placed in Social Sciences (indicated by *)

In consideration of this result we are aware of the subjectivity involved in the Faculty placing of each course, even allowing for judging and co-judging described. In order to refine these results it became necessary to examine the rationale and structure for each course provided. However, before setting out to complete such a detailed analysis for all 614 multimedia related schemes specified, we felt an examination of a sample of these courses would help us to best determine how to go about this task and what such an analysis may yield. This led us naturally into the second of our initial questions as to whether the definition of multimedia had evolved and how it may have done so.

Initial course rationale analysis

In our previous examination of course titles we took care to track Higher National Diploma (HND) courses separately from degree courses. HND courses tend to be delivered by colleges with a Further Education (FE) focus or those which may not be able to resource and staff a complete degree course. This is illustrated in the data (table 1) where 62 of 90 HNDs are offered by FE focused establishments. One further difference is that HNDs have tended to be skill or vocational orientated qualifications, compared to HE awarded degrees which may comprise levels of reflection or meta-cognitve components. To examine this situation for multimedia related qualifications we acquired details of a number of schemes for analysis.

The first HND in Multimedia in FE in the United Kingdom was produced at Halton College and validated by the Business and Technology Education Council (BTEC) in Summer 1996. The rationale for this course states:

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[6] With Dr. Michael Pengelly, CSALT, Lancaster University

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> "The proposed course in multimedia has been developed to provide students seeking a career in multimedia with experience, knowledge and awareness of production, management and technical aspects of the relevant environment. It is expected that students following the course will leave well prepared for further study in higher education or for working life in a commercial or business setting.... Construction of the course has been centered around multimedia production, authoring, design and management, forming the main themes of study for both years."
>
> (O'Donoghue, 1996: 5)

The course made use of 12 key modules which covered aspects of design and production equally and was delivered by a team of tutors drawn from the cross-college multimedia department. The emphasis on "production, authoring, design and management" provides an indication that the course was skills focused. This can be compared to a degree scheme in multimedia produced at the same college the following year whose rationale had a wider developmental focus:

> " ? [to] create a core of multimedia activities, projects and studies compulsory for all students
> ? [to] create a progressive system of study and workshops moving from the skill based to the academic and abstract .
> ? [to] create a series of options to facilitate general awareness of the changes in multimedia developments (both physical and in thinking), and to support future career choices. "
>
> (O'Donoghue, Potter & Molyneux, 1997)

The scheme also called for "Project deconstruction and critical analysis of multimedia work [as] essential components of each area of work", a mechanism for meta-cognitive activities and reflection within the scheme as a whole.

An examination of an HND provided by the University of Huddersfield in 1997 stands in comparison to these two schemes as an HE rather than FE provider of this qualification. This course developed and taught by the School of Computing & Mathematics offered the following rationale:

> " Information (text, images, audio and video) is increasingly being presented in digital form for delivery by computer based systems. The pathway is concerned with applications of the converging technologies of computing, communications (including cable) and digital media, and with supporting the design and production of attractive and imaginative vehicles for learning, entertaining, marketing, information provision and cultural exchange."
>
> (Topping et al, 1997)

Documentation suggests that design activities follow-on in year two from earlier computer related activities in year one, such as resource database management. However two specific aims of this course indicate a mixture of skills training coupled with reflective practices:

> " ? To provide an environment for students to develop technical and design skills in producing, and supporting the production of, multimedia.
> ? To produce diplomats who understand the importance of multimedia in today's world, and have the technical and design skills to communicate effectively using the tools and structures of the new media".
>
> (Topping et al, 1997)

Comparing these schemes to more recent activities allows us to investigate the possibility of a development in understanding or an evolution in what is understood by multimedia.

One related module to an existing degree programme in Educational Studies at Keele University, UK, is called 'New Learning and its Technologies' and is designed to:

> "...develop the skills and theoretical knowledge and understanding necessary to produce interactive multimedia (IMM) resources for educational purposes. The two main aims of the module are: to introduce students to rationale for the use, design and creation of interactive multimedia resources intended for use in higher education; and to assist students to create an IMM resource that exemplifies good practice in the design and evaluation of such materials".
>
> (McLean and Denning, 2000)

Whilst the paper reports a variety of findings on how students progressed with the module and took on a variety of roles to complete their tasks, from the course design viewpoint it is interesting to note that the multimedia component forms part of the *context* for the subject matter, i.e. multimedia is not studied alongside other subject materials independently, but is used to *produce and reflect* upon course materials as a means of providing a deeper insight into or to offer a new viewpoint towards subject based theoretical knowledge.

Further evidence of multimedia production, design and evaluation used to exemplify subject skills has also been identified in other schemes, including a degree scheme in 'Interactive Multimedia Arts and Animation'. (Potter et al., 2000).

As a result of these reviews there are indications that a number of multimedia related courses may have moved from a position of relatively independent study of technical skills and creative design to one of *contextual* support and communication embedded in other subject domains. The extent to which this situation is supported is, as yet, undetermined, and it seems likely that some HEIs will offer multimedia with a subject option with little thought of cross-over of context or reflective practices for financial reasons. However, these glimpses of change add purpose to a more detailed study of all 617 course structures and rationales available. This work is currently in progress[7].

---

[7] We expect to be able to report on this work during our presentation.

Learning outcomes from multimedia course provision

With such a wide array of multimedia and subject topics available it seems appropriate to question the learning outcomes from such studies. As many of these courses are new there are few students who can yet be questioned on their experiences, skills and concepts of multimedia as a result of their study. However, one such evaluation on students perceptions of multimedia allowed us to make an initial examination of possibilities.

The evaluation was carried out with 12 students participating on a HND in Multimedia course at Knowsley Community College, UK (O'Donoghue and Machell, 2000). During the first year of the course students were asked to define multimedia. Answered tended to focus into two groups;

- those which split multimedia into components for production and integration, e.g. "Visual, sound, text and video, within a digital format that can be accessed and navigated by the user"
- those which were more generic by nature, e.g. "Multimedia is the ways in which to communicate, changing a situation by decision", "A computer course with a bit of everything".

The course design consisted of a six month period of intense skills development with a range of authoring tools, graphics packages, and audio-video software, followed by a period of project work which included industrial work placements and transnational project visits. When the students were interviewed one year later their definitions of multimedia were now related to their project work and their experiences which they used as a frame of reference to explain applications rather than the stand-alone definitions previously reported.

In his examination of learning towards a synthesis for networked learning environments and online communities, Goodyear (2002) provides an account of three kinds of knowledge (academic, generic and reflexive). In doing this he introduces the term 'Working Knowledge' to which he assigns a number of attributes including "knowledge which is relevant to one's own work (when the work may be in academia or in what other people take to be the real world)" and "the idea of knowledge and knowing as an active and dynamic rather than passive and static". He goes on to add:

> "Learning in higher education should be imbued with a belief in the particular value of 'working knowledge'. Understanding and engaging with different 'ways of knowing' is key to effective action in academia *and* in the workplaces of today's knowledge economy'.'
>
> (Goodyear, 2002:55)

Developing Goodyear's theme to contextualised multimedia learning, it is possible to suggest that the skills of manipulation and production with a variety of contexts become a 'working knowledge' which the multimedia graduate can build on, in which case, the study of multimedia within a hybrid course or alongside a subject base may have many benefits, especially in meeting employers' expectations (see Harvey and Mason, 1996). How ever, there are also other themes and issues to consider, not least those of Wild and Quinn (1998) who "... advocate the development of a coherent model or models of instructional design in multimedia", and those of McLean and Denning (2000) who have adopted a constructivist approach to Interactive Multimedia Learning. More data is required on student's ideas and abilities in multimedia as a consequence of the many courses now available in order to determine the relationships between course design, rationale, tuition, and skills and concept development.

Summary

In this paper we have provided data and analysis on 617 courses available in the UK which make reference to or use of the term 'multimedia'. A large number of such courses (78%) offer multimedia or one of its curriculum variants with a specific topic. Whilst many of these topics appear to compliment the use and application of multimedia and its associated technologies, other do not appear to do so immediately. This gives rise to speculation that some HEIs may be offering courses with a component of multimedia to attract students who may not otherwise attend specific courses or institutions. Analysis of course provision suggests that multimedia related courses have increased in Arts and Humanties subject areas, and in Management and Business related subject areas, more than in computing or other ICT related areas, though the authors acknowledge limitations due to subjectivity of classification.

A limited examination of course rationales suggests that multimedia course design may have undergone a shift of focus, from an almost independent skills-based and technology-led provision, to one in which multimedia is used within a specific subject context. The benefits of this kind of course provision in relation to learning have been briefly discussed, though it is recognised that this area is worthy of more detailed debate and was not intended as a principal focus for this study.

Implication for multimedia course designers and tutors

If such a shift in the focus of multimedia learning has taken place, perhaps in other countries as may be happening in the UK, a series of questions arise with broader implications for tutors, course managers and students, not least with assessment procedures, quality of tuition and work produced, teaching strategies, and whether industries dependent on students emerging with a multimedia qualification, especially in a subject related variant, find such graduates preferable to those with perhaps a single technical or design focus. There are also implications for resources which multimedia course managers need to contend with, such as access to equipment, actually time spent in multimedia production activities, and staff training for non-technical tutors asked to participate in forms of multimedia production or learning activities[8]. Perhaps the area with the greatest implication we are currently examining relates to what we may think of as the *essence* of multimedia; if our indications of the movement of multimedia from independent subject to embedded communication and reflective medium for other curriculum subjects are true, then perhaps a rethink of multimedia teaching is required in order to best suit the needs of students, employers, and academic non-multimedia subject specialists.

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[8] Some of these issues are raised by McLean and Denning (2000) and we expect to report on this situation in more detail during our presentation.

* * * * *

Finally, on completion of this study, we asked ourselves the question whether it was appropriate to remove the term *multimedia* from the title of our own new degree scheme. Insofar as we have given the multimedia components much thought and considered constructive and re-constructive methods for employing multimedia in the communication and the contextualisation of theories of learning, replacing *multimedia* in the title would seem to be a more accurate description of the content and activities of the course. Additionally, in marketing terms, given the relatively few courses we were able to identify within Social Sciences with a learning component (see diagram 1), the inclusion of the term, within the multimedia learning arena as a whole, would appear to represent a purposeful promotional opportunity for the department and the university, but we consider this secondary to the quality of course provision and the course design.

Bibliography

England. E. and Finney, A. (1999) 'Managing multimedia: project management for interactive media', Addison Wesley.

Goodyear, P (2002) 'Psychological foundations for networked learning', in Steeples, C. and Jones, C. *Networked Learning: Perspectives and issues*, pp 49-75. Springer.

Harvey, L. and Mason. S. (1996) 'A quality graduate' in Tait, J. and Knight, P. (Eds) *The management of independent learning* pp 13-28. London. Kogan-Page.

Marton, F. and Säljö, R., (1976a) 'On qualitative differences in learning I - outcome and process', in *British Journal of Educational Psychology*, Volume 46, pp 4-11

Marton, F. and Säljö, R., (1976b) 'On qualitative differences in learning II - outcome as a function of the learner's conception of the task', *in British Journal of Educational Psychology*, Volume 46, pp 115-127

McLean, M and Denning, T. (2000) 'Learning by developing interactive multimedia resources' in 'Improving Student Learning: Proceedings of the 7th International symposium' Published by Oxford Brookes University

O'Donoghue, M.J. (1996) 'BTEC Higher National Diploma in Multimedia'. Course design and specification documents, Department of Research and Development, Halton College, UK.

O'Donoghue, M.J and Machell, J. (1999) 'Multimedia development project at Knowlsey Community College: Initial evaluation of the multimedia Training Programme'. Report for the Centre for the Study of Education and Training (CSEC), Lancaster University, UK

O'Donoghue, M.J and Machell, J. (2000) 'Multimedia development project at Knowlsey Community College: Final evaluation of the multimedia Training Programme'. Report for the Centre for the Study of Education and Training (CSEC), Lancaster University, UK

O'Donoghue, M.J. , Potter, C.A. and Molyneux, P. (1997) 'BA/BSc in Multimedia: provisional structure proposal and pathways'. Course design and specification documents, Department of Research and Development, Halton College, UK.

Potter, C.A. et al (2000) 'Interactive Multimedia Arts and Animation'. Course design and specification documents, College of Art, St.Helens College, UK.

Säljö, R., (1998) 'Learning in educational settings: methods of inquiry', in Ramsden. P, (ed.) *Improving Learning: New Perspectives*, pp 32-48. London Kogan-Page.

Topping, D. et al (1997) 'HND Multimedia'. Course design and specification documents, School of Computing and Mathematics, University of Huddersfield, UK.

Wild, M. and Quinn, C. (1998) 'Implications of educational theory for the design of instructional multimedia', British Journal of Educational Technology, vol. 29, number 1, pp 73-82.

Continuous Zoom applied to texts

Abstract

The amount of text that we are required to read in the present days is amazing. One of the reasons for a poor performance of electronic text systems may result from the fact of users to avoid reading the whole text and make decisions mostly based on their headings (Fox, 1992). Aiming to minimize this problem, we have developed a computer-based tool for continuous zoom interfaces (graphic interface that allows a text to be continuously magnified of decreased). Prior to displaying the text, this tool performs a previous analysis of the text, taking into account its grammatical classification. Then, the text is displayed in its most condensed format and lowest zoom level, where only the most important words are shown. For that, the tool uses the artificial intelligence technique (pattern recognition). The text is then displayed in its most condensed format and lowest zoom level. As zoom increases, more elements of the text become visible. It should be highlighted that the tool deals with language "traps" and whenever the pattern recognizer fails to classify a certain word, it makes that word visible in its most reduced zoom format.

Introduction

Zoomable User Interfaces are a kind of information visualization [2]. *Ken Perlin* of New York University defined the concept of *Zoomable* surface *[1]. Ben Benderson* designed and implemented *PAD++* tool, which in Maryland University gave rise to *Jazz [2]*, which in turn provided a *Java API to* develop the *Zoomable User Interfaces (ZUI).* When working with version 0.6 of *Jazz*, we had to made several extensions to its original format.

The objective of this work is to contribute to reduce the effort to read general electronic documents; to produce and test new ways to analyze texts and identify patterns of sentence constructions, as well as to classify grammatically each of their components. One of the most important questions about electronic documents lies in the research of their usability, which advantages will be provided and how they will be *[4]*.

The idea is that the tool is able to analyze any type of electronic text under the most diverse formats, such as, .doc, .html, etc, and then handle the text through a continuous zoom interface. Each text would be submitted to both a standard dictionary (an inference motor) of a specific natural language, and another zoom-related dictionary. This latter dictionary would be specific for each style of text and would serve to define the right zoom time when a certain class of elements (text) would be displayed in continuous zoom interface. At all times, text integrity would be preserved. In other words, should the inference motor fail to "find out" the class of the element, this will be visible from the first zoom level.

Pattern Recognition

Natural languages constitute a number of *traps* for any pattern recognition tool; for instance, a Word may have several meanings under diverse contexts. Such meanings could lead to a different grammatical class. In English, the word *Kiss* analyzed separately can be either a verb or a noun. The final definition will depend on the context it is employed. In other words, almost always it is necessary to analyze a whole sentence to be able to define the grammatical class of each of its components. Sometimes, the definition of a particular element of the text can influence that of another text. This problem may lead the inference algorithm to an endless *loop* condition. In this case, after a certain number of attempts, our program ends by classifying the word as *"indefinite classification*". This special class is given a differentiated treatment. Should a second element, in order to obtain its classification, need the classification of another element in the same sentence and the latter is defined as *"indefinite classification*", the former also assumes this condition. Therefore, as shown below, at constructing our patterns, we should be more economic in generic expressions, that is, we should use to the extent possible rules that should not depend on others. The more *indefinite dassification* we have, the poorer the results obtained. There is also the problem of verb conjugations. Here, the existence of a rule to deal with them is indispensable. Otherwise, we would fall into the *"indefinite classification"* condition. Word classifications may be constant, such as adjective, adverb, definite article, verb, etc., or indefinite.

Also, there is a special treatment for abbreviations. Our program tries to identify them as soon as possible, at an early stage as we separate the sentences. This process is important because the context to be analyzed is always that of a sentence. Likewise, punctuation is also viewed in a special way. There are marks that serve to end sentences and other do not. We list below a punctuation table used by the program.

Finally, there is the dictionary itself, which is constituted of lines of a text file. Each line represents the definition of a rule for word classification. Therefore, each dictionary line follows the following formation law:

<*word*>:*classification*1(context1)|classification2(context2)| .... | classificationN(contextN)

"word" is the term that we are trying to classify; "c*lassification*" (shall obligatorily be in the classification table); and "c*ontext*", has its own structure:

(*element*1,*element*2,...,*element*N)

Element includes: *classification* (as defined above), *point*, *word*, or *reserved words* (**) meaning that it does not matter how many and which elements appear in that context position; (*qq)* means that it does not matter which type of element appears in that position, however the quantity should always be match the number of occurrences of the expression (*qq)*. The examples below illustrate how such rules work:

Example:

KISS: VERB(**,PRON,KISS,**) | NOUN(**,KISS,**)

The word KISS appears in the dictionary under two possible classifications, depending on the context. It is a verb when it is preceded by a pronoun, regardless the rest of the sentence or what comes before of after the binomial "PRON", "KISS". In cases where this rule fails, the dictionary will try the next one, which will classify it as a noun, under any context.. It is if we were working with the structure: Exception1, Exception2, ..., ExceptionN, General Rule.

Obviously, the more and better the dictionary is worked out, the better the program performance. We find that the construction of this *base of knowledge* is a good exercise for subjects related to the teaching of *natural languages*. Upon analyzing a text, the program produces two files as processing byproducts. In the first file, each line represents a word, its classification and the sentence of the text where it appears.

This means that the word *He* was classified as a *pronoun* in the sentence *He gave a pie*, and so on. The second text file list the expressions that could not be classified and need be defined or better worked.

Finally, after all this analysis, the main output of the program is a list of sentences of the text, where all their components are classified in a way or another.

Continuous Zoom Interface

Of all extensions, that dealing with the management of the zoom stands out. Since we are working with text, each element will be assigned its particular zoom control. This is due to the fact that we will control the exact time when the element (text) will be visible to the final user. That time basically depends on both its *classification* defined as above and the text style.

To address this issue, the program will be provided with a zoom *dictionary* specific for each *style*. Note that while the *pattern dictionary* defined in the previous section is generic for a given natural language, our Zoom *dictionary* is more specific. This way, the program can work with any combination of both the dictionaries predefined by the final user.

Specifically, *zoom dictionary* adopts the following format for each one of their lines in the text file:

<*classification*>: magnitude level1(Context1)|magnitude level2 (Context2)| ...|magnitude levelN (ContextN).

Where:

Magnitude level is of *java float* type, which determines the time when elements under that classification used in that *context* become visible. Zero value indicates that said element will become visible right at the first moment and is therefore an essential part of the sentence. Its suppression will make the sentence senseless, or worse, it may change its meaning.

Concluding, we would like to add that, for aesthetic reasons, the automatic realignment of lines as the different elements of text appear and disappear has not been yet implanted. It is worth stressing that the user can magnify the text (zoom in) or reduce it (zoom out) at any time.

Learning management Systems: One Size Fits All?

Learning management systems such as WebCT and Blackboard are rapidly becoming the principal systems behind institutions' moves to technology-based learning settings. In settings where lecturers have had no or limited exposure to ICT as a teaching tool, LMSs pave the way for quick introduction and eventual adoption of technology-based teaching practices. Many lecturers quickly progress and grow in the field. But there are those who argue that the use of LMS tend to be counter-productive and that in their current forms, they cannot be used effectively as a learning tool. Critics argue that they support only traditional forms of teaching and encourage poor learning designs in their implementation. This panel will explore LMSs as they exist today and will explore whether they are the solution to a pressing problem or in fact problems within themselves.

The Panelists

1. Allard Strijker from University of Twente in The Netherlands whose interest is in the concept of learning objects and reusability.
2. Duan van der Westhuizen from Rand Afrikaans University in South Africa with an interest in staff development and ICT adoption within the University.
3. Tom Reeves from the University of Georgia,, USA, has expertise in the evaluation of technology-based learning;
4. Barry Harper from Wollongong University in Australia who is working on a large project exploring the development of generic learning designs for Web-based teaching and learning; and
5. Ron Oliver from Edith Cowan University in Australia will chair the panel session.

Session Summary

Duan van der Westhuizen (South Africa): LMS as successful change agents for HE
The use of LMS with their seamless and intuitive support for Web-based learning has helped to pave the way for institutions and organisations throughout the world to adopt ICT as a support for teaching and learning. They necessarily lack some flexibility and openness in their design so that they can be used by novices and experts alike. Duan will argue their strong influence and obvious success with some data showing the level of use and uptake in the short time they have been around.

Allard Strijker (University of Twente): "One Size, but still growing, LMSs: up to the next generation"
I think the current forms of LMSs are a solution that will not last long. The information that is retrieved form the objects are most of the time not useful or needed for standalone bases. LMSs will be incorporated within overall management systems and will be a feature that can be added to the existing Human Resource Systems. The weakness at this moment is that LMSs are used as a combination between portals and extended logging systems. The information that comes available is most of the times not used for adaptive learning or for management decisions.

Barry Harper (University of Wollongong). Designing Learning with LMSs
While many criticise LMS because they don't provide any learning designs, in many cases they don't need to. With the development of generic learning designs, the various LMS become very powerful tools and their flexibility and apparent lack of structure is perhaps their most powerful attribute (not the weakness that many claim). LMS serve very useful purposes if they are designed to be able to deliver resources of many forms to the users, coupled with powerful communication supports and learning management supports.

Tom Reeves (University of Georgia)
"So You Want to Know What They Have Learned: The Strengths and Limitations of LMS for High Quality Assessment"
High quality assessment is the lynchpin in an effective learning environment. Although LMS provide opportunities for alternative forms of assessment that faculty may fail to utilize, they also have their limitations. Tom's stance will be both critical and constructive.

Online Learning Design For Dummies: Professional Development Strategies For Beginning Online Designers

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Abstract: Much of the conventional development of Web-based learning environments stems from design strategies that are based on providing delivery of the course content. Contemporary courseware delivery systems encourage teachers to see the design of online learning as settings as a process of electronic delivery of content and information. As a consequence Web-based courses have tended to display limited evidence of an underpinning learning design and varying degrees of use of the opportunities and affordances of the new technologies. This paper provides an overview of instructional design principles that can guide beginning designers in the creation of Web-based learning materials that support learner engagement and knowledge construction. The paper suggests strategies for professional development activities that can help beginning designers to reconsider their pedagogy and to understand the processes required to design effective settings for online learning.

Introduction

Despite modest gains and often questionable achievements, there is still unbridled interest and enthusiasm among institutions and organizations for online learning and e-learning as the means for the presentation and delivery of higher education. Online learning has been mooted as the solution to many of the problems that face institutions of higher education. Many writers have argued the use of e-learning to attract new markets and new students. Others have argued its capacity to increase levels of equity and access for existing students, while some see the new technologies as capable of reducing the costs of delivery of programs and courses (eg. Holt & Thompson, 1998; Fraser & Deane, 1997; Nunan, 1996). While many of these claims and potentials have yet to be verified the one thing we have learned from our activities in this domain is that e-learning, when done well, can improve learning and deliver enhanced learning outcomes and has the prospect to transform the way education is conducted in these settings (Biggs, 2001)

The criticisms that many people hold for much of the current effort in the design and delivery of online learning stem from the narrow instructional design models upon which much of the material is based. The design models in use appear often to have evolved from the economic, efficiency and marketing imperatives (eg. Dehoney & Reeves, 1999; Mioduser, Nachmias, Oren, & Lahav,1999; Burbules & Callister, 2000). With on-line delivery it is possible to pursue these imperatives and at the same time to pursue such goals effective teaching and learning.

Staff development for online learning

Much of the development of online learning settings is currently undertaken by academics with little experience or expertise in this field. The skills and understandings of learning that many teachers develop through their face-to-face teaching are often insufficient to support their needs in online learning settings. Those academics who feel comfortable working with technology in online environments are rare, and there is generally little transference of expertise to their colleagues (Bennett, Priest, & Macpherson, 1999), a situation compounded by an increasing number of sessional and part-time teachers (Van Dusen, 1997).

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There is often a resistance to technology amongst university staff. Factors include a lack of experience or confidence in using technology, caution about methodologies teachers regard as unproven, and a belief that computer-based options threaten the human interaction teachers value in face to face teaching (Sparrow, Herrington, & Herrington, 2000). In particular, the speed of adoption of the Internet in higher education has caught many teachers unaware and unprepared to face the challenges required to succeed.

A crucial aspect of effective online learning may hold the key to the changing role of the university teacher. Wade (1994) argues that the promotion of learner autonomy means increased responsibility for the student which, if it is to succeed, requires 'a strong framework of *support and guidance* for the student from the outset' (p. 13). In designing effective online learning materials, perhaps the most important first step is to create a role for the teacher as one of coaching and scaffolding as an alternative to the more commonly used didactic forms of teaching. Novices frequently fail to achieve this in the online learning designs.

Changed roles for the teacher

A traditional approach to the design of learning environments proposes that the best way to deal with complexity is to simplify a topic by breaking it down into its component parts. However, Perkins (1991) suggests that the temptation to over-simplify learning environments should be resisted, and instead designers and teachers should search for new ways to provide appropriate scaffolding and support. In this situation, the teacher provides the skills, strategies and links that the students are unable to provide to complete the task. Gradually, the support (the scaffolding) is removed until the student is able to stand alone.

Many designers and administrators of online units believe that they should be self-contained resources that include everything the student needs to learn a particular topic. However, teachers who expect students to work individually on online units are not only denying them the benefits of collaboration, but also the benefits of expert assistance providing hints, suggestions, critical questions, and the 'scaffolding' to enable them to solve more complex problems. Collins, Brown and Newman (1989) point out that coaching is highly situation-specific and is related to problems that arise as students attempt to integrate skills and knowledge, a role that is still best performed by the teacher. Instead of providing and delivering information, the lecturer's principal function is to create collaborative, challenging and supportive learning environments within which the learner operates.

Instructional Design for Web-based learning

Conventional approaches with their content-based approaches can be difficult molds for many teachers to free themselves from. In our work with such teachers we have developed strategies that we have found quite successful in assisting this move. In previous research, we have described a framework for designing online learning settings (Table 1). The framework comprises three interconnected elements which are presented as critical components for the design of learning settings. In particular, the framework highlights various distinctions between the elements involved in the design of online learning settings (Oliver, 1999).

Table 1. Framework describing critical elements of online learning settings

learning design elements	description
learning tasks	The activities, problems, interactions used to engage the learners and on which learning is based
learning resources	The content, information and resources with the underpinning knowledge and with which the learners interact
learning supports	The schedules, scaffolds, structures, encouragements, motivations, assistances and connections used to support learning

The framework provides a means to identify the various elements within learning settings and suggests emphases which can be made in the instructional design process. Contemporary learning theories posit that the forms of learning design most appropriate to higher education are those based on constructivist learning principles. The above framework takes on particular and discrete forms when applied this way.

a. Learning Tasks

Most beginning online learning designers commence their planning by considering the content to be learned. Such approaches are very common and characterize online settings based on pages of text and images which learners are required to read and follow. The learning activities in technology-based environments play a fundamental role in determining learning outcomes (Wild & Quinn, 1997). They determine how the learners will engage with the course materials and the forms of knowledge construction that will take place. Contemporary thinking suggests that the activities must be active and engaging (eg. Wild & Quinn, 1997).

The beginning online learning designer must be encouraged to think not about content but about how learners will be required to use the content. They need to consider ways to engender cooperative and collaborative activities among learners which provide opportunities for reflection and articulation. The selected activities need to provide the purpose and the context for learners to deal with the content and information (Duffy & Cunningham, 1996). The designers need to plan activities with an active role for the learners in which there is encouragement and provision to take control, make decisions and act in a self-directed fashion.

b. Learning Supports

While considering the forms of learner activity the beginning online designer must also plan ways for the setting to support the leaner. This critical design element involves the provision of the support necessary to guide learners and to provide a feedback mechanism which is responsive and sensitive to their individual needs (eg. McLoughlin & Oliver, 1998). A number of writers have developed frameworks to describe the ideal forms of support required for on-line learning environment and in each case, there is usually a strong argument made for an active and involved teacher (eg. Laurillard, 1993). The role of the teacher needs to be planned as that of a coach and facilitator in place of the more didactic style often assumed. In contemporary settings, this form of learning support is called scaffolding in recognition of the way in which it helps to build knowledge and is then removed as the knowledge construction occurs.

c. Learning Resources

In choosing the learning activities and planning the supports for learning, the requirements for the forms of course content required will become evident. In learning environments based around learning tasks, learners will need access to a variety of forms of content. The materials need not all be on-line. The use of conventional materials along with electronic sources can provide the diversity often required. Previously designers created course materials where the content was rigidly organised and presented to the learners in a strict sequence. Today it is recognised that learners need to be able to access resources in a variety of ways and from a variety of perspectives (Herrington & Oliver, 1995).

An Approach to Web-based Instructional Design for Beginners

Putting these elements together in a meaningful and effective fashion is aided considerably if beginning online designers follow the 6 stage process outlined below. This process provides an organizational framework that can assists novice designers and teachers to focus on strategies that create learner-centred settings which can engage and support student learning. The framework helps to remove the attention away from the content as the organising element towards learning tasks. The provision of such a framework for the novice designer provides a strong scaffold for their learning, particularly if models and exemplars are also provided for them to follow. It is often a very simple process to model the form of professional development provided around this framework as well.

Table 2: Task-based design strategies

Stage	Stage (cont.)
1. Plan the intended learning outcomes	4. plan resource needs
2. Plan the learning tasks	5. plan support strategies
3. choose assessment strategies	6. plan the organization strategy for the online materials

1. Planning the intended learning outcomes

The best place to commence the process of developing the online learning resources is by considering the intended learning outcomes. The beginning designers need to recognize that intended learning outcomes need to be expressed in terms that describe the learning that will be achieved. For many courses, it is possible to express objectives in terms of the learner performance or competency.

It is important that the learning outcomes are not expressed solely in terms of learning process or strategies. The processes and strategies are the means by which the learning will be achieved. It is important for the beginning designers not to confuse the activities, which are a means to an end, with the intended learning outcomes.

2. Planning the learning tasks

Once the learning objectives have been stated, beginning designers need to consider and plan the learning processes that will provide learners with the experiences that will help them to learn. The learning processes need to be carefully planned with the intended learning outcomes in mind. Planning the learning experiences involves consideration of ways to engage the learners in ways that will cause the required forms of cognition and thinking. The learning activities need to involve a variety of processes that will cause the learners to deal meaningfully with appropriate resources and information.

The best forms of learning activity to consider are those that are authentic. Authentic activities have been described earlier and usually involve the development of a product or an artefact in much the same way as the learner will need to demonstrate and practice in real life. Effective learning designs often involve forms of communication and collaboration, activities that encourage the learners to reflect on their learning and to articulate their ideas in ways that strengthen and assist the knowledge construction process. Some examples of typical learning designs include:

- Having learners design and evaluate a project plan or proposal. To complete the design the learners need to develop skills and competencies in the underpinning knowledge and concepts;
- Having learners work collaboratively to develop a solution to an ill-defined problem. The learners need to plan the problem solving process, gather the necessary information, decide on the steps to be taken, suggest a solution and demonstrate the reasoning;
- Having learners assume the roles of particular players in a role-playing setting. This involves exploring the person whose role they are playing, understanding the context and the issues and acting in scenarios in ways that use this knowledge to build a further understanding of the person and the setting.

The critical factor in planning the learning design is to consider activities that are independent of the learning resources. It is important when planning the design not to be concerned with the content and resources and to see these as completely independent elements in the design process.

3. choosing assessment strategies

At the same time as the learning activities are being planned, it is important to decide how the learning outcomes will be assessed. The use of authentic learning activities provides a sound basis for assessment since the outcomes from the activities often demonstrate the extent and scope of the learning that has been achieved. The assessment strategies need to be derived from the stated learning outcomes. It is important that the forms of assessment not only provide evidence of the extent of learning but also provide guidance to the learners in ways that can model and demonstrate areas where further activity is still required.

4. planning support strategies

Online learning is best designed with deliberate and intentional support mechanisms for learners. There are many possible support strategies that can be implemented and these include roles for the teacher, other learners, workplace associates, peers, and mentors. It is also possible to plan the learning activities so that they have inbuilt supports and to provide resources which can assist in supporting learners.

The purpose of any support in an online setting is to enable learners to undertake the activities that have been set in ways which assist their independence and self-regulation. With authentic learning settings, students will require a range of supports to assist them as they develop their knowledge and skills. Many of these supports, scaffolds, can be reduced as the learning process progresses to the point where the learners develop the capacity to cater for themselves. Beginning designers can be encouraged to plan the supports as they plan the learning tasks. Often the tasks suggest the forms of support that will be required.

The planning of support strategies should be a part of the planning of learning designs and learning resources, both of which have the capacity to provide supports for the online learner. Learning activities that provide learning support include collaborative settings, settings involving workplace activities, involvement of buddies and mentors. Learning resources that provide supports include such items as templates, checklists learning pathways, and performance support systems.

5. planning the resource needs

In order to complete the learning activities the learners will need access to a variety of resources and information and part of the design process is to decide the forms and extent of the resources that will be needed. Learning resources can take many forms including such information sources as textbooks, newspapers, journals and online information sources. The beginning designers need to select resources from a variety of settings. They should be discouraged from considering writing and developing the resources themselves. They need to be encouraged to consider reuse and choosing from among those that already exist.

Depending on the forms of learning activity, the resources might also include documents and manuals from industry settings, legislation, rules procedures and policy manuals. In online settings there is considerable scope for the use of existing documents and resources. Often the environment will include resources that have been specially built for the learning setting. For example examples of previous students' work, interviews with experts, selected readings, compilations of resources. It is not uncommon for the resource sets to contain tutorials and learning modules to assist students to acquires some of the underpinning skills and knowledge.

Part of the design process is to determine what resources students will need to complete the activities that have been set and to collect (and make) these resources for the learning setting. As more and more resources are being placed on the Web, the need for developing resources is diminishing and many learning settings are able to be resourced almost entirely from existing materials. The majority of the resources in online settings should have no instructional elements. It is best to separate the learning activities from the learning resources so that both the resources and the activities can be modified and customised and reused. When the resources are also instructional elements, the capacity for customisation and reuse is significantly hampered.

6. planning the organization strategy for the online materials

Once the learning activities, resources and supports have been designed, the final stage is to consider an organisational and contextual strategy that will provide a natural and intuitive setting for them. There are many ways to organise online learning settings. Many teachers will have access to powerful online courseware delivery systems such as WebCT and Blackboard. These tools provide their own organizational frameworks for the learning setting. In some cases, it is possible and useful to design a unique interface and organizational structure, for example, a virtual setting reflective of the learning context.

Beginning designers with access to courseware delivery systems are often able to play a significant part in the process of developing the online setting. The critical factor in organising the setting is to ensure that all aspects of the learning designs, the learning resources and the learning supports are clearly evident to the learners and freely accessible. The site needs to enable learners to move freely within and to know at all times where they are in the hyperspace and how to get to all other places.

Summary and Conclusions

We have been working with beginning online designers for some years now across a variety of projects and educational sectors. Many of those looking to design and build online courses for the first time, have preconceived ideas about how the setting will be formed and many times these ideas are based on very conventional views of teaching and learning. The strategies we have presented in this paper provide a strong framework to guide the professional development of these teachers. The framework provides a structure which causes the teachers to rethink their pedagogies and to plan engaging and active learning settings where the role of the teacher is more a coach and facilitator than an expert delivering content. As well as providing a mechanism to assist in a pedagogical rethink, the framework also provides a form of blueprint and template to guide effective design strategies.

The biggest challenge we have found in providing learning support for beginning designers is to help teachers reconsider and to alter the pedagogical viewpoints they hold. Strategies that assist in this endeavour are tasks and activities that provide the learners with models and exemplars to follow. It is very important for the professional development exercise to practice what it preaches and for it to be an example of best practice. There are now many examples and cases for teachers to use for this purpose and the success of these endeavours is now becoming evident in the growing number of quality online learning settings that are beginning to emerge.

References

Burbules, N., & Callister, T. (2000). Universities in transition: The promise and challenge of new technologies. *Teachers College Record, 102*(2), pp. 271-293.

Biggs, J. (2001). The reflective institution: assuring and enhancing the quality of teaching and learning. *Higher Education, 41*(3), 221-38.

Bennett, S., Priest, A., & Macpherson, C. (1999). Learning about online learning: An approach to staff development for university teachers. *Australian Journal of Educational Technology, 15*(3), 207-221.

Collins, A., Brown, J.S., & Newman, S.E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L.B. Resnick (Ed.), *Knowing, learning and instruction: Essays in honour of Robert Glaser* (pp. 453-494). Hillsdale, NJ: LEA.

Collis, B. (1998). WWW-based environments for collaborative group work. *Education and Information Technologies, 3*, pp. 231-245.

Dehoney, J., & Reeves, T. (1999). Instructional and social dimensions of class web pages. *Journal of Computing in Higher Education, 10*(2), pp. 19-41.

Duffy, T., & Cunningham, D. (1996). Constructivism: Implications for the design and delivery of instruction, *Handbook of research for educational telecommunications and technology* (pp. 170-198). New York: MacMillan.

Fraser, J. & Deane, E. (1997). Why open learning? *Australian Universities Review, 40*(1), 25-31.

Herrington, J . & Oliver, R. (1995) The critical elements of situated learning environments. In J. Pearce & A. Ellis (Eds) *Learning with Technology, ASCILITE'95 Conference Proceedings*, (pp. 395-403). Melbourne: ASCILITE.

Holt, D. & Thompson, D. (1998). Managing information technology in open and distance higher education. *Distance education, 19*(2), 197-227.

Jonassen, D., & Reeves, T. (1996). Learning with computers: Computers as cognitive tools. In D. Jonassen (Ed.), *Handbook of Research for Educational Communications and Technology* (pp. 693-719). New York: MacMillan Library Reference.

Laurillard, D. (1993). *Rethinking University teaching: A Framework for the Effective Use of Educational Technology*. London: Routledge.

Mioduser, D., Nachmias, R., Oren, A., & Lahav, O. (1999). *Web-based learning environments: Current states and emerging trends.* Paper presented at the Ed-Media 1999. World Conference on Educational Multimedia, Hypermedia and Telecommunications, Seattle, USA.

McLoughlin, C. & Oliver, R. (1998). Scaffolding Higher Order Thinking In A Tele-learning Environment. Ottmann, T. & Tomek, I. (Eds). *Proceedings of Ed-Media/Ed-Telecom 98 World Conference On Educational Multimedia And Hypermedia & World Conference On Educational Telecommunications.* Virginia: AACE. (pp. 977-983).

Nunan, T. (1996). Flexible delivery-What it is and why is it a part of current educational debate. In *Higher Education Research and Development Society of Australasia*, Perth: HERDSA.

Oliver, R. (1999). Exploring strategies for on-line teaching and learning. *Distance Education, 20*(2), 240-254.

Savery, J. & Duffy, T. (91995). Problem-based learning: An instructional model and its constructivist framework. *Educational Technology, 35*(5), pp. 31-38.

Perkins, D.N. (1991). What constructivism demands of the learner. *Educational Technology, 31*(8), 19-21.

Sparrow, H., Herrington, J., & Herrington, A. (2000). 'Shovelware' as staff development: A useful introduction to moving online. In M. Wallce & A. Ellis & D. Newton (Eds.), *Proceedings of the Moving Online Conference* (pp. 236-246). Lismore, NSW: Southern Cross University.

Van Dusen, Gerald C. (1997). The virtual campus: Technology and reform in higher education. *ASHE-ERIC Higher Education Reports, 25*(5), 1-147. [ED412815].

Wade, W. (1994). Introduction. In W. Wade & K. Hodgkinson & A. Smith & J. Arfield (Eds.), *Flexible learning in higher education* (pp. 12-16). London: Kogan Page.

Wild, M., & Quinn, C. (1997). Implications of educational theory for the design of instructional multimedia. *British Journal of Educational Technology, 29*(1), pp. 73-82.

Vygotsky, L. (1978). *Mind in society*. Cambridge, Massachusetts: Harvard University Press.

A Web-Based Run-Length Encoded Map Generating System

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Abstract: Maps are used to display information for educational and scientific purposes on a daily basis. The capability of generating web-based interactive maps by non-specialists and non-programmers is of great convenience. The map generating system described in this paper can handle any arbitrary map, including those with embedded and disjoined regions. The resulting web-based interactive maps can be used in many different applications requiring color-coded display of quantitative data.

1. Introduction

The Digital Flora of Texas (DFT) project has been actively pursuing the construction of biodiversity informatics tools for use by interested biologists, students, scholars and researchers. One of the browsing tools that has been used extensively is the Herbarium Specimen Browser (HSB), originally developed in 1996 and modified based on user feedback over the last five years. The HSB allows users to survey the content of collections from various herbaria throughout the state of Texas. It supports fast access and dynamic filtering of data on the fly. Information related to any combination of counties, herbaria and specimens can be displayed in real time by merely clicking on the interface shown in Figure 1.

The HSB also provides an interactive map that dynamically displays the density and distribution of herbarium specimens based upon user selections of plant families, genera, or species (Fig. 2). Clicking on a county displays the characteristics of the plant specimens that have been collected from the county by the selected herbaria. The HSB supports three mapping options: counties of the state of Texas; counties of the states of Texas, Oklahoma, Louisiana, New Mexico and Arkansas (shown); and, states/provinces of North America. Lastly, it allows users to query the collection using any combination of search terms such as name of herbaria, specimen accession number or country.

Of course, for this mapping system to work properly, someone must generate the map and associate commands that make it respond to users' requests. In the original HSB, one had to obtain a map in PBM format, convert the map into Run-Length Encoding (RLE) format, and associate region names with the pixels in the image before the map could be used. The entire process was tedious and error prone.

The objective of this project was to simplify the process of generating a mapping system by providing a web-based automated tool that accepts some of the widely used graphics formats for the PC. In other words, given files in GIF, JPEG or BMP format, the system automatically generates the RLE file needed for the HSB or other run-length encoded mapping system. To remove the burden of manually associating region naming with the map regions, the system allows users to name map regions easily and generates the required files that allow the browser's mapping system to recognize the regions being selected by the user.

A verifier is also provided that allows users to check and correct errors in their naming schemes and serves as a prototype for interactive mapping routines.

Acknowledgements

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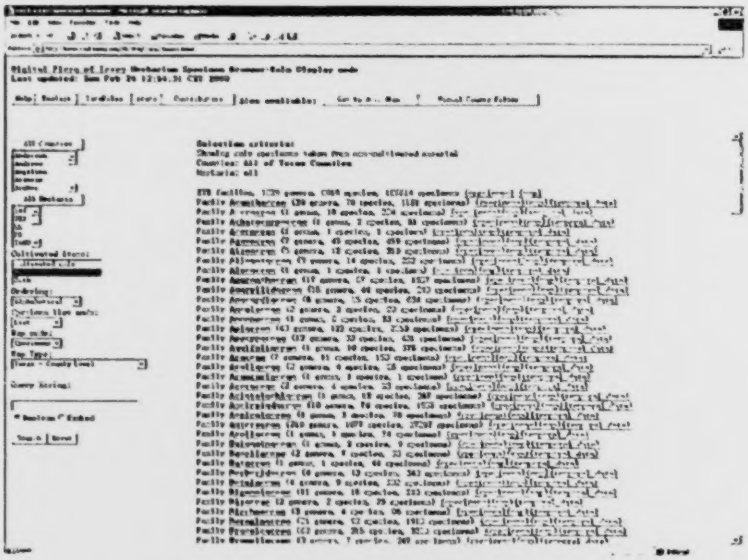

Figure 1: The interface of the Herbarium Specimen Browser

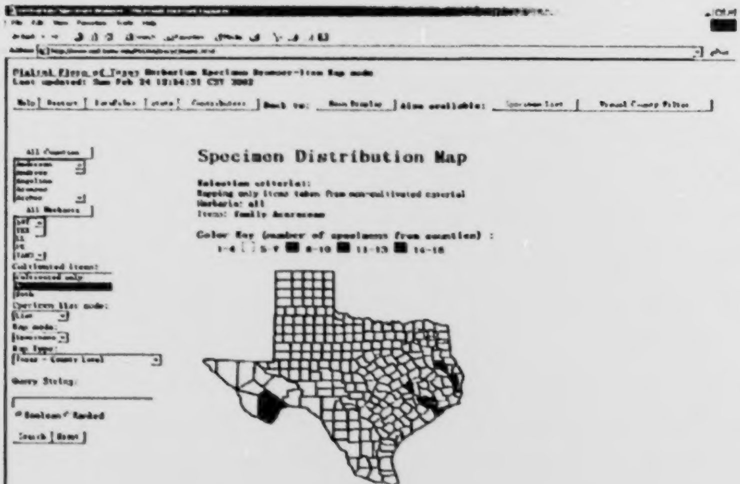
Specimen Distribution Map
Selection criteria:
Herbaria: all
1-4 5-7 8-10 11-13 14-16

Figure 2: Distribution of specimens from counties in Texas, Oklahoma, Louisiana, New Mexico and Arkansas

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QIICC - Using Technology to Involve Students In Assessment

The objective for this session is to show participants a new and innovative way of involving students in the assessment process. Participants will learn how to incorporate the QIICC Analysis protocol into everyday assessment strategies. This lecture and presentation will include a demonstration of the QIICC analysis protocol utilized in a web-based quizzing system called Telequiz. During this presentation, the theory of the QIICC Analysis protocol will be discussed. This theory dictates that each question on a quiz be rated on several variables: Quality, Interest, Importance, Confidence and Challenge.

Qualities, Interest, Importance are measured in a straightforward manner. For each question a student answers on a test or quiz, they are asked to designate the quality of the question, their interest level in the content of the question and their impression of how important the question is to the learning of the course. Each of these variables is designated using a three-level scale: High, Medium and Low.

The next variable indicates the confidence students have in the accuracy of their answer. This is gathered using the same three-level scale, and affects the score that the student receives on each question. Maximum points are awarded for a question that is answered correctly with high confidence. On questions that have been answered accurately, scores fall as confidence levels fall. For those questions that are answered incorrectly, question score rises as confidence levels fall. This is due to the fact that if someone states high confidence in a wrong answer, or low confidence in a correct answer, there is a disconnect between what the student knows and what they expect to know. If a student indicates high confidence in a correct answer, or low confidence in an incorrect answer, there is no such disconnect. That student possesses a realistic understanding of their knowledge.

The final variable is challenge. In the QIICC analysis protocol, each student is allowed to challenge a certain number of questions per testing cycle. Any question that is challenged does not count against the score. This allows students to think critically about the form and content of a question, and take a more active role in the outcome of the quiz or test.

The QIICC Analysis protocol is designed to elicit student feedback on the quality of items found on a quiz or test. By doing so, it allows the instructional staff to better analyze the effectiveness of the individual elements that are included in the assessment process. More importantly, the QIICC Analysis helps students analyze their own knowledge levels, and by doing so, understand "what they know, and what they do not know." In the QIICC protocol, students are scored on not only how accurately they answer a question, but also on how confident they are in the accuracy of their answer. This capability is a powerful tool for assessing student learning. Through the confidence variable, students are asked to take a much more critical role in the development of their knowledge. By asking for a confidence level and incorporating it into the grading rubric, it is much more important for a student to "know what they know" than is seen in other assessment strategies. By allowing for challenges, QIICC empowers students to feel comfortable with the assessment process and take control of the knowledge that is deemed important or worthwhile for learning.

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Virtual Knowledge Communities in an Industrial Environment

Nelly Osorio, Honeywell CA*

Introduction:

Honeywell CA is a worldwide company leader in industrial automation. As a high tech business, needs to have its employees on the top of the technological advancements which means permanent training and development. Also it is going through a process for making digital all the activities including employees training. The strategy being used is the creation of a Knowledge Communities (KC) portal in the Intranet. This strategy is being supported and implemented in order to achieve the most of the employees learning by using the many opportunities available in that site. In this paper, the emphasis is the learning processes, cost reduction and goals. There will be also analysed the pros and cons of that modality of training for one Latin American affiliated.

Knowledge Communities at Honeywell IA Portal:

A KC is a remote virtual space for communication, problem solving, lesson learned sharing, training and knowledge building among Honeywell employees. It is a very rich learning environment represented in a portal that includes: 1) Knowledge Communities on products, markets, disciplines, roles and methodologies, and certifications.2) templates, video tutorials, tips and tricks. 3) Training by using on line presentations, video tutorials ordered and schedule. 4) Links. 5) e-Library. 6) Other key information resources.

The Knowledge Communities: There are 60 knowledge communities in the industrial portal by disciplines, products, markets, roles and methodologies. Each KC has a similar structure: members, best practices, tools, topics, lesson learned. The rationale behind each one is: sharing knowledge, problem solving, challenging our professionals and collaborating to improve and innovate for the generation o new knowledge. Each one has a Knowledge Manager.

Training: The Employee Learning Portal includes courses, links for training, video tutorials, on line presentations, technical support and certifications. This is one the portal most important features for the digitization of the company. It is expected to reduce in a very significant amount training investment. Benefits expected: maintain people up dated on products and technology in a more effective way . On line training sessions are available to people anytime. Distance learning on line is also scheduled. The training opportunities and options are renewed and scheduled maintaining people up dated.

E-Library: people can find documents, resources and e-books in digital format. Key to Honeywell digitization initiatives as well as efforts to reduce paper copies.

Links: There are 60 links to possible sources of information, tools and key sites.

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Other Key Information Resources: there is available a diversity of information from airlines, dictionaries, people, search engines, writing guide, business, organizational charts, news, etc.

Cost Reduction Measures:

The system implemented in the portal permits to measure cost reduction by asking questions regarding: the number of people being trained, T&L costs if the training was taken in another place. That information is recorded and reports presented to the site administrator.

Some Advantages:

Sharing of knowledge at most, that was not done before.
Lesson Learned sharing between world wide affiliates
Improving of communication
Cost Reduction

Challenges:

Creation of the distance learning culture among employees.
Creation of the knowledge sharing among people
Creation of incentives for training on the web achieved

Learning Collaborative Learning: A Distance Learning Project in the DUSC Programme

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Abstract: A joint Dutch-Scandinavian distance education project, part of the DUSC Programme, was carried out from November 1999 to the summer 2001. The aim of the project was to develop a module to train lecturers in how to develop a course based on using the concept of collaborative learning in distance education, and to test and evaluate the module. In the developing process, the authors themselves, from two different countries and four different faculties, went through a collaborative process, exploring different aspects of communication and collaboration at a distance. The main communication tool was the asynchronous German BSCW system, but also the synchronous tools NetMeeting and videoconference, and face-to-face meetings were used.

Introduction

The DUSC (Dutch Scandinavian Cooperation in Higher Education) Program was an initiative of four Dutch universities of professional education to develop expertise with Scandinavian institutions of higher education. A number of projects were outlined, and Information and Communication Technology (ICT) was an explicit sub-component of these.

One of the project groups was called CLiDE (Collaborative Learning in Distance Education). The aim of the project was to develop a module to train lecturers in how to develop a course based on the concept of active learning in distance education. The idea was that up to now lecturers have been trained to develop an active learning course in a classroom situation, but often do not have the skills to develop such a course for their students at a distance. After the development of the module the module was to be tested and evaluated by running it with a selection of interested lecturers within the educational institutes of the DUSC network.

The objectives stated in the project plan clearly divided our work into two different phases: Firstly, *to develop the module*, and secondly, *to test and evaluate the module*. Accordingly, the first few months we were supposed to cooperate and collaborate in a creative design and development process, and then, for the next months, try out our results with a group of students. Most of the collaboration was to be mediated by means of electronic networks. This way of organising a project work seemed very useful and interesting, because by developing a course in a collaborative way (phase 1), we would go through processes similar to our students when the developed module was to be tested and evaluated (phase 2). We believed that this experience would make us better teachers and tutors for our students. For distance education courses in general, this way of developing a course may prove to be successful.

The Project, Phase 1

This was in fact a *distance project group*, with members in two different countries (The Netherlands and Norway). We had to rely on electronic communication, and decided to do the greater part of our collaboration based on the asynchronous system BSCW (BSCW 2002). BSCW is a computer-based conferencing tool, developed at *German National Research Center for Information Technology* (GMD), and have facilities for a great range of functionalities in the area of managing discussions and collaborative processes. We found this tool to be a good place for our discussions and contributions toward our final product: The module. We could all reach our common space in BSCW from wherever we were in the world, and so our project work, as far as this collaboration is concerned, was distance-independent.

Our *Plan of Activity* outlined four different elements or themes to be worked out by the project group: *A: The concept of collaborative learning*, *B: The choice of the digital learning space*, *C: The practical experience* and *D: Critical success factors*. Each of the project group members was assigned the role of moderator for one of the themes, and thus our responsibilities were shared by all of us. It was also our intention that being in charge in the moderating role would provide us, the project group members, with valuable experience in this aspect of conferencing and collaboration work. By doing this in phase 1 of the project, we felt we would be better prepared for the testing and evaluating part (phase 2).

We also planned other activities, other ways to do part of our project. In theme B, *The choice of the digital learning space*, we used a videoconference session, in addition to BSCW. In theme C, *The practical experience*, we used a synchronous, computer-based conferencing tool (Microsoft NetMeeting), and after theme C, we planned and carried out a face-to-face meeting in Bergen. See the complete report (Stofberg, Otteraa, Geers van Gemeren, Knudsen 2001) for experiences with these different sessions. A web-site (CLiDE 2000-01) was also established for the project; there we gathered some overall information, plans, links to literature, etc.

Our collaborations in phase 1 of the project resulted in two papers, *The Concept of Collaborative Learning* and *The Tools*, given as appendices in Stofberg, Otteraa, Geers van Gemeren, Knudsen (2001), meant as background material for the students in phase 2.

The Project, Phase 2

We defined four main tasks for our students, 1) *Familiarising with the BSCW system and the group*, 2) *Problems and possibilities in digital learning environments*, 3) *About different tools* and 4) *Synthesizing and elaborating on different aspects of web-based collaborative learning methods*. For each of the tasks, we specified certain learning objectives and a number of assignments. It was decided that the moderation was to be done by tutors in pairs. The two tutors would then take turns in taking the leading role in the moderation of the course, and would turn to the other if he/she needed advice or support in the moderation task.

Studying the contributions from our students, there are definitely a number of evaluative remarks worth mentioning. The tutors would corroborate that many of the issues were also the issues that affected the process and product of their collaborative work while designing and working out the course (phase 1). For the evaluation, we refer to the report (Stofberg, Otteraa, Geers van Gemeren, Knudsen 2001).

Conclusion

Keeping a long-term international relationship or collaborative project going is not an easy matter. Nevertheless, the special nature of this project made it possible. Building up expertise together, developing yourself and the group as a whole by going through a number of separate and clearly structured stages with each other, taking rotating independent responsibilities (to keep each one of us alert and motivated), pooling resources and knowledge, making joint selections, and then taking these personal learning experiences even further by putting them to use in the same project: this variety of elements and tasks kept the project alive and contributed highly to our achievements. All in all, we feel we have greatly benefited from this unusual experience provided for us by the DUSC programme.

References

BSCW (2002). BSCW homepage, http://bscw.gmd.de/

CLiDE (2000-01). The project group website, http://home.hib.no/ansatte/leo/clide/

Stofberg, A., Otteraa, L. E., Geers van Gemeren, S., Knudsen, I. M. (2001). Collaborative Learning in Distance Education. Report from a joint DUSC project. *Rotterdam University of Professional Education, Haarlem University of Professional Education and Bergen University College* http://home.hib.no/ansatte/leo/clide/report.htm

Web-Based Drills in Maths Using a Computer Algebra System

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Abstract: Multimedia elements addressing mathematical problems serve as an alternative or addition to classical forms of learning and teaching. Within the project *math-kit* we are developing a web-based toolbox to provide teachers and students with multimedia support to existing topics in maths. In this context, the integration of a computer algebra system (CAS) as a 'mathematical expert' offers many promising opportunities for the creation of internet-based learning units for undergraduate students. In this paper we show two examples of how the CAS MuPAD is used to create web-based mathematical drills with instant feedback.

Introduction

Mathematics is crucial for the understanding of many scientific fields especially the technical sciences. However, the level of abstraction of mathematics poses considerable problems for many undergraduate students. *math-kit*[1], a joint project of the four German universities Bayreuth, Hagen, Hamburg and Paderborn, as well as SciFace Software, is intended to offer support: we are developing a web-based toolbox to provide teachers and students with multimedia elements addressing mathematical problems.

The aspects of *math-kit* are many (see Bungenstock et al. 2002, Mertsching et al. 2002). In this brief paper, we concentrate on a single feature, namely the integration of the computer algebra system (CAS) MuPAD[2] in some of our learning units. In particular, we show two examples of how the CAS can be used to create web-based drills with instant feedback.

Using a Computer Algebra System on the Web

MuPAD is a CAS which offers several powerful libraries for symbolic and numerical computing. Furthermore, all MuPAD functions can be used in internet-based applications. The main components of this model of web-based computing are a Java client applet (e.g. Terminal or Session Applet) and the MuPAD Computing Server, with JavaScript serving as the means of communication between input/output components of the web page and the client applet (Sorgatz 2001).

The Terminal Applet allows an online MuPAD session where the user can enter CAS commands as usual. Alternatively, the Session Applet is invisible to the user and can be considered merely as a means of communicating with the Computing Server. Here, HTML forms serve as input and output components whereas the CAS and its syntax remain hidden. In this setting, user input is processed and translated into MuPAD language via JavaScript; the computations are carried out in a MuPAD session at the Computing Server. The results are returned to the client and transformed again in order to obtain presentable output.

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[1] http://www.math-kit.de - Support of the German Federal Ministry of Education and Research, project *math-kit* (08NM084) is gratefully acknowledged

[2] http://www.mupad.de

Two Examples of Web-Based Drills with Instant Feedback

It is crucial for successful learning to give the students the resources to practise certain mathematical methods and to test their performance. In this context, the necessity of constructive feedback has often been emphasized (see Musch 1999). These ideas were taken into account when developing exercises in *math-kit*. In this section, we present two exa mples of web-based drills with instant feedback using the Session Applet.

Differentiator

The Differentiator is a tool which allows students to practise differentiation. It offers a variety of functionalities: random selection of exercises or user input of problems, results checking, tips for solving the differentiation problem, detailed outline of the computation, computation of a derivative by the CAS.

An important advantage of the Differentiator is that it accepts many different forms of the same answer with MuPAD checking for mathematical equivalence. This 'intelligence' is an important argument for using a CAS. Furthermore, the list of functions presented in the exercises can easily be modified by the teacher to ensure that the student will practise at an appropriate level. The 'tutorial functions' are also of great use for the student as they help them to understand the algorithm.

Gausstrainer

The Gaussian algorithm is the standard method for solving systems of linear equations, by which a given matrix is transformed to the reduced row echelon form. The Gausstrainer supports the student when practising this transformation: the student has to apply elementary row operations to a given matrix using input forms and buttons. A protocol of the steps and the current status of the matrix are displayed and finally, of course, the student can check their result.

One merit of the Gausstrainer is that the student can concentrate on the algorithm rather than the arithmetic or MuPAD commands. Moreover, the number of attempts is unrestricted, and as only the final result is checked and not the process to the result, the student can build their own strategies as long as the operations are valid. The user can also decide on the size of the matrix and thus on the complexity of the problem.

Conclusion

We have shown that the integration of a CAS like MuPAD offers new promising opportunities for creating web-based learning elements with mathematical content. Not only does it ease the development of web-based drills as all necessary mathematical functionalities are provided by the CAS, but it also allows for constructive feedback. Furthermore, the student can do drills independently of time, location, browser, and platform and without a local installation of a CAS let alone any knowledge of how to use it.

References

Bungenstock, M., Baudry, A. & Mertsching, B. (2002). *The Construction Kit Metaphor for a Software Engineering Design of an E-Learning System.* accepted for: ED-MEDIA 2002, Denver, Colorado, USA, June 24-29, 2002.

Mertsching, B., Oevel, G., & Unger, L. (2002). *Web-based Teaching and Learning with math-kit.* accepted for: 2nd International Conference on the Teaching of Mathematics, Crete, 2002.

Musch, J. (1999). Die Gestaltung von Feedback in computergestützten Lernumgebungen: Modelle und Befunde. *Zeitschrift für Pädagogische Psychologie*, 13, 148-160.

Sorgatz, A. (2001). Mathematik im Web – Der MuPAD Computing Server. *mathPAD*, 10, 23-26.

Online Learning and Adult Basic Education: A Review of the Literature

by

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Abstract

Technology is playing an increasingly important role in the delivery of adult education. As early as 1984, Bates suggested that new technologies promised "a wider range of teaching functions and a higher quality of learning, lower costs, greater student control, more interaction and feedback for students" (p. 223). This paradigm shift has ramifications in all areas of society from the major metropolitan areas to the rural communities. "Technology has contributed to, if not caused, the shift to an information society, which is creating dramatic changes in the workforce…Adult education both reflects and responds to the forces prevalent in the sociocultural context"(Merriam & Caffarella, 1999, p.23). That shift and the associated complexity is evident in distance learning technology as it is providing some adults with a new and exciting avenue to learn. It is also broadening the gap both educationally and economically between those that have access to computer technology and those that do not. This study looks at the cross disciplinary aspects within fields of instructional technology and adult education. Conceptually, what does current research say about adult learners and their perception to computer mediated communication and distributed learning? Is online learning a means by which systemic problems can be addressed? Does distance learning provide the instructional design, curriculum and support for the rural adult learner? While there has been much research on college students and other populations of learners in metropolitan areas, there is a considerable gap in the literature about the experiences of adults in rural America and their perceptions of online learning.

This study adds to the knowledge base of adult education and instructional technology because it provides conceptual research about the "digital divide" and how that chasm is being addressed. We are currently living in the Age of Information and whether we embrace the diffusion of technology or not it is affecting our lives directly and indirectly. Information is power. This research also helps bridge the gap between our knowledge of how adults learn in new electronic educational setting and the factors that play a crucial role in this domain.

Andy's Perceived Logical Flow

1. Background of online learning

2. Statistics of online learning

3. Technology Community centers and their problems

4. Digital divide
5. Online learning for everyone? Has the instructional technology advanced to the point that adult basic education learners can be benefited? I think we sometimes forget that Instructional Technology is about the Technology of Instruction, not about media, or computers or delivery systems per se, and that there is
6. Technology and methodology: Research and theory that covers the practical application of the science of instruction and how it is changing to meet the learners need.
7. Systemic Problem with staffing community centers and finding relevant content for adult learners addressed through distance learning. Has the time has arrived?

Comments: I am pondering an analysis of the system dynamics of online learning for low-middle income rural Adults at community centers.

A subset of those dynamics is the emotions, perceptions, and factors contributing to or inhibiting education via online learning. Only the adult learner can tell us if online learning and the interactivity from the technology is effective or not.

Regarding the theoretical framework/perspective, you could say it is post-Critical Theory. We are living in an information age so we'd better learn to adapt to the changes with technology.

ACT : Acting Cartoons for Trainers' Presentations

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Abstract: In this paper, we describe the architecture of an authoring tool for creating web-based presentations that embed user interface agents as primary actors. The expressive functions of the medium (UI agents) are not yet revealed and we expect that an architecture that enables the authoring process and empowers people with no advanced technical skills, will unfold new types of mediation experiences that are not still taken under consideration. We discuss the desired authoring conditions and describe ACT's architecture that tries to realize them. ACT is comprised by two primitive modules, a) the Authoring module which includes the Kinaesthetic Space component, the Cognitive Artifact Library, the Stages Model and the Scenario Authoring Line Authoring component, b) the Scenario Processing Engine module which is responsible for the execution of script produced by the Authoring Module.

Introduction

The computer is a different, possibly unique medium, in its ability to store, deliver, and help manipulate a variety of symbol systems. The computer affords the ability to work in a number of languages, visually, acoustically, textually, numerically. Embodied animated agents are a new kind of metaphor in user interfaces, which assemble a rich unexplored expressive interactive space. Reasons for using user interface agents are (Andre, 1998, Paiva, 2001):

- an animated and personified agent can support the activities of the user in a more active and friendly way,
- an animated character can more easily provide an emotional dimension to the interaction,
- an animated character can take advantage of its body movements and expressions to convey an explanation in a more effective way
- an animated character may help user learn procedural tasks by demonstrating their execution etc.

Moreover, lifelike animated agents offer great promise for learning environments. Because of the immediate and deep affinity that students seem to develop for these agents, the potential pedagogical benefits they provide, may perhaps even be exceeded by their motivational benefits (Lester, 1999). Agent's multimodal communication channels via gestures, facial expressions and speech synthesizers raise a potential of different roles and goals it can achieve. If agents also can "sense" their world of living and they are enhanced with action capabilities , their presence functions as a better metaphor of human-to-human communication.

However, the question of who is capable to design, develop and integrate user interface agents in computerized learning experiences is not yet answered. The research community is mainly focused in other aspects of design and implementation issues such as automatic dialogue generation, behavior modeling languages, task model based interaction etc. while the involvement with the authoring process of agent's behavior is restricted in the determination of general variables that affect agent's automatic behavior. We believe that authoring tools that make feasible the creation of agent presentation acts by teachers with no advanced technical skills must be developed in order to figure out agent's multiple usage perspectives in everyday learning experiences. In this paper, we will discuss ACT, an agent-based presentation tool for creating web presentations that tries to formalize the authoring process in a way that facilitates teachers' goals and ensures the consistent behavior of the interface agent and its environmental setting.

Pedagogical Interface agents

In an abstract view, user interface agents have four modules that integrate the metaphor of face-to-face conversation in the human-computer interface (Cassel, 2000). Several authors address the need for models of *personality* in designing embodied conversational agents (Andre, 1999). Characters with personality make the information easier to remember because the narration is more compelling. Furthermore, embodied conversational agents that present consistent personality cues are perceived as more useful (Cassel, 2000). Secondly, models of *emotions* that can inform conversational behaviour, expand the communicative capabilities of the agent (Ball, 2000). With a richer expressive repertoire, the agent can easily advise, encourage and empathize with students. But how humans are communicating a particular message? *Performative acts* are goal oriented structures of speech acts enhanced with non verbal behaviour. They create the semantics of the communication message (Pogii, 1998). A conversation has also a syntactic framework. This consists of the interactional *conversational functions* that regulate the flow of the discussion. Any modality may convey several communicative goals.

User interface agents that exploit the totality of these characteristics are already in use in educational environments. "Herman the Bug", interactively provides contextualized advice to learners as they graphically assemble plants from a library of plant structures in a botanical anatomy and physiology lab (Lester, 1999). STEVE can teach students how to operate and maintain the gas turbine engines aboard naval ships, including both individual and team tasks (Rickel 2000). Students can interact with another agent, named Cosmo, as they learn about network routing mechanisms by navigating through a series of subnets. Helpful, encouraging and with a bit of attitude, Cosmo explains how computers are connected, how routing is performed, etc.

In all previous examples, agents can interact proactively and reactively with the student because they maintain a representation of the task model and incorporate dialogue interaction models and predefined heuristic algorithms for manipulating the different possible perceptual and conceptual states of the student. This kind of interactive circumstances are particularly critical for constructivist learning environments in which learners participate in active problem solving (Lester, 1999). The expressive power of a computerized presentation system should not be misvalued. We should not directly correlate presentation systems with instructionism. Although active participation in learning environments can motivate a comprehensive knowledge construction in students, "displaying acts" may assist them infer coherence and meaning on the basis of the semantic structures of the different scenes. Learning in this occasion is the reconstruct of a coherent semantic world starting from fragments (Mancini, 2000). The main actor can be an interface agent which performs and takes action in a stage which is informed of agent behavior and it can also serve automatically the trainer's goals.

Authoring and designing

Powerful commercial tools provide an impressive palette of media authoring techniques to designers. But why do designers prefer pencil and paper, to make design specifications, when they create the design of a commercial title? Research has indicated that when the authoring procedure starts with the immediate use of authoring systems, critical design issues are implicitly specified while defining minor perspectives of the development environment. The final products are usually unstructured and problematic. Causes are usually the underestimation of the potential of the design space, the "bounded rationality" of human beings, and the ambiguous activity unit. Innovative authoring tools should include:

- *Conceptual Modelling* : conceptual design is a top-down strategy for the confinement of the design space. Most of hypermedia design methodologies as HDM, OOHDM, contain in their analysis steps, a conceptual modelling procedure that not only constraints the design space but also enhances it with a semantic structure.
- *Cognitive artifacts* : research in the cognitive field has shown that thinking is heavily dependent upon the experiences with physical and intellectual objects. Decreasing the semantic distance between the computational objects and existing everyday working objects, inevitably increases the number of the cognitive schemas in which these object can participate and simultaneously decreases the required cognitive effort.
- *Activity Unit* : The authoring activity is a form of doing directed to an object. The relationship between the subject and the object of activity is mediated by a tool (cognitive artifact) into which the historical development of the relationship is condensed. The cognitive artifact is transformed into an external scaffolding that simplifies our cognitive tasks. Gradually, people form a tightly coupled system with their environment. The determination of the activity unit specifies the efforts for the cognitive artifact transformation that essentially will define the degree of complication of the authoring process.

Agent-based authoring tools usually have a semi-autonomous execution engine which frames general agent characteristics as personality and emotive behaviour into certain categorical options (Andre, 1999) and an authoring tool for adding dynamic utterances (Ball, 2000) and behavioural templates. These conditions narrow the interpolative actions of authors and presuppose discrete and global understanding approaches for the kinaesthetic behaviour spaces of agents. Teachers need to be in control of their products and always want to develop a clear understanding of the underlying assumptions in autonomous behaviours.

ACT's architecture goals

The main goals of our architecture are the following :

- To detect the appropriate cognitive design artifacts and activity units for scenario procedures that facilitate the mediation experience of user interface agents authoring.
- To provide services for creating multiple composite stages on which agents perform.
- To create an architecture that ensures coherent and consistent behaviour sequences during execution time.
- To establish an open architecture that can encapsulate a variety of agent technologies

We design ACT in such a way that it follows a theatrical metaphor. To prepare a story presentation, authors have to

- create the "theatrical" stages they want to include in their story
- create and import into the stages artifacts which change their functionality and appearance during the presentation and comprise essentially world update calls
- author reusable agent performatives
- instruct in an abstract level, the agent to perform specific tasks or actions - scenario

The overall architecture can be seen in figure 1. It consists of two modules.

a) the authoring module, which is responsible for providing the necessary facilities in the authoring process,

b) the execution module, which acts as the run-time engine.

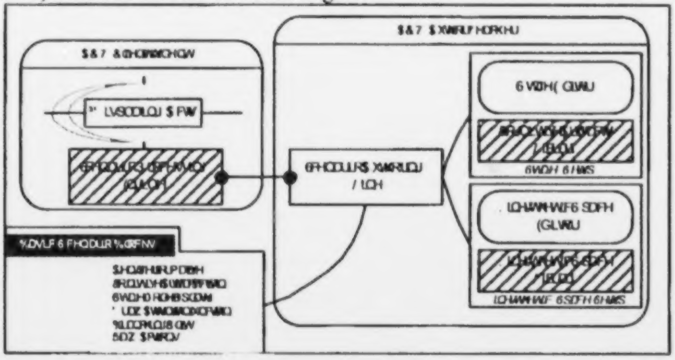

Figure 1*:* ACT architecture

Authoring Module

The authoring module consists of five components:

- the *Kinaesthetic Space Editor*, in which anyone can develop different categories of abstract performatives with an internal structure and declaration,
- the *Kinaesthetic Space Library*, which includes pre-built agent performatives,
- the *Stages Model* component, which serves as the stage constructor tool,
- the *Cognitive Artifacts Library*, which includes pre-built template-based propositional presentation items
- and the *Scenario Authoring Line* which uses the previous four in order to make available to the user a rich repertoire of activity building blocks during the presentation authoring.

The Kinaesthetic Space Editor - Library.

This component feeds the *Scenario Authoring Line* component with alternative agent performatives. We use the notion of performative in order to communicate the composite structure of the agent actions (Pogii, 1998).

The performatives that we use here are based on a model of communication in terms of goals, beliefs and emotions. A communicative act is the minimal unit of communication and it can be performed via linguistic devices or via gestural, bodily, facial devices. The meaning of a communicative act includes performative and propositional content. Different classes of performatives can be distinguished. We offer three categories of performatives :

- *emotive performatives*, that communicate emotions,

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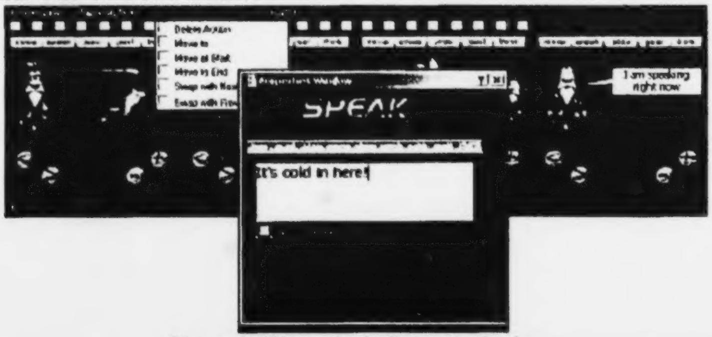
- *informative performatives*, which we can classify further as requests (order, command, implore, propose, offer and advise), as questions and as informative acts (inform, warn, announce). The system provides the means to the author to create dynamic utterances by using a library of global variables ($time, $date, $username, etc.), or select external sources of information that the system supports (e.g. services of a news agency) as sources of utterances. This gives the environment a dynamic notion and
- *believability enhancing performatives* (Lester, 1999), that can give the « illusion of life » to our character.

The whole set of performatives constitutes the kinaesthetic space. In the implementation level, the system stores sequences of gestures and utterances that correspond to different discrete performatives. The first two categories of performatives also have their own «distance» axes that specify the difference of intensity for each performative in the related category and the prerequisite familiarity the agent must have with the user. These axes are used later by the scenario processing engine in order to provide emotionally and informatively consistent sequences of performatives in the flow of the presentation (to avoid non-human behaviour). Also its subcategory of informative performatives has its own propositional declaration form which is determined by its literary operation. For example, the performative order has the definition: <order, whom*, what*>. The authors have in their disposal a rich Kinaesthetic Space Library which can be enriched by the Kinesthetic Space Authoring Tool. The Kinaesthetic Space Library can be shared between different users of the web application or someone can request to have his own instance of it.



It's cold in here!

Figure 2: Kinaesthetic Space Authoring

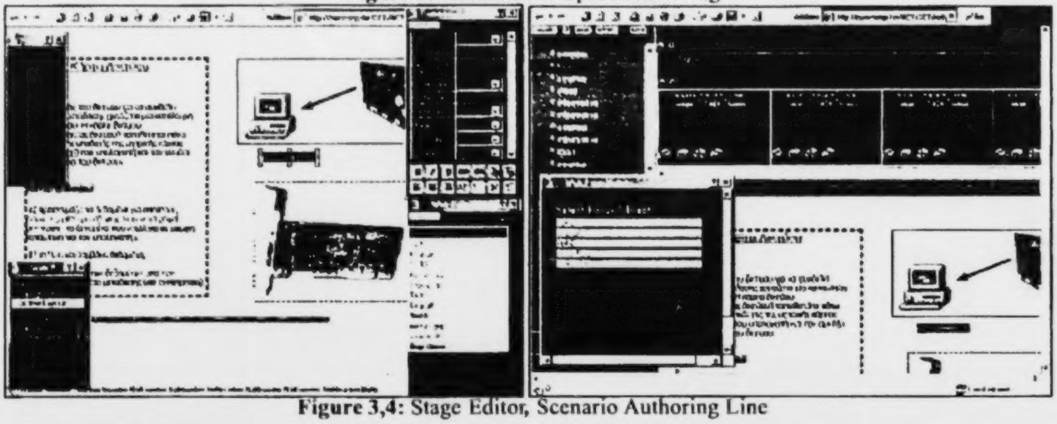


Figure 3,4: Stage Editor, Scenario Authoring Line

The Stage Model component

In order to facilitate the scene development for the agent acts and give the notion of real environmental settings, we introduce the stage model – figure 3. The stage model consists of different stages. Stages are the various theatrical scenes in which the actor can perform its pedagogical acts. Every stage has two layers:

A) A background layer which can be built by primitive HTML objects like textboxes and images. These objects are not considered as active and they are not taken into account in Scenario Processing Engine sub-components.

B) An active layer which can also have state-based objects (SB). SB objects are constituted initially by two states, a hidden and an empty state. The author can insert any object in the empty state and change its appearance properties, he can insert a new empty state or clone one of the existing. Examples of SB objects are

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an URL guide SB object in which all states contain an HTML "iframe" which displays different URLs in different states and another example is a moving SB object in which all states contain the same object with different position values. The author can insert as many objects he wishes in each state. Every primitive object can have event-based states which are selected when the corresponding events are fired.

The Cognitive Artifact library

The Cognitive Artifacts library should provide authors with authoring elements that can be easily integrated into their cognitive schemes. E.g. while commercial presentation programs provide generic computational objects (e.g. bulleted list), we differentiate our approach by providing conceptual objects like summary, comparison, multiple perspectives object. We combine the function of editing the conceptual objects with templates of related agent performatives. So, while in the first place the author should edit the list, insert the items, select the agent's performatives and specify the synchronization conditions, in our approach the author edits a template that includes the structure of the required synergies. For each conceptual object there are many behavioral templates with characterization attributes similar to the ones in the Kinesthetic space.

The Scenario Authoring Line component

The Scenario Authoring Line component functions as the central unit of the authoring tool. It embeds a conceptual organizer which makes feasible the hierarchical organization of the scenario blocks. The conceptual organizer functions also as a navigation tool because of the large number of scenario building blocks that are usually produced in such environments. The basic scenario blocks can be

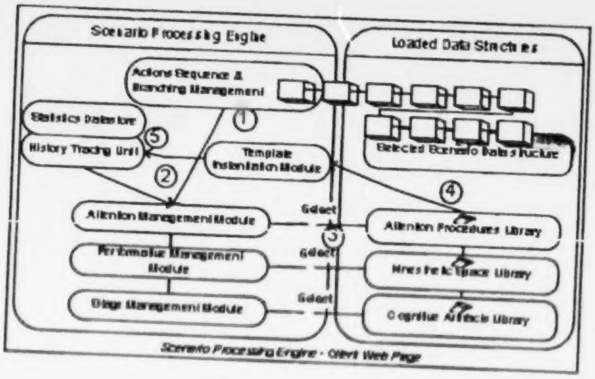
a) an agent performative, (informative or emotive)
b) a cognitive artifact (summarization, comparison etc.),
c) a world model updating (change of display state for complex objects).
d) a draw attention function (only items in active layout can be specified)
e) rawactions (very close to the kinaesthetic space authoring)
f) a branching unit .

As in most authoring tools, one of the most important factors for the design complexity manipulation is the provision of several views (Harada, 1996). Multiple views are provided with a reorganization algorithm which shows the building blocks by type (emotive performatives, informative performatives, etc.) or by conceptual section. Anytime, there exists a focus scene for which the properties are shown. Since the meaning of an action is embedded in the semantic structure of the multiple sequential building blocks, for each scene being edited, we show the list of adjacent utterances and gestures.

Scenario Processing Engine

The products of the authoring process are stored in the server datastore. In order to be executed, a new page is spawned containing the Scenario Processing Engine with the scenario data structure to be executed. The main architecture of the engine can be seen in figure 5. Our Scenario Processing Engine is predictive-reactive. Before the actual playback commences, it passes the scenario once, and computes statistical information about the flow of the building blocks. These statistics, along with more general variables that are calculated at execution time, are stored in the Statistics Datastore.

The Actions Sequence & Branching Management Module is responsible for user input and branch processing. Generally, the user can provide feedback in a branching situation, can select the conceptual section that wishes to attend, can change the speed of the execution engine and exit the presentation. More important role for this module is to analyze each building block and activate the respective Block Management Module (Attention, Performative, Stage). (1) The Block Management Units query the History Tracing Unit and the Statistics Datastore (2) in order to scan the previous engine's choices and apply heuristic rules for selecting (3) the appropriate instantiation of the building blocks from the corresponding libraries. They operate in a way that ensures their self-consistency. Each one maintains its own history of actions and has the ability to communicate with other subsystems in order to exchange required data. As an example, while executing a scenario data structure, the Performative Management Module accepts two requests for suggestion performatives that are close in time. In order not to repeat the same performative twice, it searches the informative «distance» axis in the Kinaesthetic Space Library for an adjacent suggestion performative. The Template Instantiation Module undertakes the presentation of the selected template (4) and updates the History Tracing Unit (5).


Scenario Processing Engine
Loaded Data Structures
Actions Sequence & Branching Management
①
Statistics Datastore
⑤
History Tracing Unit
Template Instantiation Module
Selected Scenario Data Structure
②
④
Attention Management Module
Select
③
Attention Procedures Library
Performative Management Module
Select
Kinesthetic Space Library
Stage Management Module
Select
Cognitive Artifacts Library

Scenario Processing Engine - Client Web Page

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Discovery of Ontologies for Learning Resources Using Word-based Clustering

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Abstract

Educational intermediaries are information systems that support the exchange of learning resources among dispersed users. The selection of the appropriate learning resources that cover specific educational needs requires a concise interaction between the user and system. This paper describes a data mining process for the discovery of ontologies from learning resources repositories. Ontologies express the associations between the learning resources metadata and provide a controlled vocabulary of concepts. Ontologies and the derived vocabularies could be used for the development of taxonomies of learning resources and they contribute to the sense disambiguation in seeking interesting and appropriate knowledge.

Introduction

The huge volume of information existing in the World Wide Web, the complexity of its structure, as well as the keyword-based character of retrieval, make the discovery of the required information resources an unfriendly, time consuming and inefficient procedure. A promising approach to tackle the existing difficulties and word sense ambiguities lies in the development of the Semantic Web (Berners-Lee et al., 2001), i.e. the existence of machine-processable and interoperable semantics in Web-based services and applications. The explicit representation of semantics is obtained by the construction and usage of *ontologies*, which could be considered as "metadata schemas providing a controlled vocabulary of concepts" (Maedche and Staab, 2001).

Educational intermediaries, also referred to educational e-markets (Hämäläinen et al., 1996) or learning media (Guth et al., 2001), host a diversity of learning resources (LR) and provide educational services to their users, who are usually Universities or organizations, which perform educational programs for their personnel. Examples of educational intermediaries are ARIADNE's Knowledge Pool, EDUTELLA, Gateway to Educational Material (GEM), MERLOT and UNIVERSAL. Educational intermediaries store metadata descriptions on each learning resource providing information on its characteristics (title, subject, type, duration, language, required equipment etc.). In order to ensure the concise communications with their users these systems should provide a meaningful catalog of the offered LR. This requirement leads to an automated ontology development for the generation of flexible and dynamic taxonomies of LR and the provision of a vocabulary of concepts capable to express explicitly and formally (i.e. machine understandably) the LR relations.

This paper proposes a methodology for the extraction of ontologies from LR repositories. In particular we use a data mining approach in order to discover the relations of the LR metadata files. Similar LR are grouped into clusters and the cluster processing provides a controlled vocabulary, which contributes to: (i) the efficient and meaningful response to queries and (ii) the dynamic creation of LR taxonomies, without the manual usage of static classification systems (e.g. Dewey, UDC). Our work is motivated by UNIVERSAL (http://www.ist-universal.org/), a European Union funded project (Information Society Technologies Programme), which aims to implement a learning resources brokerage platform for the European Higher Education Institutions (HEI). The platform hosts a variety of LR, covering many scientific domains and different educational needs (Vrabic and Simon, 2001). The following section presents the ontologies concept, while section 3 illustrates the steps we follow for the ontology discovery. Section 4 presents the experimental setting on the UNIVERSAL repository and the corresponding results. Finally, section 5 summarizes the presented work, introducing future plans.

Ontologies

Metadata are definitional data related to other data managed within an application or environment. For example, metadata would document data about data elements or attributes (name, size, data type, etc.), data about records or data structures (length, fields, column, etc) and data about data (where it is located, how it is associated, ownership etc). Metadata may include descriptive information about the context, quality and condition, or characteristics of the data and can be organized in ontologies.

In Artificial Intelligence ontology is defined as "an explicit formal specification of how to represent the objects, concepts and other entities that are assumed to exist in some area of interest and the relationships that hold among them" (dictionary.com). Noy and McGuiness (2001) define an ontology as "a formal explicit description of concepts in a domain of discourse, properties of each concept describing various features and attributes of the concept (slots), and restrictions on slots". The notion of ontology is becoming very useful in fields such as intelligent information integration, cooperative information systems, information retrieval, electronic commerce, and knowledge management.

The vision of the Semantic Web, aiming at the conduct of automated reasoning, requires computers to have access to structured collections of information and sets of inference rules that they can use. As a first step for the development of this technology, called knowledge representation, XML provides a serialized syntax of tree structures. At the same time a mechanism for encoding and transferring metadata, specified by the Resource Description Framework (RDF), is being developed by the W3C as a foundation for processing semantic information. An improved language has appeared recently called OIL (Fensel et al., 2001) describing ontologies and offering ontology editors, annotation tools and tools for reasoning with ontologies. DAML (DARPA Agent Markup Language) (Hendler, 2001) is also being developed with the aim to represent semantic relations that will be compatible with current and future technologies. While SHOE (Simple HTML Ontology Extension) (Heflin and Hendler, 2000) allows web page authors to annotate their web documents with machine-readable knowledge. Another interesting development in this area is a generic ontology for modeling ill-structured knowledge domains within educational systems in F-logic notation (Papaterpos et al., 2001).

Ontology engineering deals with domain-specific knowledge, and tries to develop technology for accumulating knowledge within reasonable size of stratified domains utilizing ontologies (Mizoguchi, 1998). The product of such a study is a catalog of the types of things that are assumed to exist (Sowa, 2000). Ontology discovery (Maedche and Staab, 2001) extends ontology-engineering environments by using semiautomatic ontology-construction tools. The framework encompasses ontology import, extraction, pruning, refinement, and evaluation.

Requirements on the ontology design are manifold. From the user's perspective the number of categories should grow with the number of resources indexed, otherwise users have to browse through either too many empty or overcrowded categories. In the first case, browsing becomes ineffective because too many clicks have to be performed to enter the leaves of the category tree. In the later case, browsing becomes ineffective, as a long list requires lots of scrolling, usually favoring the first listed resources. From the catalog administrator's perspective, the effort for categorizing resources should be the least possible. A growing category system is not desirable as the reclassification of resources is an overcostly process. That is why an adaptive category system in the field of e-learning has not been experienced yet. In this paper an approach for building adaptive ontologies is presented.

Methodology

The problem of ontology discovery could be considered as a data mining task, since the fields of the metadata indicating the title, subject(s) and description of the LR are associated. The stages inducing from the XML/RDF metadata syntax to the desired ontology are the same as those of any other data mining task: data collection and pre-processing, pattern discovery and knowledge post-processing.

Data Collection and pre-processing

During this stage, LR metadata are gathered and the title, subject and description fields of the metadata XML/RDF files are separated. The pre-processing aims to enable them to be used as input to the next stage of pattern discovery. The main objective is the selection of appropriate keywords from the metadata files that allow the discovery of similarities among the LR. For this reason function words such as articles, prepositions and conjunctions are dropped. Then, language engineering tools are used, such as the Wordnet dictionary (Fellbaum, 1998) for extracting word roots (lemmatization) and the Brill tagger algorithm (Brill, 1994) for attaching tags to words according to the part of speech they represent. The outcome of this processing transforms the remaining words into a set of unique nouns in singular number, which represent the keywords set. Finally we prepare the dataset, i.e. a matrix for which each column (feature) corresponds to an LR and each row (objects) corresponds to a keyword. The matrix consists of binary numbers indicating the existence or not of a keyword in an LR.

Pattern discovery

Given the training data in the appropriate form, interesting patterns are extracted with the use of machine learning techniques, such as clustering, classification, association rule discovery etc. The choice of method depends largely on the type of training data that are available. The main distinction in machine learning research is between supervised and unsupervised learning methods. Supervised learning requires the training data to be pre-classified. This usually means that each training object is associated with a unique label, signifying the class in which it belongs. The important feature of this approach is that the class descriptions are built relative to the pre-classification of the objects in the training set. In contrast, unsupervised learning methods do not require pre-classification of the training objects. These methods form clusters of objects, which share common characteristics. When the cohesion of a cluster is high, i.e. the items in it are very similar, it is labeled as a class.

The metadata file structure of the UNIVERSAL project provides a taxonomy field, which could be used for the data pre-classification. However as long as the field is unused we have opted for the use of unsupervised learning. In order to provide a conceptual hierarchy (taxonomy) of the LR, we could use the conceptual clustering approach, which is particularly suitable for summarizing and explaining data (Fisher, 1987). Summarization is achieved through the discovery of appropriate clusters of the data and explanation involves concept characterization, i.e., determining a useful concept description for each class. However, most conceptual clustering algorithms, produce disjoint groups. In our case, this means that the LR groups (concepts) cannot be overlapped, claim which is restrictive in educational practice, where a LR could contribute to several courses.

Due to the mentioned drawback, we have selected the Cluster Mining approach (Perkowitz and Etzioni, 1998; Paliouras et al., 2000), which discovers similar LR forming a graph and looking for all cliques in it. The algorithm starts by constructing a weighted graph G(V,E). The set of vertices V corresponds to the LR. An edge e_{ij} connecting nodes v_i and v_j exists if a keyword is common in LR_i and LR_j. The e_{ij} weight is equal to the number of the common keywords in these two LR. The edge weights are normalized by their division with the maximum weight in the graph. The connectivity of the resulting graph is usually very high. For this reason we make use of a *connectivity threshold*, aiming the reduction of the number of edges in the graph. The connectivity threshold represents the minimum weight allowed for the edge existence. After the edge reduction the method accepts all the existing cliques as clusters. Despite the large complexity of the clique-finding problem, the implemented algorithm (Bron and Kerbosch, 1973) is very fast.

Pattern post-processing and evaluation

In order to examine the produced clusters descriptiveness, we calculate the following two properties by varying the connectivity threshold:

Coverage: the proportion of LR participating in the clustering, since due to the connectivity threshold not all the LR are members of the generated clusters.

Overlap: the extent of overlap between the clusters. This is measured as the ratio of the number of the common LR and the number of all LR in the resulting clustering.

Moreover in this last stage, we pay substantial attention to the extraction of the keywords that characterize the derived clusters. These representative keywords construct a prototypical model for each cluster and provide a desired vocabulary. The selection of the descriptive keywords is done with the aid of a simple measure, which is based on the idea that a keyword is representative of a cluster if its frequency within the cluster is significantly higher than its frequency in the dataset (Paliouras et al., 2000). Given a keyword with frequency f in the entire dataset, and frequency f_i in a cluster i the difference of the squares of the two frequencies defines the required measure:

$$FI = f_i^2 - f^2$$

FI stands for Frequency Increase. Clearly, when FI is negative there is a decrease in frequency and the corresponding keyword is not candidate to the vocabulary. A keyword is representative of a cluster, if $FI > \alpha$, where α is a threshold of the frequency increase.

Experimental results

In Universal LR metadata[1] is described by using RDF (Brantner et al., 2001), which is serialized in XML. The Universal RDF binding is based on the RDF binding provided by the IMS (http://www.imsproject.org/rdf/), which combines various metadata standardization initiatives such as Dublin Core, IEEE LOM, and vCard.

For our experiments we used 69 LR descriptions stored in the UNIVERSAL repository till September 2001. The LR offered by twenty European Higher Education Institutes covering a variety of scientific domains. The result of the procedure of word separation from the fields indicating the title, subject and description of the XML/RDF metadata files were about 1,400 words. The utilization of the mentioned language engineering tools returned 678 nouns in singular number. Thus the derived dataset was a matrix with 69 columns and 678 rows.

The cluster mining algorithm was applied to the dataset and constructed sets of cliques for various values of the connectivity thresholds. Depending on the value of the connectivity threshold the coverage of the clusters and the overlap varied. Figure 1 presents the results along those two dimensions. As expected, the overlap for small threshold values is large due to the large number of very large cliques. A similar behavior follows the coverage. Around the threshold value 0.3 about half of the LR appear in the cliques (coverage equals to 0.41), while there is little overlap between the cliques (overlap equals to 0.25). This observation suggests the selection of this threshold value for the formation of the desired representative vocabulary. At this connectivity threshold value 14 clusters are generated. One of them includes 6 LR, three include 3 LR and the other ten clusters include 2 LR.

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[1] The Universal metadata model is available at:
http://universal.infonova.at/UNIVERSAL/servlet/Universal?pageID=aboutWebRDFmain

The application of the frequency increase measure for each cluster had as result a matrix with 14 columns and 678 rows. Each cell kept the FI value of each keyword for each cluster. These values ranged from −2 up to 3, while the value for most keywords in all clusters was zero. Table 1 presents the derived vocabulary per cluster for a FI level greater than or equal to 2. Overlapping clusters share common keywords and thus are grouped together. In the parentheses the number of LR in each group of clusters is indicated.

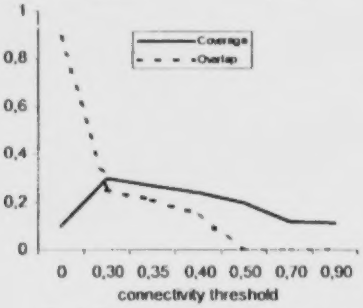

Fig. 1. The coverage and overlap curves

Except for the words shown in the table the method has selected keywords, which could be characterized as general purpose words connecting the main keywords. These words are: activity, aspect, aim, area, background, concept, core, course, detail, discussion, introduction, knowledge, layer, lecture, limit, opportunity, people, possibility, problem, purpose, reference, responsibility, result, right, share, skill, subject, syndicate, today, topic, vision, word, work.

Table 1. The derived vocabulary per cluster, connectivity threshold = 0.3, FI ≥ 2

Cluster 1 (6 LR)	Science	Cluster 9-10 (4 LR)	commerce, internet, protocol, overview, resource, system, unit, use
Cluster 3-5 (8 LR)	blast, coke, datum, development, energy, furnace, information, iron, material, reduction, technique, technology, user	Cluster 12 (2 LR)	lehrveranstaltung, objekt, ziele
Cluster 6, 11 (4 LR)	database, entity, relationship, model, system	Cluster 13 (2 LR)	application, automaton, content, context, datum, development, demonstration, description, display, framework, html, logic, machine, metadata, ontology, protocol, resource, schema, state, system, technology, tool, use, world, web, page, xml, rdf
Cluster 7 (2 LR)	architecture, control, design, engineer, model, implementation, software, system, time, treatment, use	Cluster 14 (2 LR)	business, administration, case, study, company, decision, environment levi, strauss, sourcing, supplier
Cluster 8 (2 LR)	design, graphics		

From the results of Table 1 we can conclude into a three-level taxonomy starting from a general level for the whole UNIVERSAL repository. Four main categories have been formulated consisting of Science (cluster 1), Engineering (clusters 3-5), Business Administration (cluster 14) and Computer Science (clusters 6-10 and 11). Furthermore Computer Science category could be decomposed in three subcategories: Databases & Software Engineering (clusters 6, 7, 8 and 11), E-commerce (clusters 9,10) and Web Technologies (cluster 13). Cluster 12 collects LR described in the German language and is therefore not integrated in the taxonomy. The data pre-processing phase failed for that as the language engineering tools can only accept input from the English language.

Conclusions and Outlook

In this paper we described a methodology of ontology engineering for learning resources repositories, based on the data mining approach. The main conclusions are that automated

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discovery of adaptive ontologies is essential for the operation of educational intermediaries and constitutes a powerful tool for the improvement of their services.

Critical issues for extending this research comprise the selection, testing and evaluation of appropriate algorithms for the construction of precise and meaningful ontologies. Specifically we intend to experiment using statistical clustering methods allowing the clusters overlapping. An important issue that we intent to explore is how the RDF annotations of the UNIVERSAL metadata descriptions could be used for the creation of improved ontological descriptions (Delteil, et al., 2001).

References

T. Berners-Lee, J. Hendler, P. Lassila. 2001. The Semantic Web. Scientific American, May 2001.

S. Brantner, T. Enzi, G. Neumann, B. Simon. 2001. UNIVERSAL - Design and Implementation of a Highly Flexible E-Market Place of Learning Resources. Proceedings of the IEEE International Conference on Advanced Learning Technologies, IEEE Computer Society Press.

E. Brill. 1994. Some Advances in Transformation-Based Part of Speech Tagging. Proceedings of the Twelfth National Conference on Artificial Intelligence (AAAI-94), AAAI Press.

G. Bron, J. Kerbosch. 1973. Finding all cliques of an undirected graph. Communications of the ACM 16(9), 575-577.

A. Delteil, C. Faron-Zucker, R. Dieng. 2001. Learning Ontologies form RDF annotations. Proceedings of the Second Workshop on Ontology Learning (OL2001), Seattle, USA, CEUR Workshop Proceedings (CEUR-WS.org).

C. Fellbaum (Ed). 1998. WordNet: An Electronic Lexical Database. Bradford Books.

D. Fensel, F. van Harmelen, I. Horrocks, D.L. McGuinness, P.F. Patel-Schneider. 2001. OIL: An Ontology Infrastructure for the Semantic Web. IEEE Intelligent Systems, 16(2), pp. 38-45.

D. Fisher. 1987. Knowledge Acquisition via Incremental Conceptual Clustering. Machine Learning 2, 139-172.

S. Guth, G. Neumann, B. Simon. 2001. UNIVERSAL - Design Spaces for Learning Media. Proceedings of the 34th Hawaii International Conference on System Sciences, Maui, USA 2001, IEEE.

M. Hämäläinen, A.B. Whinston, S. Vishik. 1996. Electronic Markets for Learning: Education Brokerage on the Internet, Communications of the ACM 39, 51-58.

J. Heflin, J. Hendler. 2000. Searching the Web with SHOE. Proceedings of the AAAI Workshop Artificial Intelligence for Web Search, AAAI Press, 35-40.

J. Hendler. 2001. Agents and the Sematic Web. IEEE Intelligent Systems, 16(2), 30-37.

A. Maedche, S. Staab. 2001. Ontology Learning for the Semantic Web. IEEE Intelligent Systems, 16(2), 72-79.

R. Mizoguchi. 1998. A Step towards ontology engineering. Proceedings of the 12th National Conference on AI of JSAI.

N.F. Noy, D.L. McGuinness. 2001. Ontology Development 101: A Guide to Creating your first Ontology. Stanford Knowledge Systems Laboratory Technical Report KSL-01-05.

G. Paliouras, C. Papatheodorou, V. Karkaletsis, C.D. Spyropoulos. 2000. Clustering the Users of Large Web Sites into Communities. Proceedings of the Seventeenth International Conference on Machine Learning (ICML 2000), P. Langley ed., Morgan Kaufmann, 719-726.

M. Perkowitz, O. Etzioni. 1998. Adaptive Web Sites: Automatically synthesizing Web pages. Proceedings of the Fifteen National Conference in Artificial Intelligence (AAAI 98), AAAI Press.

C. Papaterpos, N.P. Georgantis, T.S. Papatheodorou. 2001. An ontology for modeling ill-structured domains in intelligent educational systems. Proceedings of the IEEE International Conference on Advanced Learning Technologies (IEEE/ICALT 2001).

J. Sowa. 2000. Knowledge Representation: Logical, Philosophical, and Computational Foundations. Brooks, Cole.

G. Vrabic, B. Simon. 2001. Learning Resource Catalogue Design of the UNIVERSAL Brokerage Platform. Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications ED-MEDIA 2001, C. Montgomerie and J. Viteli eds, AACE.

New Learning Environments
Role of Human Education Interactive NETwork (HEINET)

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Abstract: At the beginning of the complex 21st century, education is no longer regarded as a means of teaching or certifying. ... Two vital areas are necessary in order to ensure the improvement and equity of education: first, to know what students actually learn, and second how they learn in the present context. We believe that the concept of Human Education Interactive Network (HEINET) is an instrument that can help answering these questions and improving learning conditions.

Learning versus Constructivist Approach

The complexity of educational environments is one of the main factors to take into consideration in the teaching/learning process nowadays. The stronger the development is, the more complex it becomes to learn to look beyond the immediate to the structures which prevail long enough to be "photographed", analyzed and modeled by the thing we conventionally call science. In this environment, learning and teaching and teaching and learning are absolutely independent processes, which occur at moments very near in time.

Never as today was mankind so much culture product and producer in a society, which interacts at an increasingly interplanetary level, and in which the concept of a system projects the level of data and information production in an exponential way. Never as today was it so necessary for mankind to focus its limited interaction resources with the data (world), in order to appreciate the underlying structures of such great diversity. Especially today, facing this multi-stimulating environment, it is advisable to make use of some of our sensitive faculties for cognitive acquisition, which up until now were only regarded as mere means of balancing and interacting with the environment. Nowadays it is crucial to find mechanisms that enable the increase of the cognitive performance, by using multi-modal ways of sensitive stimulation, which in turn can activate this process of change. This issue leads us to two fundamental questions: one of ontological nature (in view of knowledge) and another one of methodological nature. The first concerns understanding to which extent and where the limits to the knowledge horizon should be placed in the traditionally established relationship between teacher and learner. The second one concerns understanding the frame, freedom and flexibility that should be attributed to the references, to the conceptual frame and the environmental conditions in the present state of the Society of Information.

It seems to us that the constructivist approach to knowledge is an adequate response to the first question, for it establishes the balance between the components of instruction and construction in the teaching/learning process. The second question, of a more methodological nature, can be dealt with within a perspective of flexible orientation of teaching/learning towards solving real problems, adequately framed by the different contexts in which they occur.

Within the constructivist approach, the teaching/learning processes have to consider measures to promote the development of learners' performance/cooperation competences. Therefore it will be necessary that learners have the possibility to apply and exercise new knowledge, thus developing their new skills and differences of thinking/acting. For this purpose, the teacher should choose to use different approaches to the lesson plan:

- Creating groups and assigning tasks, hereby promoting the cooperative side of learning, through discussion and confrontation of ideas;
- Supporting contents through the application and determination of real cases;
- Developing simulations, which encourage the active application of new knowledge and skills;

Supporting this kind of approaches, it is up to the teacher to decide for the most adequate learning methodology to use. This decision depends essentially of the contents and of the starting conditions of the learners. Some of the methodologies we consider most interesting are: cooperative learning, learning through "anchorage" and construction/simulation sets.

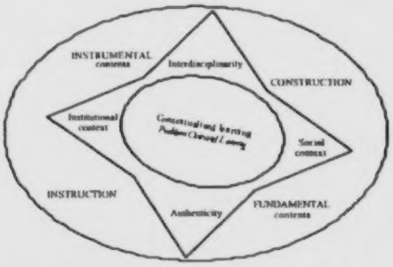

Figure 1: Teaching/Learning Methodology

Improving Classroom Teaching

At the beginning of the complex 21st century, education is no longer regarded as a means of teaching or certifying. The bounds of education lie on the attitude of encouraging the acquisition of multidimensional knowledge, as well as on the development of corresponding skills. This results in a set of knowledge, attitudes and behaviors capable of providing a responsible and enterprising citizenship, founded on innovation, renovation and the leveling by the highest pattern of common life. Two vital areas are necessary in order to ensure the improvement and equity of education: first, to know **what students actually learn**, and second **how they learn in the present context**. We believe that the concept of Human Education Interactive Network (HEINET) is an instrument that can help answering these questions and improving learning conditions. Learning environments, traditionally called classrooms, are currently facing processes of change, which are the essential outcomes of two great tendencies:

- The velocity of change introduced by the Information Society and by all technical means that operate within it;
- The need to find edification/installation solutions, which in the short term do not acquire characteristics of obsolescence, resulting from the exponential growing of maintenance costs;

The development of HEINET at the School of Health Sciences, in the Viseu Centre of the Portuguese Catholic University, enabled us to fulfill these vectors, as well as to increase the global performance of the system, concerning the following aspects:

- It sends on solid and information about the teaching and learning processes within the new scientific-pedagogical unit;
- The conditions at the learning space provide crucial information for the development of the new pedagogical methodology used at the unit at stake – *Flexible Learning – Problem Oriented Learning*;
- Evaluation of the pedagogical methodology/learning process and factors to be focused on.

From these three vectors emerges the need for the use of HEINET as a first step towards making pedagogical processes and learning contents more uniform. However the improvement of learning does not happen only by adopting pedagogical standards. The pedagogical team (teaching staff, learners and other learning actors) should as far as possible analyze the processes themselves, in order to attain the optimized use of the different learning spaces. The inherent ideas to the creation and implementation on HEINET reveal a concern for the continuous improvement of the teaching/learning system in its different dimensions: the system, the process, the products and finally the users. HEINET, as a means for optimization, allows us to focus on teaching in the real learning by students, which conveys a new vision/mission to the teaching/learning process.

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Every Word a Click: The Hypertext Being Smart

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Abstract: Hypertext, one of representatives of Internet is well known for its unique features for knowledge generating activities. Now, the new types' smart hypertext is appearing to overcome current hypertext's limitations. They seem to be promising since they start developing recognizing the current Internet users' needs. The study's purpose is to investigate the new hypertext's meaningfulness on knowledge activities and to propose hypertext's future direction. And it calls researchers' attentions by asking its interrelationship with cognitive development.

The Problems

The hypertext is well known as a tool to represent rich semantic relationships. A learner builds up her memory structure by adding a new object to existing memory structure. So some factors such as proper visual association, meaningful relationships or appropriate category are very significant to enhance learning. For this reason, hypertext is very suitable to support knowledge activities.

The current hypertext is built up only by links created by a web author. It is incomplete in terms of user-centered information environment with the following reasons. Very often a web page's information can be interpreted as very different anchors from information author's original intention. It could mean that it does not provide the right response or feedback according to users' inquiry. Immediate response is one of very important factors in knowledge activities because otherwise, a user might lose her curiosity or even forget soon what she would look for. Thus, with some kinds of aids, if a user is able to construct her own hypertext-links for herself, presumably, she is able to follow her own curiosity and to facilitate knowledge activities. It could also encourage a user's flexible and creative thinking process. On the basis of such a point, I propose that the current hypertext should be more developed to be more user-centered, context-oriented and learning-focused. On the basis of this perspective, I searched the Internet and found out three new types' hypertext applications, Atomica (www.atomica.com), Flyswat (www.flyswat.com) and Microcosm (www.microcosm.com) reflecting my perspective.

The Example

Among them, Atomica, a free shareware is an exemplary one to demonstrate the above perspective. Its key point is the simple human computer interaction, which is that one just clicks on the word you want defined or explained. When a user clicks a word on where it is available, whether you're using, for example, an e-mail client, a word processor or a spreadsheet as well as Web, Atomica automatically searches its relevant information as well as definition and then opens a small window to show the list.

There is an example for understanding its features. Suppose that a user was reading an article on the Web, or an e-mail and she came across this sentence: "The abstemious people from Woonsocket invested aggressively in companies like Tecumseh Products, hoping to become as rich as their idol, John Kluge." And suppose she had no idea what "abstemious" meant, where Woonsocket was, what Tecumseh Products did, or who Mr. Kluge was. To find them out quickly using the Internet, she needs to look up each term individually, which requires her to leave the document that she was reading and laboriously type in each term for multiple searches, probably at multiple sites. Instead, she could use Atomica that fetches such answers from the Internet, without leaving the text she was reading. Also, Atomica combines the ability to search multiple information sources simultaneously with a natural intelligence that helps to ensure targeted results. Users don't have to memorize Boolean logic or even construct an English language query. For the kinds of information Atomica is designed to parse-word definitions, language translations and company profiles-it works well.

Finally, one of the most distinguishable elements of Atomica is trying and guessing the entire phrase or context of a word that a user clicks on although it is still very limited. If, for example, a user clicks on either word in the phrase "Supreme Court," the program pops up with an answer about the highest court in the U.S., not a definition of either word on its own. And it pays attention to capitalization. It knows that the word "polish" is something a user does to furniture, but Polish is a language and culture (Wall Street Journal, 2000).

However, the service is still a work in progress. First, it doesn't work with text inside an image. Second, it is not able to search multimedia-based information such as mp3 files or quicktime movie files. Third, while it draws on a host of reference works and Web databases, it doesn't use premiere sources, such as the Encyclopedia Britannica and major newspapers. It tends to rely on almanacs, single-volume encyclopedias and little-known reference sites, though it does use major dictionaries (Wall Street Journal, 2000).

The Suggestions and Discussion

I conducted the small pilot study with five graduate students in Teachers College, Columbia University in order to explore for the new hypertext's future direction. Based on Atomica's functions and the results of the pilot study, I propose the following directions.

First, hypertext is merging with a search engine. With it, hypertext is becoming more effective and is able to reduce users' information seeking efforts considerably.

Second, the future hypertext's success empowered by a search engine depends on, I believe, how much it understands users' intention. Namely, they should be smart enough to understand not only what a user is looking for but also the whole context where a user is. The findings of a pilot study support it. Its subjects merely used very simple search formulations. What they wanted to obtain was simply the quick and effective search results and not-so-complicated human-computer interaction. Hence, the concept of 'agent software' is inevitable one so that it can play a role like a secretary or a task manager reducing human users' cognitive overload to a certain degree that they feel comfortable. At the same time, such agents will restrain information overload by filtering and analyzing information on web pages.

Third, when the smart agent, hypertext provides advice or a hint to users by being modeling and doing scaffolding exactly like a teacher in a classroom, I assume that it could reduce users' unnecessary search behaviors and assist developing their' meta-cognitive process. Atomica's 'did you mean?' description or its additional key words' list can be exemplary.

Finally, while more successful information seekers seem to be able to initiate their search behaviors on their own, less successful ones need a structure to help them search and do knowledge activities. Hence, it will be worth to consider if hypertext can provide different levels' gateway or interface design according to information seeker's search capability consisted of novice, intermediate and expert.

Such a new hypertext seems to be worthy for further consideration to influence users' information search behavior. Although I have explored mostly the positive impacts of it but there should be negative impacts such as users' dependence on its smart functions. Thus, it should be pondered critically to what degree and in what ways it would support human beings' Internet search. That is, we should investigate its multi-dimensional aspects carefully. I hope that this study could draw educational researchers' attention to explore its roles and potential to build up the enhanced learning environments.

References

Choo, C. W., Detlor, B. & Turnbull, D. (1999). Information Seeking on the Web - An Integrated Model of Browsing and Searching, 1999 ASIS Annual Meeting contributed Paper.

Mossberg, W. (10/05/2000). No Need to Leave the Page As Atomica Fetches Answers, *Wall Street Journal*.

Unz, D. C. & Hesse, F. W. (1999). The Use of Hypertext For Learning *Journal of Educational Computing Research*, v20, n3, 279-295.

The Role of a Reusable Assessment Framework in Designing Computer-Based Learning Environments

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Abstract: This paper will introduce the concept of a reusable assessment framework (RAF). An RAF contains a library of linked assessment design objects that express a) specific set of proficiencies (i.e. the knowledge, skills, and abilities of students for a given content or skill area), b) the types of evidence that can be used to estimate those proficiencies, and c) features of tasks that will aid in the design of activities (e.g. features that need to be present in order for students to produce the evidence, features that affect task difficulty, etc.). While RAFs can speed the design of many kinds of assessments, in this paper we focus on their use to aid instructional designers in embedding assessments within computer-based learning environments. The RAF concept is based upon the evidence-centered design methodology described in Mislevy, Steinberg, Almond, Haertel, & Penuel (2001).

The Problem

There has been substantial discussion and research concerning the advantages of embedding assessments within instructional activities and learning environments (e.g. Shavelson, 1992; Hopper, 1998; Treagust, Jacobowitz, Gallagher, and Parker, 2000; Van Lehn, 1988). Van Lehn (1988), for example, describes several ways in which embedded assessments can help people learn including a) determining appropriate tasks based upon estimates of students' skill level, b) determining when to provide feedback, and c) adapting explanations to students' level of understanding. However, designing learning environments that embed assessments is a labor-intensive activity. There are several reasons for this. First, creating learning environments is already hard. Given the time and budget constraints that instructional designers face, it is hard to justify the added time effort, time, and expense of incorporating reliable, valid assessments as part of a learning environment. Secondly, designing embedded assessments requires an interdisciplinary approach involving experts in such diverse areas as educational measurement, psychology, instructional design, statistics, and the content area. The opportunity to assemble a team that has the requisite knowledge of both assessment design and instructional design is rare. Consequently, while students could benefit from interacting with learning environments that contain well-designed embedded assessments, not enough are produced.

The primary problems of the current paper-pencil tests

Billions of dollars are spent each other on education, yet there is wide spread dissatisfaction with our educational system among educators, parents, policymakers and the business community. Efforts to reform and restructure schools have focused attention on the role of assessment in school improvement. After years of increases in the quantity of formalized testing and the consequences of inappropriate test scores, many educators have begun to doubt the measures used to monitor student performance and evaluate programs. They claim that traditional measures fail to assess significant learning outcomes and thereby undermine curriculum, instruction and policy decisions. The timed nature of the tests and their format of one right answer has led teachers to give students practice in responding to artificially short texts and selecting the best answer rather than inventing their own questions or answers. When teachers teach to traditional tests by providing daily skill instruction in formats that closely resemble tests, their instructional practices are both ineffective and potentially detrimental due to their reliance on outmoded theories of learning and instruction.

Contrary to past views of learning, cognitive psychology suggests that learning is not linear, but that it proceeds in many directions at once and at an uneven pace. Conceptual learning is not something to be delayed until a particular age or until all the basic facts have been mastered. People of all ages and ability levels constantly use and refine concepts. Furthermore, there is tremendous variety in the modes and speed with which people acquire knowledge, in the attention and memory capabilities they can apply to knowledge acquisition and performance.

According to Dietel et al (1991), Current evidence about the nature of learning makes it apparent that instruction which strongly emphasizes structured drill and practice on discrete, factual knowledge does students a major disservice. Learning isolated facts and skills is more difficult without meaningful ways to organize the information and make it easy to remember. Also, applying those skills later to solve real-world problems becomes a separate and more difficult task. Because some students have had such trouble mastering decontextualized "basics," they are rarely given the opportunity to use and develop higher-order thinking skills.

Recent studies of the integration of learning and motivation also have highlighted the importance of affective and metacognitive skills in learning. For example, poor thinkers and problem solvers differ from good ones not so much in the particular skills they possess as in their failure to use them in certain tasks. Acquisition of knowledge skills is not sufficient to make one into a competent thinker or problem solver. People also need to acquire the disposition to use the skills and strategies, as well as the knowledge of when and how to apply them (Dietel et al, 1991). These are appropriate targets of assessment. Thus, different types' alternative assessments are being considered now.

Alternative Assessment on Computer-Based Learning Environments

Alternative assessment based on cognitive modeling may be a more valid indicator of students' knowledge and abilities because they require students to actively demonstrate what they know. The following were described by Leighton et al (1999) as the characteristics of alternative assessment: (a) assessment should be integrated with instruction; (b) it should be transparent, that is, it should help students learn to monitor, self-evaluate, and reflect on their own performance; (c) assessment tasks should be authentic, extended over time, meaningful and challenging; (d) students should have access to tools, resources and coaching support during assessment of their performance and learning; (e) assessment should be diagnostic, providing information about students' knowledge, cognitive processes, misconceptions and errors during performance of problem-solving tasks; (f) students' knowledge and their ability to apply (transfer) their knowledge to new or novel problems should be assessed; (g) ability to collaborate effectively with others in solving problems should be assessed. These characteristics of alternative assessment address limitations of traditional testing approaches and promote more authentic assessments of knowledge, learning, cognitive processing, and problems -solving skill in complex natural domains and contexts of task-oriented action. And some studies show that the integration of assessment and Intelligent Tutoring System (ITS) could play a role as the alternative assessment framework as a problem-solver to cure the current malfunction ((Dietel et al, 1991). However, because designing and confirming validity of a cognitive assessment is on very early developing stage, needless to say, embedding such one on ITS that is already hard to develop should be double-efforts. Therefore, as I mentioned earlier, many researchers and practitioners for ITS tend to assess learners temporarily only for their specific purpose. Consequently, such assessment methods being used so far are not easy to transfer to another ITS. RAF would help solving such barriers.

Defining of Evidence-Centered Design (ECD) Methodology

The RAF concept is based upon the evidence-centered design methodology described in Mislevy, Steinberg, Almond, Haertel, & Penuel (2001). To grasp RAF's essential mechanism better, it will be necessary to consider what ECD is.

Its essence is focused on reasoning on the basis of evidence. When we reason from masses of data of different kinds, humans interpret complex data through some underlying "story" - a narrative, or an organizing theory. We attempt to weave a sensible and defensible story around the specifics. And it is the story that builds around what we believe to be the generative principles and patterns in the domain. Based on their story and principles, we can use them as building blocks when we tackle some novel problems that pose new questions or presents new kinds of evidence. In this spirit, RAF applies an approach structuring arguments from evidence to inference manage uncertainty (Mislevy et al, 1999). RAF approach is an evidence-centered perspective on assessment design, and object definitions and data structures for assessment elements and their interrelationships on the basis of student model, task model and evidence model.

Student Model:

The student model indicates, "What complex of knowledge, skills or other attributes should be assessed?" The student model variables are the terms in which we want to talk about students - the level at which we build our story, to determine evaluations, make decisions or plan instruction - but we do not get to see the values directly (Mislevy et al, 1999). The student model variables, all proficiencies that learners would acquire would be defined through cognitive task analysis. And then we just see what the students say or do and must use it as evidence about the student model variables. However, we encounter the evidentiary problem of constructing this inference from limited evidence. Hence, The inference drawn from what the learners say or do may be also on the basis of probability rules, which may be able to rule out its uncertainty.

Evidence Model:

The evidence model means, "What behaviors or performances should reveal those constructs and what is the connection?" The evidence model lays out our argument about why and how the observations in a given task situation constitute evidence about student model variables. There are two parts of evidence models, the evaluative submodel and the statistical submodel. The evaluative submodel extracts the salient features of the "work product", that is, whatever the student says, does, or creates in the task situation. The statistical submodel updates the student model in accordance with the values of these features, effectively synthesizing the evidentiary value of performances over tasks. Defining statistical submodel is beyond this study's purpose so I will not mention it any further.

Here, I will illustrate more clearly what work product means since it is a very important element mapping between the concept and data scoring. According to Mislevy et al (1999), it is a unique human production, as simple as a mark on an answer sheet, as complex as the presentation of disconfirming evidence or a series of work product represent "observable variables". It represents what is important in a performance on the basis of our belief. And these mapping between learners work product and doing assessment could be very simple or could be very complicated to require several expert's evaluation of multiple aspects. In the same context, they can be automatic, or they can require human judgment.

Task Model:

Task model means, "What tasks or situations should elicit those behaviors?" A task model provides a framework for constructing and describing the situations in which learners act and includes specifications for the environment in which the learner will say or do, or produce something. The examples could be characteristics of stimulus material, instructions, help, tools, and affordances. It also includes specifications for the work product, the form in which what the learner says, does or produces will be captured. A particular task is produced by assigning specific values to tasks model variables and providing materials that suit the specifications there given, a task thus describes particular circumstances meant to provide learners an opportunity to act in ways that produce information about what he or she knows or can do more generally. Accordingly, the task controls the level of complexity or difficulty of circumstances that learners encounter. The task itself does not describe how we should evaluate what we see. This is specified in the evidence model. The advanced ITS is a supreme place providing the means for producing theses situations, and capturing, evaluating and communicating what learners do there.

A Solution

One solution to this problem is to develop assessment frameworks that compile the needed assessment design expertise into reusable chunks that instructional designers can instantiate as they design learning environments. In the paper, we will describe the structure of an RAF in terms of an assessment delivery model proposed by Almond, Steinberg, and Mislevy, 2001. The figure below (adapted from Almond, Steinberg, and Mislevy, 2001) provides a conceptual representation of the components of learning and assessment delivery systems.

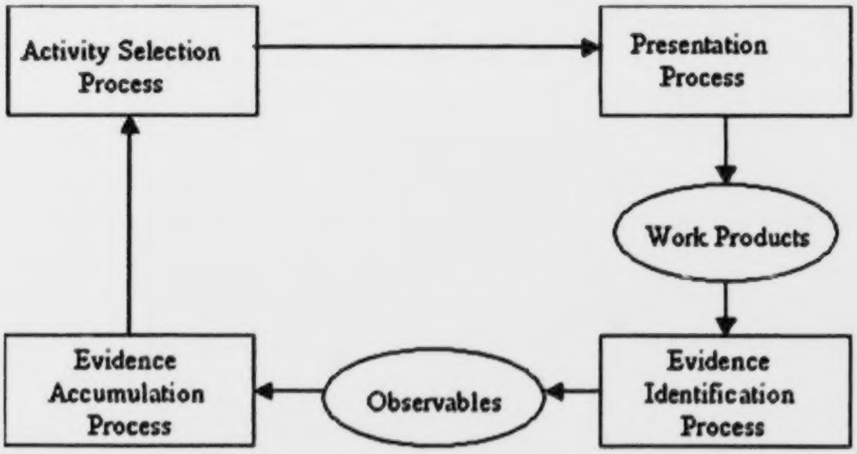
Activity Selection Process
Presentation Process
Work Products
Evidence Identification Process
Observables
Evidence Accumulation Process

Figure 1: The Four-process model of Almond, Steinberg, and Mislevy (2001)

The activity selection process is responsible for determining on which activity a student will next work. This process could be as simple as allowing a student to choose the next activity or as complicated as an automated decision based upon the systems assessment of a students strengths and weaknesses. The presentation process is responsible for providing all direct interactions with a student including presenting all instructional and activity related material, recording all student interactions, and capturing student work. The evidence identification process scores student work, extracting evidence from the student work products as a set of "observables" – variables that contain evaluations of the student performance along a set of relevant dimensions. The evidence accumulation process uses the observables to update a student model that consists of a set of estimates of students' knowledge, skills, and abilities.

As displayed in figure 2, in an RAF several parts of this framework are defined by assessment designers before instructional designers begin their work.

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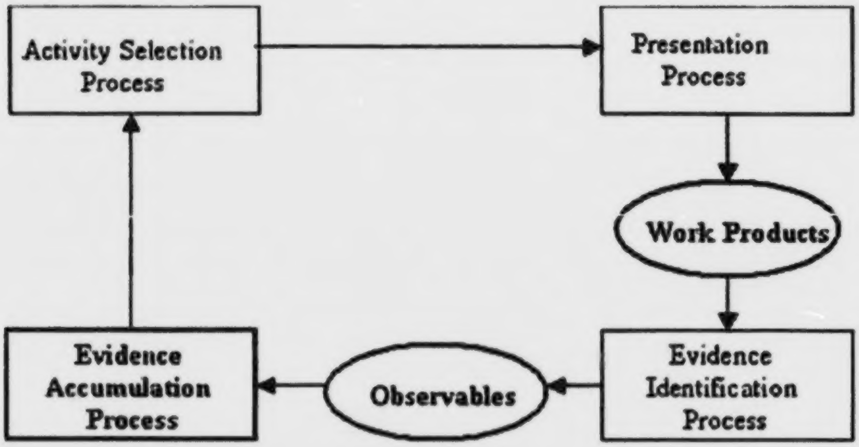
Activity Selection Process
Presentation Process
Work Products
Evidence Identification Process
Observables
Evidence Accumulation Process

Figure 2: The Four-process model with the RAF components highlighted

In the figure, these predefined components are represented in bold text. Specifically, the evidence accumulation process is defined and implemented, and the observables and the work products are defined. In addition, the RAF includes task models as defined by Mislevy, Steinberg, and Almond (1999). The task models consist of collections of task features that include a) features that need to be present so that students will create appropriate work products (i.e. those that contain the needed evidence, b) features that affect task difficulty, and c) features that can be varied to produce task variants. The task models in the RAF define requirements for tasks that instructional designers may create. However, as will be described in the paper, considerable flexibility remains for instructional designers to design many new creative tasks as long as they incorporate selected subsets of features from the task models.

An Example: an RAF for Science Inquiry

In this section, we will describe an example RAF for the area of science inquiry. We will first present the general structure of the RAF including proficiencies, evidence, and task features. We will then provide an example of how an instructional designer might use the predefined RAF to design a computer-based learning environment with embedded assessments for middle school children. The domain of the example will be science inquiry focusing on the physics of hot air balloons. The domain of the knowledge is provided with the form of computer-based simulation program. Whenever learners encounter a challenge task, they solve it; otherwise they are not able to go to the next step. During such an itinerary, their learning progress is captured by systems, their learning outcomes are collected and measured through RAF method.

Educational Importance

An RAF is a way to represent assessment design knowledge in reusable structures. Just as the object-oriented programming movement in computer science allowed a new, deeper level of code reusability for programmers, RAFs offer instructional designers access to reusable assessment design knowledge, and hence, make it easier to for them incorporate embedded assessments in their designs, without overly constraining their creativity.

Implementation/Research perspective

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A RAF will be used to as a tool to support the research project that examines the correlation between assessment and a learner's information search behavior on intelligent tutoring system (ITS). Through being used in such a project, a RAF's validity and usefulness will be examined and it can point out a RAF's limitation as well as additional usefulness in an actual performance.

References

Dietel, R.J., Herman, J.L., & Knuth, R.A. (1991). What does research say about assessment?, http://www.ncrel.org/sdrs/areas/stw_esys/4assess.htm

Mislevy, R. J., Steinberg, L.S., & Russell G.A. (2000). Evidence-centered assessment design, http://www.educaion.umd.edu/EDMS/mislevy/papers/ECD_overview.html

Mislevy, R.J., Steinberg, L.S., & Russell G.A. (2000). A sample assessment using the four-process framework, *the technical report.*

Steinberg, L.S., & Gitomer, D.H. (1996). Intelligent tutoring and assessment built on an understanding of a technical problem-solving task. *Instructional Science*, 24, 223-258.

Van Lehn, K. (1988). Student modeling *Cognitively Diagnostic Assessment*. Hillsdale, NJ: Lawrence Erlbaum Associates.

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Hurricane Strike!
A Case Study in Instructional Multimedia Development

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Abstract: This paper examines the decision-making associated with the design and production of Hurricane Strike!, a CD-ROM and Web-based instructional multimedia module that teaches about hurricane science and safety for 6th–9th graders. The module design is based on anchored instruction (Cognition and Technology Group at Vanderbilt, 1992) that engages the learner in a variety of activities related to the science of hurricane development, movement, and structure, and to home and personal safety practices for when hurricanes threaten. Our process of defining the problem, iteratively creating solutions, and frequently evaluating those solutions illustrates the general pattern of Analysis, Synthesis, and Evaluation in the instructional design process, but also demonstrates how the process is often unsystematic and how the phases typically overlap.

Overview

New instructional development projects are always approached with a mixture of excitement and uneasiness. It was no exception in our case when the Federal Emergency Management Agency (FEMA) asked the COMET® Program (Cooperative Program for Operational Meteorology, Education & Training, http://www.comet.ucar.edu) to create an instructional multimedia program on hurricane safety for an audience of children. The excitement came from expanding our products beyond the professional meteorologist community we usually serve, and from being able to contribute an educational piece that could save lives. We were uneasy because of several unanswered questions: Could we develop something suitable for kids, making it both appealing and highly educational? What technologies would allow us to make compelling media that could be used in a wide range of schools? How would we share the focus on science education (our specialty) and safety education? What can we do well for a *very* modest budget? And finally, what processes will be most effective and efficient for completing the project?

This paper examines the decision-making associated with the design and production of *Hurricane Strike!*, a CD-ROM and Web-based instructional multimedia module (http://meted.ucar.edu/hurrican/strike) that teaches about hurricane science and preparedness for 6th–9th graders who live in regions vulnerable to hurricanes. The module design, modeled on anchored instruction (Cognition and Technology Group at Vanderbilt, 1992), engages the learner in a variety of activities related to the science of hurricane development, movement, and structure, and to home and personal safety practices for when hurricanes threaten. Our process of defining the problem, iteratively creating solutions, and frequently evaluating those solutions will illustrate the general pattern of Analysis, Synthesis, and Evaluation in the instructional design process, but also how the process is often unsystematic and the phases typically overlap.

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Background

The COMET Program is a not-for-profit organization that provides classroom and distance education and training for weather forecasters. COMET also produces materials to improve the use of weather products by users of weather forecasts, such as emergency managers. The program has developed over 180 hours of computer-based training in the past 11 years, including many hours of Web-based training. *Hurricane Strike!* is the first project we have attempted for a K-12 audience.

This project required contributions from a people with a wide variety of skills, including part-time efforts from a lead instructional designer, two additional, *very* part-time consulting instructional designers who also handled project coordination (the lead designer lived out-of-state), graphic artists, multimedia authors, a digital audio technician, a multimedia quality assurance professional, two volunteer middle school teachers to review the design and content, volunteer subject matter experts from FEMA, the Red Cross, and the National Oceanic and Atmospheric Administration (NOAA), contributed recording and voice talent from The Weather Channel®, and our own kids as willing subjects for formative evaluation sessions. Additional important resources for this project included support from management to attempt a new type of project, and existing content, data, and graphical images we had already developed for training forecasters and emergency managers on similar topics

Analysis (Defining the Parameters of the Problem)

Sources of analysis data primarily included discussions with FEMA professionals, email and conference calls with teachers in school systems affected by hurricanes, and reviews of existing content on hurricanes, hurricane hazards, and public safety for hurricane preparedness. While most of the analysis was done at the front end, new analysis information continued to be received after production began. This information was not ignored, and was considered while our work progressed.

The need for this product was based on the fact that increasing populations are living in hurricane-prone areas in the U.S, both on the coast and inland. Their vulnerability requires that the public become more hurricane-aware. We believe that such awareness can be promoted effectively by educating students about why/when/where and how hurricanes form, the difficulties in predicting their strength and movement, the hazards associated with them, and the protective measures people can take. Students in middle school and above are an ideal audience for this effort because they can influence their parents to take appropriate preparedness measures and because they will eventually become decision-making adults.

As suggested above, the project had two, sometimes complementary, sometimes competing, goals. It should contribute to science education and support the National Science Standards. At the same time, it should achieve the very important goal of teaching hurricane safety and preparedness, a goal that could have a direct impact on saving lives and reducing property losses during hurricanes. Yet these distinct goals should not be allowed to make the final product seem un-integrated.

These goals helped us derive many objectives regarding knowledge of safety measures and hurricane science. However, we quickly worked to establish priorities, knowing that the effort, unless it received further funding, would have to be relatively narrow. In consultation with FEMA, we were able to establish the safety and preparedness goal as primary. This goal was most in line with FEMA's organizational mission and would have the most direct impact on saving lives and property. However, the secondary goal of enhancing hurricane science education contributed to the first by providing learners the rationale for the safety measures. Because additional funding was considered a possibility, we created a priority table instead of simply dropping objectives. Many of the objectives that were considered lower priority were ones that treated the science in more depth. Others regarded understanding the jobs of hurricane forecasters and emergency managers. We also reluctantly dropped the priority of an objective to have learners understand the experience of surviving a direct hit of a forceful hurricane. While this would have been engaging, it presented uncertainties to production because it required travel to interview hurricane survivors.

Our FEMA representative desired a "whiz-bang" treatment to grab students' attention. The product needed to stand up to commercial products in terms of a sophisticated look and highly interactive nature. But of course, this desire had to face serious constraints:

- Available funding for the project was much lower than is typical for a highly interactive multimedia project. We needed to find ways to leverage off existing products and available staff time.
- The project could not interfere with our core project efforts in any way.
- The product needed to be relatively easy for teachers to use, while pushing the technology to a comfortable limit.

Other constraints also affected our eventual design decisions:

- The product needed to be flexible for use in multiple contexts, such as assigned or independent self-paced instruction, guided group instruction within a classroom setting, or kiosk-based delivery in a traveling exhibit.
- It needed to be designed in sections short enough to hold a student's attention and to fit within classroom lesson times.
- It was meant for wide and inexpensive distribution, so it needed to be Web-based, but also available on CD-ROM for those with limited bandwidth Internet connections.
- The product needed to be fun, not didactic, but suitable for a rigorous science curriculum.
- The teacher reviewers on the team wanted it to be relatively self-contained for easy use, so it needed to include evaluation tools.
- As mentioned above, it had to link to National Science Standards and also to the newly released Red Cross "Masters of Disaster" Curriculum.
- Since the initial budget was low, but the aims high, it needed a modular design that was expandable in case new funding should become available.

Synthesis (Creating a solution)

Early on, when only a limited analysis of the needs and goals of the project had been done, we had already begun considering solutions. Because we had to decide whether we even wanted to pursue the project, early consideration was necessary about how we might approach it and remain within the given budget. We thought that the safest approach was to take an existing module, "Community Hurricane Preparedness," which we had designed for emergency managers, and simply adapt the content for teenaged students. Instead of the complex decision-making simulation it contained, we would substitute several game-like exercises to maintain an equal level of engagement. Had we carried it out this design, the product would have been more like a textbook with multimedia elements to help maintain interest. Clearly, this was the safest route to ensure the project could be done within budget.

However, while we felt the more textbook-like portions of the adult module were fine for the professionally motivated users of "Community Hurricane Preparedness," we worried that we would quickly lose our younger audience without a higher degree of interaction. Besides, our representative from FEMA who funded the project expressed an enthusiastic desire to push the technological envelope and create something that would wow students (and decision-makers who might fund additional projects). We felt this expectation was a bit high given the limited funding, not to mention the high standards of today's teenagers when it comes to technology. But we listened and pondered our options.

Still early on, and before our first extensive meeting with FEMA, we agreed that a good approach would be to create a learning scenario that would involve students in decision-making related to hurricane safety and preparedness, while also supplying motivating experiences with science content through games and simulation. The exact story for the scenario was still vague, but the main character would be a teenager who experiences the events around an approaching, and then landfalling, hurricane. As this treatment evolved, we realized that the science content could be delivered in the guise of information provided to the main character to help her understand the potential impacts of the hurricane and to understand the limited predictability that we face when making decisions about preparedness and safety. We considered the use of stories to be an effective instructional strategy for involving and engaging learners, as well as providing an effective structure for encoding and recalling information (Schank, 1990). The story would allow us to model good safety and preparedness behavior, rather than simply providing information about good behavior. In addition, the scenario structure allowed for relatively easy future content additions. If budget allowed, we would simply add supporting activities to the design. We were sold on the idea and the FEMA representative liked it as well, but could we create a learning scenario and stay within budget?

We thought we could, but only if we borrowed as much content from existing sources as possible, reducing the content gathering activity that is typically required. We already had expertise in hurricane science and safety, had contacts who would be willing to supply the expertise we did not have, and possessed many visual and verbal source materials from the "adult" module. Another cost-saving attribute of the project was that the sponsor was not asking for a set schedule for completion. We would have the luxury of fitting the project into the small lulls within our more schedule-sensitive core projects. We decided to hire an instructional designer from outside the organization, but one who was a former employee, highly aware of our sponsors, the content area, and our development processes. His consultant status allowed the project to be non-disruptive to our core projects.

In addition, we saved on development costs by "paying it forward." Macromedia Flash was a Web tool that was relatively new to us, but we knew it was about to become an important tool for us because of the interactive and visually compelling Web applications that could be built with it. We would use this project to stimulate an R&D effort for developing Flash skills and techniques that would be useful in the near future. Instead of risking schedule slippage on core projects, our prototyping with Flash would happen on a project that did not present any schedule risk.

Before fleshing out the scenario any further, the lead instructional designer developed a design matrix that depicted how and where each of the primary learning objectives would be treated in the scenario. We would have students:

- *Identify the main ingredients that support or prevent hurricane formation.* This is done within a discovery learning game where students experiment by changing the values of necessary ingredients to create the optimal conditions for hurricane formation.
- *Understand the key characteristics, life cycles, climatology, and classification schemes of tropical storms and hurricanes.* This is presented more as information, but treated in a visually compelling way, with embedded interactions included. Students use worksheets to encourage engagement with the material. Because we had an existing 3D digital model of a hurricane developed for a previous project, we include an activity to explore this model via "virtual reality" software. However, the model was reworked to illustrate concepts at the proper level for this new audience. Discarded methods of treatment included video footage of a flight through a hurricane. It was decided that the bandwidth required for adequate video quality was prohibitive.
- *Identify factors that can contribute to uncertainty in hurricane forecasts.* This is necessary to help the public understand why evacuation can sometimes be necessary even though the hurricane never becomes a local threat. This is treated both with information content and with a simulation/game that allows learners to change the positions of high- and low-pressure systems and see the resulting hurricane path. This exercise was developed using actual numerical model simulations performed by a NOAA researcher at Colorado State University, although the game is not a fully functioning simulator itself. The interface for this simulation is reproduced below.
- *Identify hazards associated with landfalling hurricanes.* Again, this content is treated with information presented with engaging media qualities and supported with embedded interactions and worksheet questions. Discarded treatments included presenting interviews with survivors of hurricanes and others. We decided that this would likely require travel and would increase uncertainty in the schedule.
- *Choose appropriate safety and preparedness measures for hurricane events.* It was this content that would primarily drive the scenario. This is discussed more fully below.

The scenario itself involves the learner making a visit to Camille Castillo and her parents in the coastal Florida community of Ft. Walton Beach, site of the actual Hurricane Erin strike in 1995. The scenario unfolds over 7 days as Hurricane Erin develops, approaches, and then makes landfall at Ft. Walton Beach. Each day as the hurricane nears and then finally arrives, the learner participates with the family as they prepare their home for the threat and prepare themselves and Aunt Betsy for the potential of evacuation. Safety activities include choosing what to pack in the evacuation duffle bag, going over emergency plans, shopping for appropriate emergency supplies, preparing the house for high winds, and advising Aunt Betsy what to do as she evacuates her mobile home and then returns to a potentially damaged home after the storm passes.

Each day the learner has access to an informative TV weather update (courtesy of The Weather Channel) and instructional applications stored on the family's laptop computer. The laptop computer applications primarily treat science topics, but some relate to the hazards and safety of hurricanes as well. The primary interface for Hurricane Strike!, the Castillo Home, is displayed below. Learners receive a task list each day to remind them of things they need to do, but they can also just explore the rooms of the house and click on the active items that lead to the various instructional activities. For example, Hugo the dog presents a new task each day by way of the various items he carries in his mouth—clicking on Hugo when he carries the purse instigates a shopping trip for emergency supplies.

Evaluation (Fine-tuning the Solution)

Evaluation activities for the project began almost immediately. After our initial planning meetings and further reflection, the instructional designer for the project created a Project Plan that included our analysis assumptions and a detailed list of proposed objectives. In addition, he also created a Planning Matrix that described the potential ways we would treat each objective. FEMA representatives and two middle-school teachers reviewed these documents to validate our conclusions. This helped us clarify our priorities, but fortunately, they did not observe any major misconceptions on our part.

As the scripts for various sections were written, they were shared with the middle school teachers and content experts from the Red Cross, FEMA, and COMET. This helped us correct misleading or incorrect pieces of content and also helped us confirm the material was written at the correct level. As the pieces were developed, we performed formative evaluation by trying them out ourselves, but also observing how our own middle school-aged children used them (we had purposely chosen a modular design so that we could develop and test incrementally).

The scenario structure offered tremendous opportunities for learning activities, but it was a bit daunting to think through all the usability issues in advance. As we recorded audio content and prototyped several days of the scenario, the difficulties became apparent. For example, since many computer games are designed to be exploratory and open-ended, we had speculated that this approach would be engaging to students. But since we also had specific learning objectives we wanted learners to achieve, we weren't willing to allow them to bypass or miss out on activities (which some of our testers did). Worksheets were designed as a solution to provide the structure necessary to ensure that learners used all the parts of the module. Similar to that way a list in a scavenger hunt works, learners would have to explore each element of the module in order to complete the worksheets. But this is also where the comparison with a home computer game broke down. Completing the worksheets could be perceived as a typical school assignment as opposed to part of a game. Therefore, some of us felt it necessary to provide more guidance within the module so that the task of completing worksheets was less stressful. There were a few heated debates within the team about the amount of guidance necessary. In the end, we erred on the side of clarity by providing task lists for each day and making the items learners needed to click more obvious.

Another design decision that generated lots of debate centered around the simulation/game that allows learners to move high- and low-pressure systems to see their effects on hurricane paths. This was originally proposed as a type of bowling game, including pins to knock down and a scoring system. Kids would probably have loved this, but some of us were concerned with the ethical dimensions because hurricane strikes (and spares) obviously can take lives and cause serious destruction. Also, we had to remind ourselves that the most important learning objective was not knowing what forces move hurricanes, but that hurricane movements are difficult to predict. In the end, the "game" became more of a scientific simulation that drives this point home. Some kids who tested this application ended up making their own game out of the exercise anyway when they tried to make the hurricane strike certain cities. At least they are learning about the causes of atmospheric flow patterns and why hurricane paths are hard to predict, we told ourselves.

Usability was the most frequent issue we encountered during formative evaluations. For example, nearly all the instructions and interfaces for the various exercises needed some tweaking. However, as the members of the team reviewed each other's work, many aesthetic concerns were raised as well. These are by nature subjective and sometimes difficult to resolve with group consensus. We did the best we could, giving and taking to keep the project moving. Subject matter experts raised a few content issues during their final reviews, but early reviews of the scripts meant such issues were few and did not require any major revisions.

Summary

As this paper has demonstrated, the instructional design process is often non-linear. We may conveniently think of the process as sequential Analysis, Design, Development, Implementation and Evaluation phases, but such linearity in reality would be stifling. Many authors have recently developed models that describe a process of iterative refinement of the problem definition and solutions (Willis & Wright, 2000) or depict a dynamic system of interacting authoring activities that lead to one of many possible solutions (Tennyson, 1997). In our experience, such models of the instructional design process more accurately describe how good ID is done.

Like all projects, this one began with substantial analysis activities, but we also began almost immediately mentally trying out solutions, even when only a limited amount of analysis data had been gathered. These initial trial solutions were necessary to consider fully our production needs and implementation constraints, and to determine how best to use the available budget. The early potential solutions essentially became additional analysis data to allow us to consider project needs. We did not allow early synthesis of potential solutions to box us in, however. Only a few isolated components of the product saw early development activity; the bulk of the development work was done only after thorough analysis and design review. Evaluation was an essential part of the project and occurred throughout. Designated reviewers and fellow team members reviewed documents and prototypes at all phases, including the initial analysis. Such formative evaluation, performed by a range of staff and user representatives with a variety of skills and perspectives, saved many hours of wasted work. Some team members may become frustrated with this "committee" approach to project decision-making, but, if done within reason, more highly participatory design and evaluation can lead to important improvements and reduced effort by identifying more numerous and diverse design options and issues early in the process.

References

Cognition and Technology Group at Vanderbilt (1992), The Jasper experiment: An exploration of issues in learning and instructional design. *Educational Technology Research and Development*, 40(1), 65-80.

Schank, Roger (1990), *Tell me a story: A new look at real and artificial memory*, New York: Macmillan.

Tennyson, R. D. (1997). A system dynamics approach to instructional design. In S. Dijkstra (Ed.), *Instructional design: International perspectives* (Vol. 1, pp. 413-426). Mahwah, NJ: Lawrence Erlbaum Associates.

Willis, J., & Wright, K. E. (2000). A general set of procedures for constructivist instructional design: The new r2d2 model. *Educational Technology, 40*(2), 5-17.

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Education Communities, Government and Technology: Partnering for a Better Tomorrow

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Abstract: Though schools report an increase in the quantity and quality of use of technology in education, many still question of the merit of use of technology in K-12. Technology simply used as information distribution deserves such scrutiny and criticism. Using technology in educational projects in a variety of ways increases novelty and student interest and can also approach higher critical thinking levels. Government has recognized a challenge of preparing children for a lifelong commitment and involvement in the court and identifies the schools in playing a key role in meeting this challenge. This project calls for direct involvement of the Court in a variety of programs in partnership with the schools, integrating education on the court into the curriculum in K-12. This project between the courts and schools demonstrates how partnership between public agencies enhanced by technology has the tremendous potential to multiply the impact of civic education for students.

Introduction

There is a distinct point in the diffusion of innovations that I have come to call the point of no return, not to be seen as detrimental, but to indicate that a society cannot function without that innovation and would indeed be deemed primeval with its absence. Surely, communication technology has reached that point. One indicator of this placement is that the product is seen as essential across living category dimensions such as education, religion, entertainment and consumerism. Another indicator in reaching this pinnacle is that the use of the innovation cuts across age lines. Despite the increase in the quantity and quality of use of technology in education, there is still the persistent questioning of the merit of the technology in K-12 education (Panel on Educational Technology, 1997). Technology simply used as information distribution deserves such scrutiny and criticism. The research in technology use in education points to four distinct ways that technology can be used as media (Bruce and Levin (1997). Media as inquiry emphasizes the use of the Internet and other databases for data gathering for research or other problem-centered, fact-finding activities, media for communication underscores functions such as email and word-processing, media for construction looks at computer-aided design and media for expression represents more interactive outcomes of technology projects. Using technology in educational projects in a variety of ways, thus a variety of levels, not only increases novelty and student interest, but as the activity moves to higher levels of interactivity it also approaches higher critical thinking levels.

At the same time education is assessing its use of technology in the classroom, government is evaluating its role in the community, how it is perceived in the community and how the court can partner with the education community to educate K-12 students on the Court's role in the community and on their future role and responsibilities in the administration of justice. We realize that the court and the schools face the very real challenge of preparing children for a lifelong commitment and involvement in the Court and have identified the schools in playing a key role in meeting this challenge.

The overarching project plan calls for direct involvement of the Court in a variety of programs in partnership with the County A Superintendent of Schools integrating education on the court into the curriculum in K-12. This project infuses educational objectives with the goals of the Court, increases involvement and interest on the part of our educators, and places the learning of the courts into a familiar and credible context for the students - the educational context. This model reflects the ideas of the Goals 2000 legislation in using authentic tasks in teaching with technology http://www.ed.gov/pubs/EdReformStudies/EdTech/overview.html#authentic.

The Project

This prototype project between the courts and schools in County A demonstrates how partnership between public agencies enhanced by technology has the tremendous potential to multiply the impact of civic education for young students. Schools and students who participate in this project will develop knowledge about and appreciation for the justice system and its important contribution to a free society. In State A's schools the courts are first studied in third and fourth grade. Very little material is available to make this study concrete and meaningful for young students. Most teaching is done from generic national textbooks with little relationship to the students' own community. Television reinforces a concept of law and justice based on heroic individualism rather than Constitutionally protected procedure and thoughtful, reflective deliberation. This is reinforced by the problem that teachers have little direct experience with the justice system beyond jury summons or a traffic issue.

The Internet offers the opportunity for many classrooms to learn about and participate virtually in the justice system. Structured creatively and at the proper level of difficulty, the online experience can be interactive and memorable. In addition, classroom support materials can be made available to a wide audience at very little cost.

Recognizing the enormity of such a project, the Court and County A Superintendent of Schools have decided that the first step in enabling this collaboration is to initiate the project focusing on the elementary school grades in the social science and history curriculum. Initial meetings have determined that the curriculum has to be innovative and exciting for students, must blend educational and Court goals, and meet the Judicial Counsel's long-range goals for community outreach and education.

Specifically, the project includes 1) *Multimedia Curriculum.* This package includes web-based lessons and non-web-based activities that will be scheduled throughout the year that promote the court in the community, including school assemblies that feature court-related speakers, a formal integration of law day into the schools throughout the school year, while still identifying May 1 as the "official" Law Day as recognized by Congress. Appreciating the research that indicates that online materials are more attractive to teachers when included in a "curriculum package" we will link these activities with corresponding web-based curriculum that will be designed for student preparation or post study to tie the activity to further education of the court, 2) *Virtual Courthouse.* The historic courthouse of County A houses a wealth of information, stories, and legends that can only add to a student's understanding and appreciation of the role of the court and law in the community and county. Our plan for the County A Virtual Courthouse is to use actual diagrams and pictures of the County A Courthouse, not cartoon or clip art as is typically used. The courthouse will be interactive and hyperlinked, using pop-up figures that will respond to questions that a student may ask from a set of pro-preprogrammed questions. Various paths will be available for a teacher to choose to focus on in a lesson (with corresponding online curriculum material) that teachers help in designing, and 3) *Virtual Fieldtrips.* County A Courts and Superintendent of Schools propose to develop a virtual fieldtrip to the courts for 3rd and 4th grade students. The discussion so far is that this online project will utilize the hyper-linking capability of the Internet by allowing the user to follow multiple pathways through the site. For example, a user might follow the day of a person who is serving on a jury; a typical day in court of an attorney; or a day in the life of a judge. These "day in the life of" Virtual Field Trips will each be supported by classroom materials. The materials will be developed by outstanding teachers in the region and be specially designed to meet the needs of County A's diverse student population but with an eye to the curriculum of schools throughout State A. As part of this Virtual Tour, various times will be scheduled for students to interact with a court official via email in a type of "Ask and Expert" experience. These may be part of a response to video interviews of a judge, a bailiff, an attorney, a court reporter, etc. posted on the site.

References

Bruce, B.C., & Levin, J.A. (1997). Educational technology: Media for inquiry, communication, construction, and expression. *Journal of Educational Computing Research*, 17(1), 79-102. Available online: http://www.lis.uiuc.edu/~chip/pubs/taxonomy/index.html

Panel on Educational Technology, President's Committee of Advisors on Science and Technology. (1997, March).

Report to the President on the use of technology to strengthen K-12 education in the United States [Online]. Available: http://www.ostp.gov/PCAST/k-12ed.html

Designing for a moving target

Designing an effective learning experience on a PDA in a wireless environment has forced a reexamination of the instructional design principles normally associated with the content development process, a team of instructional designers in Canada has concluded. The typical project management model that has been applied to face-to-face and elearning projects can't be relied on for the emerging *mlearning* environment. Instructional design strategies have to be modified for a mobile learning environment that seems to be changing monthly.

Several significant issues are affecting the instructional designers responsibilities in the new mlearning world. Constantly changing PDA devices means that the potential of the technology platform is largely unknown and enormously difficult to design for. Uncertainties surrounding the type(s) of content that may or may not work on the market-ready PDAs impact on the choices available to the subject matter experts. While many of the learner and faculty support issues are similar, the complexities of these resources are increasing. And, of course, for many pilot exercises, the costs for mlearning production activities seem to be larger than for their elearning counterparts.

At the end of the day, how can the instructional design principles developed over the past few years be applied to a moving target? Moreover, how can student and faculty expectations for a satisfying and, ultimately, successful learning experience be met? These questions—along with the increasing importance of the development project team that involves content providers, SMEs and instructional designers—will be explored against the backdrop of a pioneering mlearning educational experience at two leading Canadian colleges.

Assessing Student Programming Knowledge with Web-based Dynamic Parameterized Quizzes

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Abstract: Web-based knowledge assessment with on-line quizzes is one of the oldest and most popular ways of using the Web in education. Almost all major Web courseware management systems support authoring and delivery of on-line quizzes made from static questions. Our work attempts to address several known shortcomings of static questions. We suggest an approach and a system to author and deliver Web-based dynamic parameterized quizzes for programming-related subjects. The system has been used in a practical class for two semesters with both desktop and mobile computers and in both aasessment and self-assessment modes. This paper briefly describes the system and summarizes the results of its formal classroom evaluation.

Introduction

Objective tests and quizzes are among the most widely used and well-developed tools in higher education. Web-based knowledge assessment with on-line quizzes was the first to be implemented and currently the most well developed and most popular interactive component in Web-based education [Brusilovsky & Miller 1999; Brusilovsky & Miller 2001]. All major Web courseware management systems support authoring and delivery of on-line quizzes made from static questions. A lot of efforts have been put by the vendors of these systems to support a larger variety of question types, make question authoring easier for a teacher, and provide support in managing quizzes and pools of questions. Yet, with all these powerful authoring tools can't solve a few inherent problems of this traditional assessment tool - quizzes made of static questions.

All these problems come from an obvious fact: when author creates one static question, one and only one question is created. Modern authoring tools made creating of Web quizzes much easier then it's used to be[1], however, creating every question is still a large investment of time because, if questions are taken seriously, creating the content takes much more time than entering this content into a system. Thus, every question is an expensive component of teaching material and the number of questions that can be created for a particular course is relatively small. In this context, it is quite natural, that in both assessment and self-assessment contexts all students in the class are using the same set of static questions[2]. It creates at least two well-known problems:

- In an assessment context, the use of the same set of questions for the whole class provokes cheating. Cheating is quite an issue even for the classroom quizzes. For take-home and Web-based quizzes cheating become a major problem that actually prevents the teacher to rely on results of this kind of quizzes. Cheating is an issue not only within the class, but also between classes. In the places where the same questions are being used in several classes (during the same term on during different terms) the students are known to accumulate and pass each other the correct answers.
- In the self-assessment context, where the cheating is not a problem, the students usually suffer from the lack of material: There are usually too few questions to work with and one question can be answered only once.

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[1] A number of my colleagues who were creating quizzes with the top-of-the-line Blackboard 5.1 system have claimed that the old "paper and pencil" way is still much easier for them. Creating quizzes in an editor such as Microsoft Word is still faster (especially taking into account slow Web-based authoring tools). What can really save time is automatic grading (at least for large classes). However, in many cases, quizzes are graded by Teaching Assistants and thus this saving does not affect the professors themselves.

[2] A more progressive approach where every student is getting a subset of a pool of questions developed for a quiz is used very rarely exactly because questions are expensive to develop.

A known remedy for this approach is the use of *parameterized questions*. With this approach, an author creates a pattern of a question. At the presentation time, the pattern can be instantiated with parameters taken from a particular set. This, every question pattern is able to produce a large or even unlimited number of different questions. Parameterized questions are currently a focus of one of the promising research directions in the field of Web-based education (WBE). A number of pioneer systems such as CAPA [Kashy et al. 1997], WebAssign [Titus, 1998 #1386], EEAP282 [Merat & Chung 1997], or Mallard [Graham, Swafford & Brown 1997] have has explored the use of parameterized questions in different settings. The early results are very encouraging, For example, the authors of the CAPA systems have carefully monitored the use of their system and reported that the use of parameterized questions can practically eliminate cheating [Kashy et al. 1997].

Our own work capitalizes on the experience of early systems with parameterized questions and is aimed at extending their application area to a non-traditional and challenging subject of programming languages. We have developed an approach and a system to author and deliver Web-based dynamic parameterized quizzes for programming-related subjects. The system has been used in a practical class for two semesters with both desktop and mobile computers and in both assessment and self-assessment modes. This paper briefly describes the system and summarizes the results of its formal classroom evaluation.

Parameterized Questions for Programming-related Subjects

Traditionally parameterized questions are used in math-based courses such as physics and various math subjects. In these application areas, a correct answer to a parameterized question can be specified by a formula that includes one or more question parameters. In this context, creating parameterized questions and checking the correctness of student answers is relatively easy: the question author provides the interval for the possible values of a randomized parameter (or parameters) and specifies the formula to calculate the correct answer. The quiz system generates a question and stores its parameters along with the content of the question. To check the student answer, the correct answer for the given set of parameters is calculated using the provided formula and compared with the given answer. The formula-based approach is simple and powerful. It even enables the system to recognize most typical misconceptions if an author can provide a "wrong" formula that corresponds to a misconception.

Unfortunately, the formula-based approach can't be used in programming except for very simple cases of calculating numerical expressions. Our challenge was to design a different approach that can work for a large variety of questions in programming courses. While analyzing several large pools of questions created for courses based on such languages as Lisp, C, and Java, we have found that a large portion of questions in these pools are code evaluation questions. In a code evaluation question, the user is provided with some fragment of a program and is asked to predict the value of a particular variable or a string to be printed at the end of execution of this fragment. This kind of questions is very important - it enables the teacher to check the student's understanding of the semantics of programming language constructs. Semantics of a programming language is an important body of knowledge on itself and also a prerequisite to a higher level programming skills.

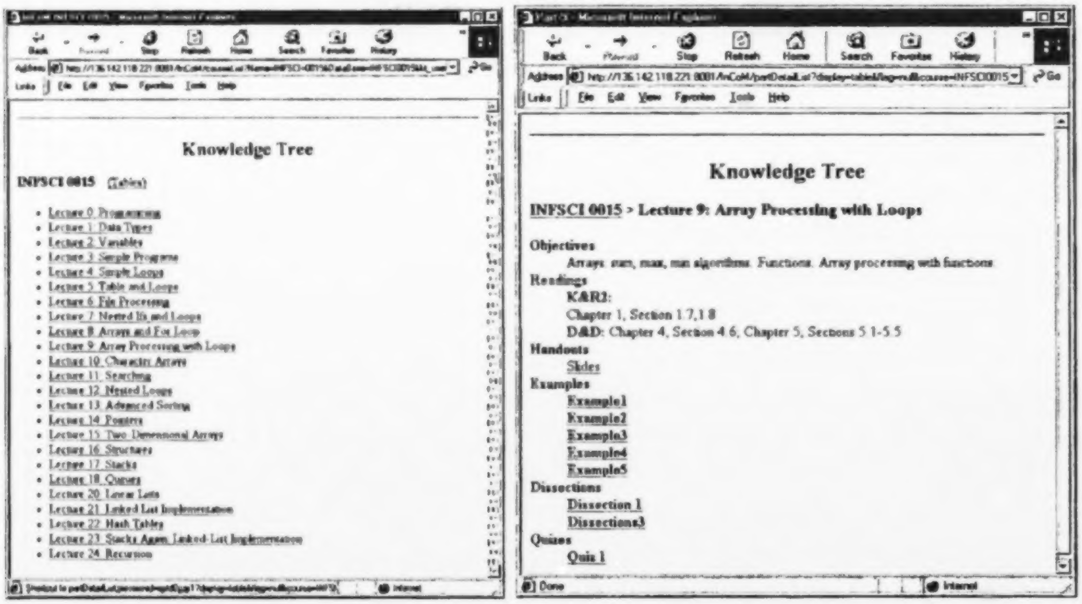
In traditional Web-based courses, where code evaluation questions are very popular. They are authored much like other kind questions in the form of multiple choice or blank-filling using provided tools for developing of static questions. They are evaluated by comparing the answer given by a student with the answer pre-specified by a teacher. However, it is known that code evaluation questions allow a different approach to checking the correctness of student answers. Using a language interpreter or compiler the system can ran the given fragment of code and calculate the correct answer for a code evaluation questions without the need for a teacher to provide it. Then it can compare the calculated answer with student answer. We have used this approach is several earlier systems such as ITEM/IP [Brusilovsky 1992], ILEARN [Brusilovsky 1994], and ELM-ART [Weber & Brusilovsky 2001] to save some sizeable amount of question development time and to avoid authoring errors.

When developing our system QuizPACK (Quizzes for Parameterized Assessment of C Knowledge) we have attempted to combine our earlier work on code evaluation questions with the ideas of parameterized questions. Our motivation was to create a system that would allow a teacher to create parameterized code evaluation questions and quizzes easier than creating static questions with existing authoring tools. The idea of QuizPACK is very simple. A teacher provides the core content of the question: a parameterized fragment of code to be evaluated and an expression that have to be evaluated by the student at the end of the fragment execution. The system does the rest: randomly generates a question parameter, creates a presentation of the parameterized question in a Web-based quiz, gets the student's input, compares the student answer with the result of running the parameterized code "behind the stage", and records the results into a server-side database.

The current version of QuizPACK can support a whole programming-related course based on C or C++ programming language. It supports simple questions based on a few lines of code as well as very advanced questions with the code that includes multiple functions and header files. QuizPACK allows the teacher to prepare full quizzes of different length in the form of static sequence of parameterized questions. It also allows a teacher to display various kinds of reports about the student performance on quizzes. The following sections of the paper presents the student's and the teacher's side of QuizPACK and reports some result of its evaluation in a Data Structure course based on C language.

Students Interface of QuizPACK

The students are accessing the quizzes using our KnowledgeTree learning portal. The KnowledgeTree portal allows a a teacher to create a course support Web site that can use course materials distributed among different servers. With knowledgeTree, a teacher is able to specify the objectives, readings, and other critical information for every lecture and to specify relevant learning activities of different kinds. In particular, a teacher can specify a set of quizzes to suport a lecture. When a student selects a quiz in KnowledgeTree, the portal request the selected quiz from the quiz server and passes the student parameters to the server. The server immediately loads the first question of the quiz in a separate window.



Knowledge Tree

INFSCI 0015 (Tables)

- Lecture 0 Programming
- Lecture 1 Data Types
- Lecture 2 Variables
- Lecture 3 Simple Programs
- Lecture 4 Simple Loops
- Lecture 5 Table and Loops
- Lecture 6 File Processing
- Lecture 7 Nested Ifs and Loops
- Lecture 8 Arrays and For Loop
- Lecture 9 Array Processing with Loops
- Lecture 10 Character Arrays
- Lecture 11 Searching
- Lecture 12 Nested Loops
- Lecture 13 Advanced Sorting
- Lecture 14 Pointers
- Lecture 15 Two Dimensional Arrays
- Lecture 16 Structures
- Lecture 17 Stacks
- Lecture 18 Queues
- Lecture 20 Linear Lists
- Lecture 21 Linked List Implementation
- Lecture 22 Hash Tables
- Lecture 23 Stacks Again Linked-List Implementation
- Lecture 24 Recursion

Knowledge Tree

INFSCI 0015 > Lecture 9: Array Processing with Loops

Objectives
Arrays: sum, max, min algorithms. Functions. Array processing with functions
Readings
K&R2:
Chapter 1, Section 1.7,1.8
D&D: Chapter 4, Section 4.6, Chapter 5, Sections 5.1-5.5
Handouts
Slides
Examples
Example1
Example2
Example3
Example4
Example5
Dissections
Dissection 1
Dissections3
Quizes
Quiz 1

Figure 1: KnowledgeTree, a portal for accessing distributed Web-based course support material. Left side: a list of lectures created by a teacher. Right side: a view of a lecture with associated learning material. Different items are usually served by different activity servers.

The parameterized question is presented to the student just like a normal static fill-in question. First, the program fragment to be evaluated is presented then the expression to be evaluated, then form box to write down the answer (Figure 2, left). One or more constants that the student can see in the body of the question are, actually, instantiated parameters. They may be different for different students taking the quiz as well as for the same student attempting the question several times. In a properly designed question, the value of the expression to be evaluated depends on the instantiated parameters and thus will also be different for different students. Every student is supposed to mentally execute the program, evaluate the specified expression, enter its value into the box, and hit "submit" button. After that the system generates an evaluation screen for the student. The evaluation screen repeats the content of the question, evaluates the correctness of the student's answer, provides the correct answer if the student's answer was incorrect, and generate a link to the next question (Figure 2, right). This screen lets the student to re-think the question and the answer. In particular, the student may want to attempt the same question again by using the Back button and reloading the question screen. The student can attempt the same question many times, though in evaluation context only the results of the first attempt is recorded (Figure 2, right). Students may finish working with the quiz anytime simply by closing the quiz window and returning to the KnolwedgeTree portal. Note that the student interface does not sport elaborated graphics and uses the minimal required space to present the question and the feedback. It was done to enable working with questions on multiple handheld wireless devices. As a result, the QuizPACK perfectly works on small Windows CE computers like HP Jornada and even on Palm-based organizers.

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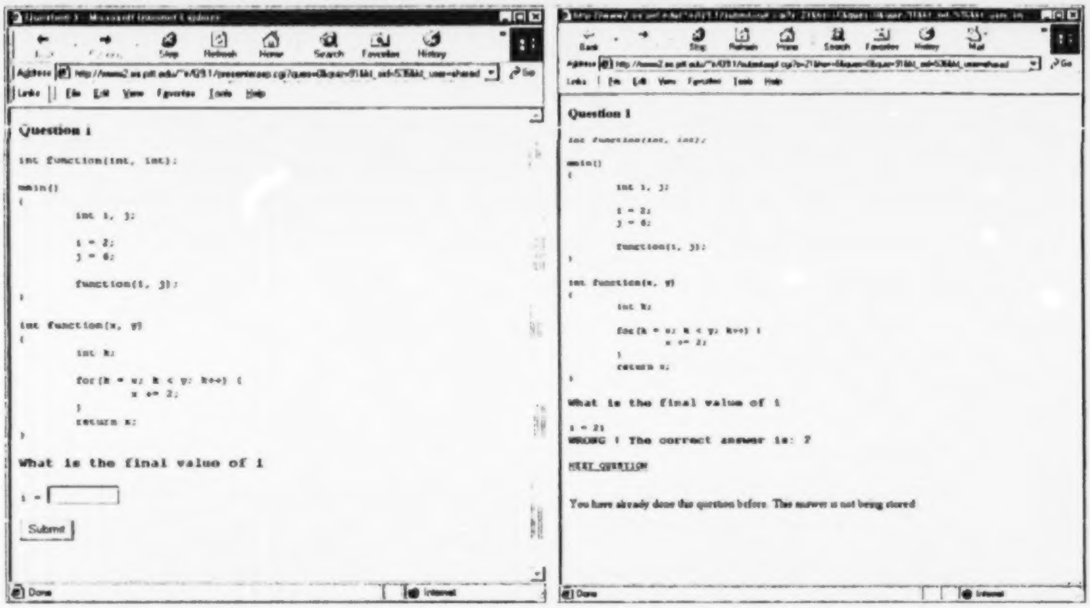
We welcome the readers to try QuizPACK system by logging in to KnowledgeTree system at http://dbpc.sis.pitt.edu/sharad/kt/login.html. The system allows self-registration. We suggest to use your e-mail address for your login name to avoid name conflicts.



Question 1

```
int function(int, int);

main()
{
        int i, j;

        i = 2;
        j = 6;

        function(i, j);
}

int function(x, y)
{
        int k;

        for(k = x; k < y; k++) {
                x += 2;
        }
        return x;
}
```

What is the final value of i

i =

Question 1

```
int function(int, int);

main()
{
        int i, j;

        i = 2;
        j = 6;

        function(i, j);
}

int function(x, y)
{
        int k;

        for(k = x; k < y; k++) {
                x += 2;
        }
        return x;
}
```

What is the final value of i

i = 21
WRONG ! The correct answer is: 2

NEXT_QUESTION

You have already done this question before. The answer is not being stored

Figure 2. The user interface of QuizPACK.

QuizPACK from the Teachers Point of View

Teachers use QuizPACK to publish online parameterized quizzes for the students. There are three major steps a teacher has to complete in preparing a quiz.

- First, the teacher has to provide the programs to be evaluated. The code of each program has to reside in a separate file. The place of a randomized parameter in the code of the questions is denoted by a pseudo-variable Z. At the question generation phase QuizPACK every occurrence of Z variable will be substituted by an integer randomized within some interval. In effect, a teacher defines a pattern of a question. A pattern is a simple way for a teacher to give different questions of the same difficulty level to all the students without being biased with the choice of questions for different students.
- Second, the teacher has to specify a quiz in a special quiz index file. Each line in this file corresponds to one question. For each question the teacher has to specify the name of the file with question code, the lower and the upper limits for randomized variable, an expression to be evaluated by the students, and a type of this expression (i.e., *int* or *float*). With this approach, the code of the question in QuizPACK is separated from the pedagogic information such as randomization limits and expression. It allows the author to use the same question code in different quizzes with possibly different parameters.
- The last step is to compile a quiz. QuizPACK system is developed to can work on any Unix system with a variety of Web servers. The system itself is a collection of several prototype data files and several commands (in Unix sense). The commands are all written in C++ and can be recompiled on any Unix platform. The authoring interface for compiling a quiz consists of just two commands. The *newquiz* command generates a folder (catalog) for a new quiz with all required prototype files. The name of this folder is also the name of the quiz. This is the folder where teacher have to place the question files and the quiz index file for the quiz. Naturally, these files can be simply created inside the quiz folder using any editor, moved from other folders or transported by FTP from another computer (including Macs and PCs). After all files are added to the quiz folder, the author has to execute *compile* command that generates and compiles a set of CGI programs for the quiz. More exactly, two CGI programs are generated for each

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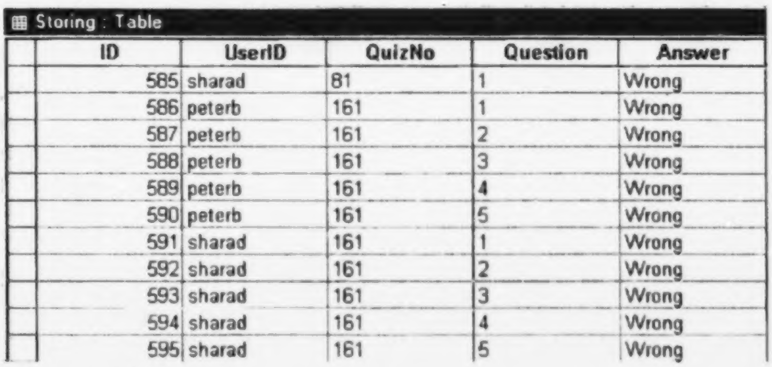
question - one to present the question and one to evaluate the answers. The code of the original question is included into both of these programs. Thus, the same code provided by the teacher is used for both - presenting the question and evaluating the answer. If the author will decide to changed or update the quiz, the *compile* command should be used to re-generate the quiz.

QuizPACK authoring aproach allows the authors to create and compile quizzes remotely using Telnet and FTP tools. Note that the authoring side of QuizPACK does not use traditional Web form-based authoring approach, but relies on generic text editing and communication tools. For teachers of programming subjects it's a benefit, not a shortcoming. A full-featured randomized quiz can be produced very fast, with the use of familiar tools on their preferred platform and with minimal authoring efforts over creating the code for questions. Teachers can publish the questions from their homes and then can just e-mail the students to take the quiz. They don't need to come to the class and distribute the papers to the students to take the quiz.



ID	UserID	QuizNo	Question	Answer
585	sharad	81	1	Wrong
586	peterb	161	1	Wrong
587	peterb	161	2	Wrong
588	peterb	161	3	Wrong
589	peterb	161	4	Wrong
590	peterb	161	5	Wrong
591	sharad	161	1	Wrong
592	sharad	161	2	Wrong
593	sharad	161	3	Wrong
594	sharad	161	4	Wrong
595	sharad	161	5	Wrong

Figure 3: The structure of a database table with the quiz results.

QuizPACK use a specific http-based protocol to communicate the results of the student work with every question to a server specified by a teacher. We have successfully used this http-based approach to support communication between distributed components of educational software in our previous work [Brusilovsky, Ritter & Schwarz 1997]. With this approach any http server can be used to log or store the results of the student's work. For the needs of our own course we have implemented a simple storage server using Microsoft Internet Server and Microsoft Access database. The database stores results of the student's work in a very simple format (Figure 3). This is a convenient solution since allows to produce easily a variety Active Server Pages (ASP) scripts for creating student progress reports. With these reports, teachers can evaluate the performance of the a class or a particular student on a quiz or question level by calling the URL for one of the ASP scripts.

Evaluation of the System

During the Fall semester of 2002 we have performed a formative evaluation of QuizPACK in a real university course "Data Structures and Programming Techniques" at the University of Pittsburgh. The course was based on C programming language. During the first part of the course, we have use QuizPACK in in-class assessment mode using wireless handheld computers. During the second part of the course we have used the system in out-of-class self-assessment mode using regular desktop computers. The analysis of the in-class use of the system is beyond the scope of this paper since the results were significantly influenced by the use of wireless computers. Below we discuss some results of the evaluation of QuizPACK in the self-assessment mode.

QuizPACK was used to serve self-assessment quizzes of 5 to 10 questions each for almost every lecture of the second part of the course. The questions were prepared to let the student practice the knowledge of programming constructs and data structured introduced at the corresponding lecture. In addition to self-assessment computer quizzes we have also used regular paper-and-pencil assessment quizzes at the beginning of every lecture. A few weeks before the end of the course we have prepared a short 9-question assessment tool to collect the students feedback about QuizPACK. The students were informed about the questionnaire and were encouraged to fill it in. The participation in the study was voluntary. All participants were rewarded by thee extra credit points. In total, 27 students of 40 choose to participate. It's important to note that all students participated in the study have taken at least three self-assessment quizzes over the duration of the course.

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Overall, the students have got a very positive feeling about the self-assessment questions. 48% of respondents though that it "can significantly help", 37% though that it "can help", 15% thought that it "can sometimes be of help" and none found them useless. The ability to take a parameterized quiz several times was also highly evaluated. 56% found this feature "very useful", 26% found it useful, 19% found it "sometimes useful": and none "useless".

The last of the questions in the questionnaire allowed the students to provide an unstructured feedback. We have specially welcomed critical feedback and suggestions. While we have not asked about praise, many students has provided a very encouraging feedback from unspecific: "The self-assessment quizzes were of great help" to very specific: "The quizzes helped me to figure out link list implementation". The students also appreciated the parameterized nature of the quizzes: " You can also take the self-quizzes over and over again unlike the [paper-and-pencil] in class quizzes. You learn more for taking different quizzes over and you din't have to stress yourself over getting the answer right the first time". The students have also pointed out several problems and generated a number of suggestions. One of the most often mentioned suggestion was to provide self-assessment quizzes for every single course lecture, not just for a subset of them: "There were a few areas, I had trouble with, but there were no quizzes to go along with them". Many students also wished the tool not only reported the write answer, but also provide a detailed explanation of how this was obtained. We think that such an explanation can be generated by an explanatory visualization tool are planning to explore this direction. Finally, a number of students commented that they prefer a quiz format where all questions are shown on one page (as in paper-in-pencil quizzes). This format allows them to see the whole set of questions, take them in arbitrary order, and re-consider the answers before submitting the whole set.

Summary

We have reported an approach and a tool QuizPACK that enable teachers to produce easily parameterized quizzes for programming subjects. Parameterized quizzes greatly increase the productivity of a teacher enabling them to produce a range of questions where regular tool allows producing only one question. Parameterized quizzes prevent cheating in an assessment mode and allow the students to take the same question over and over in the process of mastering the subject. The tool was used in an undergraduate programming course and was very positively evaluated by the students. We are planning to continue the work in this direction taking into account students suggestions generated during the first formative evaluation.

References

[Brusilovsky 1994] Brusilovsky, P. (1994). ILEARN: An intelligent system for teaching and learning about UNIX. SUUG International Open Systems Conference, ICSTI. 35-41.

[Brusilovsky & Miller 1999] Brusilovsky, P., & Miller, P. (1999). Web-based testing for distance education. WebNet'99, World Conference of the WWW and Internet, AACE. 149-154.

[Brusilovsky & Miller 2001] Brusilovsky, P., & Miller, P. (2001). Course Delivery Systems for the Virtual University. In Tschang, T., & Della Senta, T. (Eds.), Access to Knowledge: New Information Technologies and the Emergence of the Virtual University. Amsterdam: Elsevier Science. 167-206.

[Brusilovsky, Ritter & Schwarz 1997] Brusilovsky, P., Ritter, S., & Schwarz, E. (1997). Distributed intelligent tutoring on the Web. In du Boulay, B., & Mizoguchi, R. (Ed.), Artificial Intelligence in Education: Knowledge and Media in Learning Systems . Amsterdam: IOS. 482-489.

[Brusilovsky 1992] Brusilovsky, P.L. (1992). Intelligent Tutor, Environment and Manual for Introductory Programming. Educational and Training Technology International, 29 (1), 26-34.

[Graham, Swafford & Brown 1997] Graham, C.R., Swafford, M.L., & Brown, D.J. (1997). Mallard: A Java Enhanced Learning Environment. WebNet'97, World Conference of the WWW, Internet and Intranet, AACE. 634-636.

[Kashy et al. 1997] Kashy, E. et al. (1997). Using networked tools to enhanse student success rates in large classes. FIE'97, Frontiers in Education Conference, Stipes Publishing L.L.C. 233-237.

[Merat & Chung 1997] Merat, F.L., & Chung, D. (1997). World Wide Web approach to teaching microprocessors. FIE'97, Frontiers in Education Conference, Stipes Publishing L.L.C. 838-841.

[Weber & Brusilovsky 2001] Weber, G., & Brusilovsky, P. (2001). ELM-ART: An adaptive versatile system for Web-based instruction. International Journal of Artificial Intelligence in Education, 12 (This issue), To appear.

EQUAL: A Universal Design Framework and Implementation of Novice Programming Language and Computing Environment for Native Users

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Abstract: In the evolving Information Society (IS), programming and computing skills are becoming important in educational, professional and personal endeavors and constitute an integral part of computer science education. In the current programming languages, programming constructs, semantic concepts, and syntactic elements, are based on English and implemented using ASCII character sets, seriously limiting the universal access to programming and computing skills. Especially, native users (e.g., non-English speaking students, adults, linguistic minorities etc), encounter enormous difficulties in understanding and translating their programming plans into the syntax and semantics of a programming language. Authors have designed and implemented a universal design methodology and experimental programming language – EQUAL and its compiler/interpreter and an integrated programming environment, in which, native users can write and execute programs in their native "*customized*" programming languages. EQUAL provides a unique opportunity to native users for learning programming and may be used as a scaffolding tool for teaching basic concepts of programming and computing.

Introduction

In the evolving Information Society (IS), programming and computing skills are becoming important in educational, professional and personal endeavors and constitute an integral part of computer science education. With globalization and rapid developments in Information Technologies (IT), the majority of Internet users do not use English, native users' issues may become serious because the vast majority of the world's population who do not, and will not in the foreseeable future speak English will be excluded from the Information Society. Students and people lacking programming and computing skills may become a serious individual and social problem [Dyson, 1997] and in the worst case, may lead to - Internet Apartheid [Shneiderman, 2000]. Native users referred to here include non-English based educational background students (e.g., primary and high schools, colleges and universities), adults, indigenous societies, people with special needs, linguistic minorities from developing and underdeveloped countries from Asian, the Middle East, Eastern European, African and South American countries or geographical regions. For these native users, it is unrealistic and impractical to learn and adapt to English based paradigm of HCI interactions and communications. In particular, millions of native students, for some reasons (e.g., political, social, etc.) are compelled to learn in native medium, have no alternative solutions to learn the IT skills and programming expertise.

Policymakers, educators and government administrators from these countries have realized the potential of IT and their impact on the emerging information societies. Even with special initiatives, free hardware or subsidized access to Web, Universal Access (UA) to appropriate linguistic and cultural content, textual information structures and programming languages has been a serious impediment to the development of IT skills and effective E-applications (e.g., E-democracy, E-Governance, E-Learning etc). Unfortunately, simple textual information structures (e.g., email addresses, domain names, operating system components), novice programming languages (e.g., LOGO, BASIC etc.) and textual languages (e.g., command, query, programming etc.) are not available and useful to the native users.

In general, from a technical point of view, there is a critical need of *Enabling*, *Scaffolding*, and *Assistive* mechanisms to cater to the diverse requirements of native users. Enabling mechanisms are mainly concerned to the enabling the native users to interact in native languages and socio-cultural environments with the computers. Scaffolding mechanisms are necessary to help and assist the native users to join the main stream of English based paradigm of HCI interactions and programming. Special assistive mechanisms are necessary to the native users with special needs. We consider *universalization* textual information structures and textual languages as fundamental strategy to support enabling, scaffolding and assistive technologies for the diverse needs, preferences and requirements of native users. With a long, term goal of *IT Empowerment and Life Long Learning*, we take the proactive approach of *universalization* of textual information structures and textual languages, and as a step towards a *Inclusive Society*, we recommend that, the "*digital divide*" has to be minimized by developing sustainable, enabling and scaffolding technologies by adopting universal design perspectives towards the design and implementation of textual information structures, programming languages and computing environments.

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With respect to computer science education, in particular, teaching and learning of programming languages and computing skills with English as "*programming paradigm*" will seriously limit the universal access to IT technologies and programming skill. Because of historical reasons the majority of programming languages and programming paradigms (e.g., declarative, procedural, functional, object oriented etc) are mainly based on English semantics and syntax and implemented using ASCII character sets. Especially, the native users such as students and adult users, whose medium of education and instruction is in their native, natural languages and socio-cultural environments, encounter enormous difficulties in understanding and translating their programming plans into the English-based semantics and syntax of a programming language. In the new technology adaptation for Educational Computing and Learning, in particular, with respect to programming languages, non-availability and non-accessibility of programming languages and computing environments (e.g., integrated editors, debuggers etc) and language processors (e.g., interpreters, compilers, translators etc) constitute a major stumbling block to native users [Rogers, 2000]. Other factors, such as lack of native user interfaces and interactions, linguistic barriers, complex social and cultural factors will continue to hinder the effective learning of programming and computing skills. We also believe that user interfaces to systems for programming and computing environment can critically influence the development of programming skills. Hence, a wide range of native user programming languages and computing issues must be included in the universal design and universal access to programming languages, language processors and computing environments.

In this paper, we mainly focus on on-going work research work related to the universal usability issues of programming languages, language processors and computing environments from native users' perspectives with more emphasis on semantics and syntax i.e., notational aspects of programming languages and programming constructs. We also discuss a universal, inclusive design methodology of programming languages, language processors and computing environments. Furthermore, it will contribute to the better understanding of native user requirements, universal design of programming languages and computing environments, and implications to scaffolding and teaching tools.

Native Users: A Profile

The research studies on needs and requirements of native users are scarce and poorly understood. Within the scope of our research work concerned with universal design methodologies and universal access to textual languages (e.g., command, query, programming etc) with a long term research goal of "*Information Technology for All (IT4ALL)*", we define and focus our studies to a diverse, global, end-user populations called "*native users*". In-house studies on usability and universal accessibility of textual languages and novice programming issues were conducted with the help of researchers, HCI experts, native users and students with diverse multilingual and multicultural backgrounds. From these preliminary studies, in general, native users may be defined as end-users, including users with special needs with one or more characteristics such as: (a). They prefer or use their native, natural language-like constructs for human-computer interactions and programming. (b). They have minimal or no English knowledge. (c). Their medium of education and instruction is in their native, natural languages and socio-cultural environments. (d). They are novices or posses minimal computing skills. (e). Native student communities would like to acquire not only information manipulation skills but also skills of programming. (f). Native users may also include people with special needs, (e.g., visually challenged users prefer to use native Braille).

Native User HCI Model and Programming Language Issues

In general, programming is the task of mapping the mental plans and program compositions into language constructs, i.e., semantics and syntax of a computer language to achieve a particular computing task. For historical reasons, the majority of programming languages and paradigms are derived from English semantics and syntax and implemented using ASCII character sets. A native user HCI model of interaction and communication between the native user and the computer for programming tasks can occur at conceptual, semantic, syntactic, and lexical levels. At *conceptual* level the "*meaning*" of the task model should match the native user's world model, and here reside the concepts of programming, programming language features, relationships, and operations. At the *conceptual level,* the technology, programming paradigms, metaphors are new and unfamiliar to the majority of native users. At the *semantic* level, the ideas from the conceptual level are represented by means of a programming language placed in the context of a computing task. The abstract operations from the conceptual level are fully defined in terms of objects, functions and programming constructs of a programming language. At the *semantic level*, the semantics of programming do not match well with the natural semantics of native users' languages. At the *syntactic* level, the "*grammar*" of the programming language is defined, including the arrangement of valid programming elements and program construction. At the *lexical* level, the primitive elements such as tokens and literals of a programming language are used to write a program to achieve a computing task. The "*grammar*" at the *syntax* level is highly inflexible to the requirements of the native users and the ASCII-based lexical tokens at the *lexical* level do not cover the majority of native user languages and cultural conventions.

In other words, the majority of programming languages *"do not speak the language"* of the native users and seriously hamper understandability, memorability, learnability and ease of use of programming languages. The native users are compelled to use semantic and syntax concepts that are not compatible and comprehensible to the majority of native users. Hence, current programming languages does not provide flexible approaches and alternative opportunities to native users to learn programming. In general, programming is difficult, but native users encounter additional difficulties at conceptual, cognitive, semantic and syntactic levels in translating the programming plans into the formal syntax of a programming language. Thus, we need not only syntactic but also semantic and cognitive adaptations in programming languages and computing environments.

In general, from the native users' perspective as well as from the preliminary usability studies, the major issues are:

- **Lack of Computing Resources:** The native user computing resources are scare and poorly understood. The computing resources include programming languages, language processors, computing environments, teaching and learning resources and materials. There is a critical need of production, publication and dissemination of computing resources for the native users. Other serious issues are complex computing concepts, unfamiliar metaphors, unnatural programming paradigms, lack of integration of pedagogical concerns, and poor training and teaching resources.
- **Syntactic Inflexibility:** The majority of syntactic elements or vocabularies, punctuation, programming conventions and cues of programming languages is based on English syntax, and conventions and implemented using ASCII character sets. Using ASCII character set, seriously hampers the universal access to programming at syntactic and lexical levels for non-Roman based scripts and complex native language diacritics.
- **Semantic Mismatch:** The semantics of programming constructs do not match well with the concepts and semantics of native user natural languages. For example, many programming semantics of input/output statements (e.g., READ, WRITE, INPUT, OUTPUT, PUT, GET, PRINT etc) have a generic form <*VERB*> <*objects*>. Many native users' languages (e.g., Asian, Arabic, Indian etc) have the generic form <*objects*> <*VERB*> and sometimes freely mixes both the formats in general communication. Similarly, the IF-THEN conditional statement and its variants have a generic structure IF <*condition*> THEN (*statements*), but these programming constructs have diverse native interpretations. In novice programming studies, it is observed in [Bonar and Soloway 1985, Ebrahimi, 1994] that, the majority of semantic errors arise due to the semantic mismatch and novice users relaying on preconceived knowledge and translating the programming plans using their natural language semantics.

The visual programming systems, programming by demonstration and form-based programming may be used to address some of the native users programming issues by providing native "*customized*" GUI components. Visual languages for programming may help and highlight only a few aspects of programming and manipulation of information structures. But, it is observed in [Gilmore and Green 1984, Green and Petre 1992] that the textual languages are more useful in learning the skills of programming such as comprehension, creation, documentation, modification and debugging and learning programming

EQUAL Design Principles and Rationale

EQUAL (*Easy, Quick, Universal, Accessible Language)* is a universal, human-centric, inclusive design methodology for the design, implementation and evaluation of textual languages for command, query, programming tasks and computing applications for native users, including native users with special needs [Patil et al., 2001a, Patil et al., 2001b].

Since, native users are novices, the research studies and empirical results in the fields of *Psychology of Programming [*Hoc and Nguyen, 1990, Dyck and Mayer, 1985, Rogalski and Samurcay, 1994] and *Novice Programming* [Mayer, 1981, Bayman and Mayer, 1983, Bonar and Soloway 1985, Boulay 1989] provide valuable insights and may be extended and integrated into the universal design of novice programming languages and computing environments.

It is observed that natural language-like constructs and commands are effective in the design of user interactions with the computer systems [Ledgard et al., 1980, Landauer et al., 1983, Biermann & Ballard, 1983]. Even the recent studies [Pane et al., 2001] demonstrate the concept of "*natural programming*". Natural programming does not mean that the native users should use their natural languages, but the languages of programming and interactions should be as "*natural*" as possible and able to "*mentalize*" the interactions, learn quickly and use effectively - *support of high degree of naturalness.*

Cognitive processes and structures, program constructs play a vital role in problem solving, programming and comprehension [Hoc and Nguyen, 1990, Rogalski and Samurcay 1994]. Such an understanding would lead to better programming languages whose syntactic structure more closely reflects internal semantic structures thereby easing the process of programming - *support closeness of mapping.*

The process of translating a programming plan into one that is compatible with the computer is a highly cognitive activity. The programming language should minimize the difficulty of this translation by providing high level primitives that match the operators in the programming plan and composition - *exploit cognitive dimensions of notations and information structures.*

The characteristics of the language and notational aspects play a vital role in acquiring the skills of programming. Avoid unnecessary and confusing operators, cryptic programming constructs, complex data structures and control statements - *keep it simple and effective.* From the basic guidelines and principles of usability engineering, the programming languages and computing resources should satisfy the needs, preferences and requirements of native users - *speak native users' languages.*

Salient Features of EQUAL Language

EQUAL is a simple, experimental, novice programming language mainly designed by taking into consideration the special needs and requirements of the native end-users, including visually impaired users. The design and rationale of the EQUAL language is discussed more detail in [Patil et al., 2001a]. Here we highlight the salient features:

- EQUAL language features are deliberately kept simple but have important features of programming to teach novice programming. Syntax is simple, readable, understandable and consistent with native user's knowledge. EQUAL supports simple data types, commands and statements and control constructs.
- The language "*vocabularies*" and programming paradigms are highly customizable to the universal needs and preferences.
- The computing environment is "*internationalized*" and supports divers time, date, currency, calendar, numeral standards and formats.
- The visually impaired native users can program using native Braille codes using suitable transcription mechanisms. The programming constructs and interactions (e.g., messages, errors, results etc) may be extended and enhanced with digitized speech and text-to-speech technologies in users' native languages.

EQUAL Programming Constructs

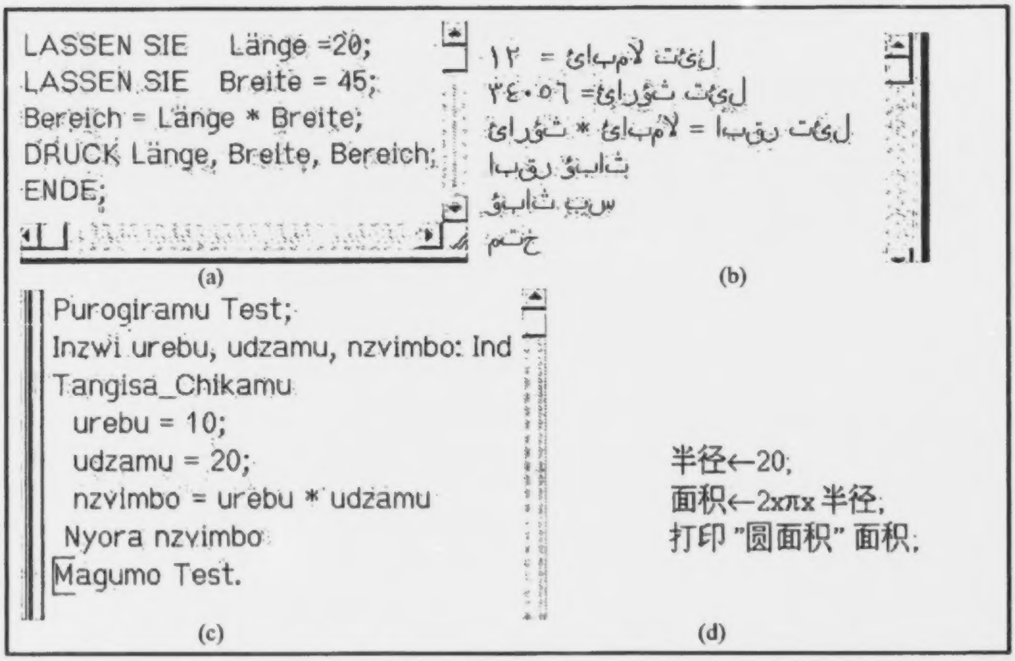
Variable Names, Values and Operators

The empirical studies in [Carroll 1978, Teasley 1994] have demonstrated that meaningful variable names and numerical values improved program comprehension and facilitate learning. For example, in a simple statement *Area_of_Circle: = 2 * PI * Radius*; may represented in EQUAL for Chinese user (Refer Fig 1d). In Arabic (Refer Fig. 1b), programs are written and displayed in bi-directional format and prefer 'five pointed star' or 'X' for multiplication operator. The assignment operator '=' may be represented by ' '. The general interpretation of statement termination symbols ';' varies considerably (e.g., ';' is used for question mark in Greek). The enclosing the string constants, also vary considerably (e.g., «string constant» in French,

„string constant" in German, etc.). The relational and logical operators are quite confusing and native users misinterpret their meaning and it is mainly due to lack of knowledge of Boolean algebra. EQUAL universal design framework supports these notational flexibility and adaptations, and EQUAL helps in easy comprehension and facilitates effective learning. These simple adaptations will reduce cognitive loads, avoid unnecessary frustrations and motivate native students to learn programming skills.

Command Names and Simple Statements

Both formal and informal observational analyses repeatedly identified names, naming and structural contexts as an important practical problem [Landauer at el., 1983]. The majority of assignment statements, input/output statements are simple imperative statements or commands and often take the form of **VERB** *<objects>* or *<objects>* **VERB** or mixed format. EQUAL supports the above formats and exploits the natural *"patterns"* of commands, programming constructs and information structures that are consistent with native languages and general communication conventions.



```
LASSEN SIE    Länge =20;
LASSEN SIE   Breite = 45;
Bereich = Länge * Breite;
DRUCK Länge, Breite, Bereich;
ENDE;
```

(a)

```
ليكن لامباى = ١٢
ليكن شوراى= ٣٤٠٥٦
ليكن رقبا = لامباى * شوراى
ثابق رقبا
سب ثابق
ختم
```

(b)

```
Purogiramu Test;
Inzwi urebu, udzamu, nzvimbo: Ind
Tangisa_Chikamu
  urebu = 10;
  udzamu = 20;
  nzvimbo = urebu * udzamu
 Nyora nzvimbo
Magumo Test.
```

(c)

```
半径←20;
面积←2xπx 半径;
打印 "圆面积" 面积;
```

(d)

Figure 1: Cropped screen shots of EQUAL programs in German (a), Arabic (b), (c) Zimbabwean-Shona and (d) Chinese versions.

Control Statements

Control strategies and looping constructs are very difficult concepts and demand high cognitive loads [Soloway et al., 1983]. It may be observed that, just by providing equivalent control and looping constructs in native programming language constructs may be insufficient and inadequate, some time quite misleading and confusing from the preconceived knowledge [Bonar & Soloway, 1985]. In IF-THEN statement or its variants, it is observed that [Pane et al., 2001] end-users use THEN for *"sequencing"* which contradicts the meaning of *"consequently"* in the formal languages. In REPEAT or WHILE control constructs, native users fail to understand the terminating or exit conditions. One effective design strategy is to *"map closely"* the natural semantics of native users' languages and concepts onto the formal semantics of programming. In the present state of research, explicit training is the best way to circumvent these difficulties.

EQUAL Implementation and Computing Environment

The basic design principle of the EQUAL language design and development environment is to separate the formal grammar, semantic concepts, syntactic and lexical components and represent them in a language independent, user defined profiles and culture neutral representations. From these design constrains and specifications, EQUAL design and development environment provides an integrated platform to generate automatically or semi-automatically language components, scanners, parsers and compilers/interpreters [Patil

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et al, 2001b]. Special morphological and linguistic knowledge is necessary to process complex languages. EQUAL uses Unicode, Java, XML and Compiler technologies and functional components may be deployed as standalone application or client-server architecture.

The EQUAL computing environment consists of *Code Window*, *Input Window*, *Output Window*, *Error Window* and *Help Window*. The native users can write EQUAL programs using Unicode compatible text editors and submit them for the compilation. The syntactic and semantic errors are displayed in the *Error Window* with necessary information to facilitate easy correction. In case of an error-free EQUAL program, the interpreter/compiler will execute the program on Java Virtual Machine (JVM). The *Input Window* expects the inputs to the program and generates the outputs in the *Output Window*. On-line help information and documentation is available in the *Help Window*. The error messages, dialogues, help information, training and learning resources are hand-coded and stored in separate files in native user preferred languages. EQUAL is flexible enough to incorporate pedagogical and learning modules.

Conclusions and Future Work

In this paper, we discussed the universal accessibility and usability issues of textual information structures, programming languages and computing environments from native users' perspective and developed a universal design framework and methodology for the design, implementation and evaluation of programming languages for computing tasks and applications. We highlighted universalization of textual languages as a basic strategy for the enabling, scaffolding and assistive technologies with necessary conceptual, semantic, syntactic and lexical adaptations in computer languages and computing environments. We also discussed the salient features of the EQUAL language in a few representative native user languages such as Arabic, Chinese, Zimbabwean and German. The EQUAL design methodology and computing environment is also flexible to incorporate native users' versions of Braille codes, digitized and text-speech technologies. We believe that, the EQUAL language and EQUAL computing environment provide a unique opportunity to the native users to learn programming and computing skills. We highlighted the general principles, guidelines and design methodology of EQUAL, but they are also applicable in different textual languages, programming paradigms, and textual applications. The experimental work is in progress and the implementation of complex data types, control constructs, usability studies and critical evaluations are planned in the future work.

References

[Bayman and Mayer, 1983] Bayman, P. and Mayer, R.E. (1983), A Diagnosis of Beginning Programmers' Misconceptions of BASIC Programming Statements, *Communications of the ACM*, Vol. 26(9), 677-679.

[Biermann et al 1983] Biermann, A.W., Ballard, W.B.W. and Sigmon, A.H. (1983), An Experimental Study of Natural Language Programming, *International Journal of Man-Machine Studies*, 18, 71-87.

[Bonar and Soloway, 1985] Bonar, J.and Soloway, E. (1985), Pre-Programming Knowledge: A Major Source of Misconceptions in Novice Programmers, *Human – Computer Interaction*, Vol. 1, 133-161.

[Carrol l, 1978] Carroll, J.M. (1978), Names and Naming*: An Interdisciplinary Review*. IBM Research Report RC 7370, 1978.

[Coombs et al. 1982] Coombs, M.J., Gibson,R. and Alty, J.L. (1982), Learning a First Computer Language: Strategies for Making Sense, *International Journalof Man-Machine Studies*, Vol. 16, 449-486.

[Dyson, 1997) Dyson, E. (1997), Education and Jobs in the Digitial World, *Communications of the ACM*, Vol. 40(2), pp.35-36.

[Ebrahimi, 1994) Ebrahimi, A. (1994), Novice Programmer Errors: Language Constructs and Plan Composition, *International Journal of Human-Computer Studies*, 41, 457-480.

[Gilmore and Green, 1984] Gilmore, D. J. and Green, T.R.G. (1984), The Comprehensibility of Programming Notations, *HCI-Interact'84: Proceedings of the IFIP Conference Organised by Task Group on HCI*, London, U.K, 461-464.

[Green and Petre, 1992] Green, T.R.G. and Petre,.M. (1992), When Visual Programs are Harder to Read than Textual Programs, *Human-Computer Interaction:Tasks and Organisation, Proceedings of ECCE-6 (6th European Conference on Cognitive Ergonomics)*, van der Veer, G.C, Tauber, M.J., Bagnaroa, S and Antavolts, M (Eds)., Rome, Italy.

[Hoc and Nguyen, 1990] Hoc, J.M and Nguyen-Xuan (1990), A, Language Semantics, Mental Models and Analogy, *Psychology of Programming*, Hoc, J.M, Green , T.R.G, Samurcay, R and Gilmore, D.J (Eds.), Academic Press, London, 1990, 139-152.

[Landauer et al, 1983] Landauer, T.K., Glotti, K.M. and Hartwell, S. (1983), Natural Command Names and Initial Learning: A Study of Text Editing Terms. *Communications of the ACM*, 26, 495-503.

[Ledgard et al, 1980] Ledgard, H., Whitehead, J.A., Singer, A. and Seymour,. W. (1980), The Natural Language of Interactive Systems, *Communications of the ACM*, Vol. 23, 556-563.

[Madon, 2000] Madon, S. (2000), The Internet and Socio-Economic Development: Exploring the Interaction, *Information Technology and People*, Vol.13(2), 85-101.

[Mayer, 1981] Mayer, R.E. (1981), How Novices Learn Computer Programming, *Computing Surveys*, Vol. 13(1), pp.121-141.

[Miller, 1981]Miller, L.A. (1981), Natural Language Programming: Styles, Strategies and Contrasts, *IBM Journal,*Vol.20(2), 184-215.

[Pane et al, 2001] Pane J.F, Ratanamahatana , C.A and Myers B.A (2001), Studying the Language and Structure in Non-programmers's Soultions to Programming Problems, *International Journal of Human-Computer Studies*, Vol 54, No. 2, 237-264

[Patil et al, 2001a] Patil, Basawaraj., Maetzel, K. and Neuhold, E.J. (2001a), Design and Implemenation of Universal End-User Commands, Interfaces and Interactions, *UAHCI, 2001, New Orleans, USA, 516-520.*

[Patil et al 2001b] Patil, Basawaraj., Maetzel, K. and Neuhold, E.J. (2001b), Native End-User Languages: A Design Framework, *13th Annual Workshop on Psychology of Programmng, Bournmouth, UK, 113-126.*

{Rogalski and Samurcay, 1994] Rogalski, J. and Samurcay, R. (1994), Acquisition of Programming Knowledge and Skills. *Psychology of Programming,* Hoc, J.M.,Green, T.R.G., Samurcay, R. and Gilmore, D.J (Eds), Academic Press, London, 157-174.

[Rogers, 2000] Rogers, P.L. (2000), Barriers to Adopting Emerging Technologies in Education. *Journal of Educational Computing Research*, Vol.22 (4), 455-472.

[Shneiderman, 2000] Shneiderman, B. (2000), Universal Usability, *Communications of ACM*, Vol. 43(5),pp.85-91.

[Soloway, 1983] Soloway, E., Bonar, J., and Ehrlich, K. (1983), Cognitive Strategies and Looping Constructs:An Emperical Study, *Communications of the ACM*, Vol. 26(11), 853-860.

[Teasley, 1994] Teasley, B.E. (1994), The Effects of Naming Style and Expertise on Program Comprehension, *International Journal of Human-Computer Studies*, 40, 757-770.

The Portal Project: Video Windows Between Cultures

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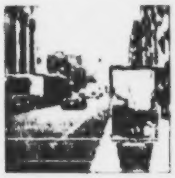
Abstract: This paper describes the pilot portal project, involving development of public installations in two distant locations, which will act as portals into each other. The current state of the world is calling for new means of world-wide communication and understanding. The Portal Project is a work in progress. Its objectives are to connect people and places, and to encourage broad cultural and environmental observation and reflection. Portals will be supported by a network of cameras streaming live video which is received and projected by plasma screens in other locations and collectively displayed at a website. The video installations will promote awareness and communication among participating foreigners.

Introduction

The Portal Project will bring together people and places in a way that has become possible only through the advent of modern communication technologies, via live video web streams. Unlike more traditional art projects that usually happen at a specific place and time, for those particular observers who choose to participate, the Portal Project installation creates a framework of experience to facilitate cross-cultural interaction at the most basic, passive, everyday level.


New York, US 11:20

Vienna, Austria 5:20

Imagine this: While taking a break from work at 11:20 in New York, right next to the fed ex truck, you will be able to look into Vienna, where idle Austrians enjoy an afternoon stroll. You may even make a friend and arraign to meet on sixty-first and Lexington in New York and Stephansplatz in Vienna.

Rationale

Cities are complex environments, comprised of people, social interactions, communities, architecture, invention, history, etc, offering offer rich learning opportunities. However, our everyday lives make the meanings of the city and the dilemmas coexisting in it remain unseen. We become accustomed to them as part of our visual environment and they no longer provoke our reflection (Greene, 1978). Art, and urban installations, have the potential to make these resources more evident for us.

The installation inserts itself in the city landscape intercepting people in their daily existence. It calls for being seen and, in the same process, makes the city itself visible by its inhabitants. It provides an opportunity to bring the background to the stage. By including the mediational device, the images of a spot in a city get the status and attention of a spectacle. This project, inspired by Kit Galloway and Sherrie Rubinowitz's 1974 installation "Hole in Space," allows for taking a look at the lives, faces, spaces, and reactions of the others; people from another city and culture. This is a chance for seeing but also a chance for awareness of being seen. And being seen in a way that we don't know ourselves - by other eyes, by other culture, as others.

New York and Vienna are dissimilar and alike. Almost the same neutral space of the central touristy area exists in every city, an equivalent functional place, crossed by city people with similar concerns, walking on avenues and squares. Big cities' spaces are common to all big cities around the world in globalization, where people are always in transit with their bodies and sensibilities.

Our present time highlights the need for cultures to find new ways of communicating and of seeing each other and themselves. American people and all cultures are subject to stereotyped perceptions of the others, of us, and of conflict – in which the media plays a mayor role. The Portal Project intends to provide a different, less censored and less edited insight opportunity for understanding. It intends to provoke questioning, confusion, reflection, awareness. And in this process of identification and differentiation, it intends to mobilize citizens of distinct cultures in active explorations of the complex world community within which we are all connected. If we are successful with this pilot connection, we will expand to other connections between locations of similar and dissimilar environments and cultures.

Design and Technology

Much like backlit print advertisements at bus stops, the Portal Project uses a metallic frame to become integral part of the city landscape and our daily visual experience as inhabitants of our cities. Instead of print, however, this metallic structure contains a 50" plasma television screen. The moving images are a live video feed, streamed over the Internet, from an identical box located in Vienna. Both boxes, hidden on top of the structure, contain a network video camera connected to the Internet via a high-speed connection. These boxes, therefore, become windows into a different city and culture. Like a window, they provide a view into a different environment, as well as becoming part of the familiar one.

Complementary WWW Site

The website will include the live images of the two locations one next to the other on the screen. The two sites and the reactions of people looking at the screens may be seen by any website visitor. The site will include a discussion forum and chat room for the observers to discuss these views. Links to useful resources, such as online translation dictionaries and cultural historical references, will be provided. An archive of selected video clips and discussions will create a record of the participation of the users and viewers in the installation. This archive, as well as the experiences of comparing the two screens and/or of being in the location of one city will be the basis for educational activities designed for school and museum groups.

Future Directions

The project is in its early stages. Our near future goals are to establish corporate, government, school and museum partnerships. We are seeking partnerships with organizations wishing to promote their products by donating their use. We are looking for the provision of space in the ideal locations, balancing public access and security, in each city. We are also seeking partnerships with schools and museums to collaborate in the development of supplementary educational materials provided on the web site. This methodology can be exported and expanded by altering the locations and connections in the network. For example, other projects may be intended to remind city folk of non-human aspects of nature, involving live-video feeds from cameras in remote outdoor locales to projections in cities, or they might support/build/highlight the connection between people of similar ethnic origin living across the world.

Reference

Greene, Maxine (1978) *Landscapes of Learning*. NY: TC Press.

Reusable Models of Pedagogical Concepts - a Framework for Pedagogical and Content Design

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Abstract: Standardization initiatives in the field of learning technologies have produced standards for the interoperability of learning environments and learning management systems. Learning resources based on these standards can be reused, recombined, and adapted to the user. However, these standards follow a content-oriented approach. The process of applying pedagogical concepts is not covered by these standards. In the last years, several approaches for pedagogical and didactical concepts have emerged, but their use within a framework of standards is not yet consistently solved. Therefore, a model is presented which combines pedagogical and content-oriented design. The model, based on the Essen Learning Model, is a basis for the reuse and recombination of pedagogical expertise.

Introduction

Development processes of learning environments have changed significantly in the last years. The enormous cost for multimedia production led to the consequence that a high amount of end-users are necessary to be efficient. Learning resources have to be adapted and updated in shorter periods of time. Furthermore, learning environments must be individually tailored to the users needs and preferences in order to optimize the learner's performance.

Standardization is a means to ensure interoperability between systems. Both, learning management systems and learning environments have been subject of standardization initiatives. These initiatives, such as IEEE Learning Technology Standards Committee (LTSC), Instructional Management Systems (IMS)-Project, or the Advanced Distributed Learning Network (ADLNET) have developed a broad range of standards, from high-level specifications for architectures to bindings for certain components. However, most of these approaches focus on the reuse of content. These specifications do not provide adequate concepts for modeling pedagogical concepts. As a consequence, several approaches of pedagogical models, such as Educational Modeling Language (EML) or Tutorial Modeling Language (TML) are being developed. These models cannot be seen as a substitute for content-oriented standards. Moreover, a framework for the combination of content-oriented standards and pedagogical approaches is needed to model a complex learning environments.

In this paper, an approach is presented providing a framework for the description of pedagogical and didactical concepts. The approach is based on the Essen Learning Model (ELM). ELM is a development model for the development of learning environments. It provides support for developers, designers, content providers, teachers, and learners on various levels. Processes and activities in project management, quality assurance, curriculum development, course design, and implementation are supported. Furthermore, the specification of learning technology standards is integrated in this model.

First of all, related standards are presented. It is shown how these standards provide a framework for the interoperability of learning environments. Secondly, related approaches for pedagogical concepts are presented. Furthermore, an introduction to relevant aspects of the Essen Learning

Model is given. We focus on the aspects of modeling pedagogical concepts. As a conclusion, further research activities are suggested.

Learning Technology Standards

Learning Technology Standards are being developed by several initiatives. In this section, the relevant standards for learning environments are presented. Currently, two standards have reached a high level of maturity (Pawlowski, Adelsberger 2001a, Pawlowski 2001): Learning Object Metadata (LOM) and the Sharable Content Object Reference Model (SCORM).
Learning Object Metadata (LOM) is a standard by the IEEE Learning Technology Standards Committee (LTSC) for the description of learning resources (LTSC 2001). LOM are used to describe learning resources, such as learning environments. For this purpose, nine categories are included: General, Lifecycle, Meta-Metadata, Technical, Educational, Rights, Relation, Annotation, and Classification. This standard is useful to describe general characteristics of learning environments to facilitate search, retrieval, and reuse of learning resources. However, the description of educational aspects is limited to a generalized summary (e.g., interactivity type, learning resource type, interactivity level). This classification cannot be used to represent detailed information on pedagogical and didactical concepts used in a learning environment.
The Sharable Content Object Reference Model (SCORM) (Dodds 2001a, Dodds 2001b) by the *Advanced Distributed Learning Network (ADLNET)* is a standard to ensure interoperability between Learning Management Systems (LMS) and learning environments. SCORM integrates LOM and the content aggregation model which is a standard to represent the structure of a learning environment and relations of learning units. The run-time environment in SCORM is the interface between LMS and learning environments. It controls the sequence of a learning environment by integrating the Computer Managed Instruction (CMI) standard (LTSC 2000). This standard can be used to represent courses and learning environments. However, the focus of this standard is to combine and control learning environments. The main aspect is to model content and its structure. Although the structure can implicitly contain a pedagogical approach, no pedagogical concept is used to determine the structure, navigation, or other adaptations.
Both standards serve as a base for interoperable description and reuse of learning environments and learning resources. However, these standards need individual extensions in order to apply pedagogical concepts.

Pedagogical Models

The current representation of metadata such as LOM does not provide an adequate representation of pedagogical concepts (Koper 2001, Pawlowski 2001). Additionally, there is no adequate mapping of content-oriented representation to a pedagogy-oriented representation. A variety of models have been developed in order to close this gap.
The *Tutorial Markup Language (TML)* (Netquest 2000) is a markup language for the development of tutorial systems. Questing and problem-solving scenarios can be specified through questions, answers, rules, and help functions. It is possible to develop simple tutorial systems. However, only certain didactical approaches can be realized using TML.
The *Instructional Material Description Language (IMDL)* (Gaede 2000) represents structure, content, assessments, metadata, and a learner profile. The approach strictly follows an instructional design approach. Therefore, it restricts the pedagogical design. It is not flexible enough to model any given pedagogical approach.
A promising approach for the representation of pedagogical concepts is the Educational Modeling Language (EML) (Koper 2001) which is based on a meta-model for pedagogical modeling. It focuses on the embedding of learning resources in a pedagogical context. The metamodel consists of four components:

- *Theories of learning and instruction* describe theories, principles, and models of learning and teaching. The model distinguishes between empiricist, rationalist, pragmatist-sociohistoric, and eclectic theories.
- The *Learning Model* describes the interactions of learners in specific learning situations.
- The *Domain Model* represents the domain in which a learning environment is used.
- The *Unit of Study Model* describes the design of learning units depending on learning theories, learner models and domain models. The following categories are included in this model: Unit-of-study, Metadata, Roles, Learning-objectives, Prerequisites, Content, Activity, Environment, Method.

EML provides a promising representation of content and pedagogical concepts. Currently, there is no mapping to other standards such as SCORM. In order to use both standards, a common framework must be specified.

Essen Learning Model (ELM)

ELM Development Model

The Essen Learning Model is a modular system (Fig. 1) supporting development processes as well as the system's use on different levels: the support of curriculum design (C-level), the development of learning sequences (D-level), and the development of learning units (E-level) (Adelsberger, Bick, Pawlowski 2000, Pawlowski, 2000, Pawlowski, 2001). Three abstraction levels can be distinguished: The *generic development model* provides knowledge for a variety of contexts. This generic model is customized depending on the users' needs and preferences, and transformed into a specific process model for each development project. The *process model* is implemented using the Architecture of Integrated Information Systems (ARIS) and provides a framework for educational technology projects. ARIS is a frame concept for a global description (modeling) of computer supported information systems, covering the whole life-cycle range - from business process design to information technology deployment (Scheer, 1998). The third level is the *result* of the development process in the form of certain implementations for each module.

Figure 2 represents the main processes of the Essen Learning Model. The result of ELM-C is a detailed network of learning objectives and goals, determining structure and relations of learning sequences (e.g. courses). Based on these results, learning sequences are developed in ELM-D. The focus of this phase is to find an adequate didactical method together with the right technology depending on learning objectives and user groups. Finally, single learning units are designed and implemented in ELM-E, using the Extensible Markup Language (XML).

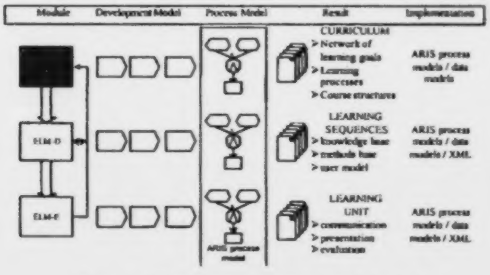
Module
Development Model
Process Model
Result
Implementation
ELM-D
ELM-E
CURRICULUM
> Network of learning goals
> Learning processes
> Course structures
ARIS process models / data models
LEARNING SEQUENCES
> knowledge base
> methods base
> user model
ARIS process models / data models / XML
LEARNING UNIT
> communication
> presentation
> evaluation
ARIS process models / data models / XML
ARIS process model

Fig. 1: The Essen Learning Model

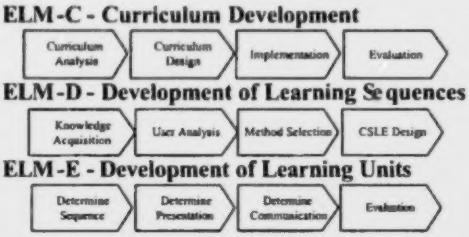
ELM-C - Curriculum Development
Curriculum Analysis
Curriculum Design
Implementation
Evaluation
ELM-D - Development of Learning Sequences
Knowledge Acquisition
User Analysis
Method Selection
CSLE Design
ELM-E - Development of Learning Units
Determine Sequence
Determine Presentation
Determine Communication
Evaluation

Fig. 2: Main process of ELM

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Modeling Pedagogical Concepts in ELM

Modeling pedagogical concepts mainly consists of three processes in ELM:

Context Modeling: Learning cannot be separated from the context. The context includes the environment of the learner (e.g., institution, organization, company) and the learner's experiences and knowledge. The context is analyzed on two levels: A description of the learner's characteristics and preferences and the organization the learner is involved in.

Content Modeling: The content of a learning environment is described on three levels: learning sequences, composite learning units, and learning units. These levels correspond to the structure of SCORM (Content, Block, Sharable Content Object).

Didactical Modeling: Didactical concepts are directly related to the leaner (actor), learning objectives, learning setting, and the description of a method (see Fig. 3). The description of a method consists of phases (activities) which can be grouped to phase blocks. Furthermore, experiences and the usability of a method for certain content, settings, or learning objectives is described (see Bick, Pawlowski, Veith 2001). By this description, a knowledge base for didactical methods is created. Designing a learning environment means that the context, content, and didactical method must be related. As an example, the method "simulation game" consists of the phases introduction, motivation, activity/interaction, reflection, abstraction, and analysis/feedback. These phases are mapped to learning units. The mapping of learning units to phases provides the connection between the pedagogical model and the content model (e.g., SCORM).

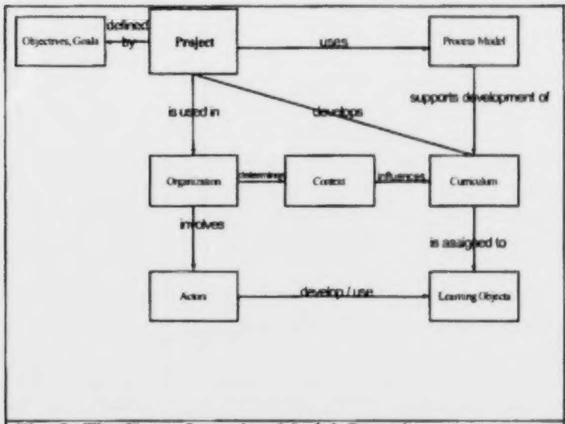
Objectives, Goals
defined by
Project
uses
Process Model
is used in
develops
supports development of
Organization
determines
Context
influences
Curriculum
involves
is assigned to
Actors
develop / use
Learning Objects

Fig. 3: The Essen Learning Model Overview

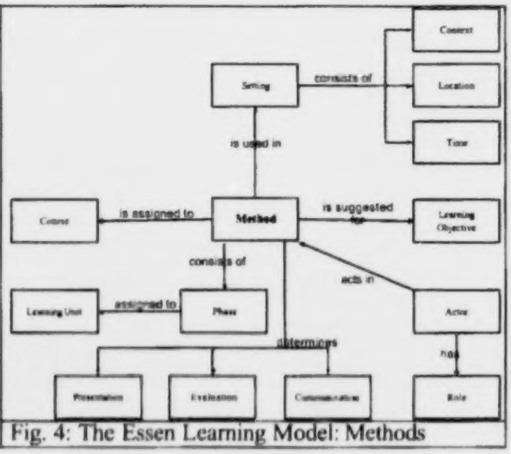
Context
Setting
consists of
Location
Time
is used in
Course
is assigned to
Method
is suggested for
Learning Objective
consists of
acts in
Learning Unit
assigned to
Phase
Actor
determines
has
Presentation
Evaluation
Communication
Role

Fig. 4: The Essen Learning Model: Methods

The model of a pedagogical concept consists of the three main components (context, content, and method). In Table 1 the information model for methods is described.

Table 1: Information Model Method

Category	Description
General Data	
Dublin Core	Dublin Core-Elements
Reference	Reference to external information model

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Category	Description
Description	
Name	Name of the method
Source	Source of the method
Recommendation	Recommendation for context, learning objectives, content, actor
Template	Reference to a template, template format
Setting	
Context	Reference to context specification
Location	Location, Distribution
Time	Period, temporal restrictions
Phases	
Phase	Name of a phase of the method, aggregation
Kind	Kind of a phase (grouping to phase blocks)
Sequence	Relation to other phases, sequence, schedule, sequence operator (linear, parallel, free)
Runs	Repetitions of a phase
Interaction	
Description	Description of intended / possible interactions
Role	Role of participating actors, description of role
Type	Type of interaction
Topology	Unidirectional, bidirectional
Kind	Synchronous, asynchronous
Applications	Communication applications/systems
Reference	Reference to external interaction specification
Presentation	
Type	Type of presentation object
Applications	Presentation application
Reference	Reference to external presentation specification
Evaluation	
Kind	Kind of evaluation (Test, Scenario, …)
Applications	Reference to evaluation application
Evaluation	Reference to learning object evaluation

Conclusion

In this paper, the weaknesses of current standards have been identified. Learning technology standards such as LOM and SCORM focus on content-oriented models of learning. The representation of pedagogical concepts is neglected in these model. It has been shown that most existing pedagogical models do not provide a generic representation for pedagogic expertise. The Educational Modeling Language (EML) is a step towards a generic representation. However, pedagogical specifications and other existing standards need to be mapped into a common framework. The Essen Learning Model provides this framework by integrating existing standard with a generic pedagogical model. This model serves as a base for a high-quality design of learning environments from a pedagogical and content perspective.

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References

Adelsberger, H.H., Bick, M., Pawlowski, J.M. (2000). The Essen Learning Model - A Step Towards a Standard Model of Learning Processes. In Bordeau, J., Heller, R. (Eds.): *Proc. of ED-MEDIA 2000, World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Charlottesville, VA: AACE.

Adelsberger, H.H., Körner, F., Pawlowski, J.M. (1998). A Conceptual Model for an Integrated Design of Computer Supported Learning Environments and Workflow Management Systems, *Proc. of Teleteaching '98: Distance Education, Training and Education*, XV. IFIP World Computer Congress, IFIP Vienna.

Baumgartner, P., Payr, S. (1998). Learning with the Internet - A Typology of Applications. In *Proceedings of ED-MEDIA 1998, World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Freiburg, Germany, 1998.

Bick, M., Pawlowski, J.M., Veith, P. (2001). The Essen Learning Model - A Step Towards a Representation of Learning Objectives. In: Montgomerie, C., Viteli, J. (Eds.): *Proc. of EDMEDIA 2001, World Conference on Educational Multimedia, Hypermedia & Telecommunications*. AACE, Charlottesville, VA 2001.

Bloom, B.S. (1973). *Taxonomy of educational objectives, Handbook I: Cognitive Domain*. David Mc Kay.

Dodds, P.(Ed.) (2001a). *Advanced Distributed Learning Initiative - Sharable Courseware Object Reference Model – SCORM, Version 1.1.* [WWW Document] URL http://www.adlnet.org/scorm/ docs/SCORM_2.doc, last access 2001/07/25.

Dodds, P.(Ed.) (2001b). *Advanced Distributed Learning Initiative - Sharable Content Object Reference Model – The SCORM Overview, Version 1.2.* [WWW Document] URL http://www. adlnet.org/ library/documents/scorm/specifications/SCORM_1.2_Overview.pdf, 2001-10-01, last access 2001/11/01.

Gaede, B. (2000). Die Instructional Material Description Language und das Produktionssystem für interaktive Lernsoftware ProfiL [The Instructional Material Description Language and the priduction system for interactive learning software ProfiL]. 10. Arbeitstreffen der GI-Fachgruppe Intelligente Lehr-/Lernsysteme, Hamburg 2000.

IEEE Learning Technology Standards Committee (2000). *Draft Standard for Computer-Managed Instruction (CMI), Version 3.4.* [WWW Document] URL http://ltsc.ieee.org/doc/wg11/CMI-Sem34.doc, last access 2001/05/30.

IEEE Learning Technology Standards Committee (2001). *Draft Standard for Learning Object Metadata, Version 6.1.* [WWW Document] URL http://ltsc.ieee.org/doc/wg12/LOMv6.1.html, 2001/05/12, last access 2001/05/30.

Koper, R.: *Modeling units of study from a pedagogical perspective – the pedagogical meta-model behind EML.* [WWW Document] URL http://eml.ou.nl/introduction/articles.htm, last access 2001/07/01.

Netquest (2000): *Tutorial Markup Language (TML)*. [WWW Document] URL http://www.ilrt.bris.ac.uk/netquest/liveserver/TML_INSTALL/doc/tml.html, last access 2000/09/25.

Pawlowski, J.M. (2000). *The Essen Learning Model - A Multi-Level Development Model.* In Staff and Education Development International 4 (2000).

Pawlowski, J.M. (2001). *Das Essener-Lern-Modell (ELM): Ein Vorgehensmodell zur Entwicklung computerunterstützter Lernumgebungen [The Essen-Learning Model (ELM): A Development Model for the Development of Computer-Supported Learning Environments].* Dissertation. University of Essen, Germany.

Pawlowski, J.M., Adelsberger, H.H. (2001a). Standardisierung von Lerntechnologien [Standardization of Learning Technologies]. *Wirtschaftsinformatik 43* (2001) 1.

Pawlowski, J.M., Adelsberger, H.H. (2001b): Electronic Business and Education. In: Adelsberger, H.H., Collis, B., Pawlowski, J.M. (Eds*)*: Handbook on Information Systems for Education and Training. In: Bernus, P., Blazewicz, J., Schmidt, G., Shaw, M. (Series Eds.): *International Handbook on Information Systems.* Springer, Hamburg 2001.

Suess, C. (2000). Adaptive Knowledge Management: A Meta-Modeling Approach and its Binding to XML. In: *H.-J. Klein (Ed.), 12. GI-Workshop Grundlagen von Datenbanken, Plön, TR 2005, Christian-Albrechts-Universität Kiel, Germany*, 2000.

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Essential Elements in the Design and Development of Inclusive Online Courses

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Abstract

This paper discusses the issues that we consider central to accessible online education. A recent research project investigated the accessibility of online courses for students with disabilities by evaluating existing courses, developed by academics at the University of New South Wales (UNSW). The evaluation revealed evidence that some aspects of the courses were inaccessible, but that with careful design guidance and awareness of the needs of students with disabilities, those courses could be made more accessible. As a result a set of Guidelines for Accessible Online Courses was produced (Pearson & Koppi 2001) specifically to aid academic developers of online courses with limited technical ability.

However, these guidelines assume that the academic developer understands and accepts the issues related to inclusive design and development. We decided therefore to take a step back and use our experience and the knowledge gained through researching the guidelines to identify the specific issues that one needs to consider, and the required skills to understand inclusion and accessible design. The issues were encapsulated into five major themes: legal or quality assurance requirements; awareness of and the ability to use the available guidelines and protocols; some understanding of the assistive technologies used by students with disabilities; awareness of designing for inclusion; and understand and apply the checking tools and mechanisms that are available

These themes have been incorporated into a series of face-to-face workshops and an online course offered in flexible mode, aimed at assisting the academic in understanding both the broader issues of accessibility, and in developing the skills and knowledge for accessible course design.

Background

Our own research (Pearson, 2001) and others (Grimaldi and Goette, 1999) have noted the liberating effect for students with disabilities being able to access learning materials and resources on the web. However, the same research concludes that students may have particular needs which need to be addressed in the design of online course and learning materials and which can in fact present further barriers to inclusion. Some examples include:

- students with vision impairments may use screen magnifiers or screen readers
- those with hearing impairment may need captioning or commentary for video and other multimedia
- students with learning disabilities such as dyslexia might use speech recognition software for data input
- people with other disabilities including aphasia or colour blindness need clear access to structure, careful use of colour, and consistent organization of learning materials
- students with physical disabilities may use alternative input mechanisms and need easy navigation

All of these requirements have an impact on the way the student interacts with a learning environment. Furthermore, some students might not be fluent in the language of study or there could be other technical barriers e.g., a slow modem or they might be using a text-only browser – all of these things can present further barriers to access. While many of the adjustments, which make sites accessible for use with screen readers, also provide effective access for others with disabilities; that is not always enough. Careful design – particularly in the context of online learning – can mean more effective access for all students and provide a better experience for all.

Partners

This work is a collaborative project between University of New South Wales (UNSW), and University of Teesside (UoT). UoT provide the research expertise in special needs and accessibility, while UNSW contribute the technical expertise and resources. The courses have been developed for staff development purposes at UNSW and for a Masters level module for Multimedia students at UoT.

Introduction

As a result of a research project (supported by the Leverhulme Trust, UK) which set out to investigate the accessibility of online courses (in this case courses developed in WebCT), we produced a set of guidelines for accessible online courses (Pearson & Koppi, 2001). The guidelines were based on those produced by the Web Accessibility Initiative (http://www.w3.org/WAI/) but have been designed specifically to aid academic developers of online courses with limited technical ability. The guidelines constitute a handbook and guide for academic developers for the design and implementation of online courses. They provide advice, practical examples, references and links for the designer. The guidelines are available to staff at UNSW, but also to anyone requesting them both in print and online (in an accessible format).

Following on from this research and the resultant guidelines, we set out to explore the extent to which the guidelines can be used as a basis for staff development and to encourage prospective online course designers to develop courses which are accessible and inclusive for all students. We used the Guidelines first as a basis for the development of a face-to-face workshop concerned with accessibility. The workshop was used not only to train Teaching Fellows in accessible design, but also as a pilot for the creation of an online course in accessible design. Our experience of the face-to-face workshop provided us with the opportunity to reflect on the process, the content and the tasks and consider how they could be translated to a flexible mode(Koppi and Pearson, 2002).

Five major themes were identified which we considered desirable for the academic to understand, appreciate or develop skills in for accessible design. These five themes encompass:

- legal or quality assurance requirements;
- awareness of and the ability to use the available guidelines and protocols;
- some understanding of the assistive technologies used by students with disabilities;
- awareness of designing for inclusion; and
- understand and apply the checking tools and mechanisms that are available.

The workshops and online course were developed to cover these five areas. The remainder of this paper discusses each of these areas and how they relate to the development of accessible online courses and the designer's role in meeting the requirements of students with disabilities.

Legal and Quality Assurance Considerations

The rights and needs of students with disabilities are now recognised in the Special Educational Needs and Disability Act 2001 and through changes to the Disability Discrimination Act 1995 in the UK, the Disability Standards for Education under the Disability Discrimination Act 1992 in Australia, and the section 508 of the Americans with Disabilities Act in the USA. Those developing courseware need at least to be aware of the acts and take this into consideration in the provision of online resources.

However, it is perhaps more relevant for academics to consider accessibility in terms of quality assurance and the Quality Assurance Agency's (QAA) (in the UK) expectations of Higher Education Institutions in complying with legal obligations. The QAA set out 24 precepts or standards that institutions are expected to meet, including treating students with disabilities as part of the academic community. Possible action includes:

- accessible Web and Intranet sites, and alternative formats for programme details and other information;
- adaptation of course material (including electronic material) and course delivery to ensure access; and

- training staff to use relevant technology and to produce accessible electronic courseware, (JISC, 2001).

Guidelines and Protocols

Web designers and course developers need to be aware of and be able to use the guidelines to ensure that their web sites and courses are compliant with the W3C thereby meeting basic accessibility requirements.

The W3C guidelines for accessible web design are, at present, quite technical in nature and lack examples. Although the WAI are working on developing a more user friendly set of guidelines, the Pearson and Koppi (2001) Guidelines for Accessible Online Courses, are designed to assist the average non-technical academic designer who is developing online learning materials and resources. They consist of a set of tips, techniques, examples, references and links to other sources of information to help the developer to produce accessible courses. There are also other guidelines, most of which are based on those developed by the WAI at W3C, relating to the design of web sites in general.

Assistive Technologies

Assistive or enabling technologies are devices, hardware or software, which enable people with disabilities to use the computer. Examples of assistive technology include screen readers (such as JAWS), screen magnifiers, alternative keyboards or input devices, voice recognition software and text-only browsers. Some experience in the use of these devices is beneficial for the courseware developer. It helps to understand the way that students interact with the online environment and the overheads that the use of such technology can involve, including difficulty in navigation and the extra time that may be required. Experience in interacting with the learning environment using assistive technologies can also highlight their limitations when used with certain features e.g., chat rooms. Some assistive technologies (e.g., screen magnifiers, high contrast screen settings) can also be used for simple accessibility checks.

Designing for Inclusion

Design is central to the whole issue of accessibility and in this context we are really referring to learner-centred design (Pearson & Green 1999), which means understanding and considering who the user is, what their needs are, what you want them to learn, how they are going to learn it, and how you are going to support them in achieving their learning objectives (McLoughlin and Marshall, 2000; and Winnips, 2001). In addition, we need to consider structural, navigational and interface design, and we also need to think about designing accessible resources and documents.

Accessible document design requires some forethought and skill to be accessible to those using assistive technologies. The academic designer needs to consider the structure and appropriateness of their documents as well as the format in which they are presented. PDF documents, for instance, can be a particular problem. With the correct tools and skills, however, many PDF and other documents can be made accessible.

Checking tools and mechanisms

Checking tools can be used for either checking documents for accessibility before they are published or to check an existing web site online. There is a number of tools, or mechanisms, available.

BOBBY (CAST 2001) can be used to check single pages online, or can be downloaded to check entire web sites on payment of a license fee. It provides checks on the accessibility of web pages in accordance with the W3C guidelines and the requirements of ADA section 508. The checks are, however, largely functional and many design elements require a manual check.

A-Prompt (Accessibility Prompt 2001) evaluates web pages for accessibility barriers and making repairs to correct those problems. A-Prompt is also based on the W3C guidelines and is made available free of charge through the University of Toronto and the University of Wisconsin.

Authoring tools such as Macromedia Dreamweaver include a number of plug-ins or extensions that enable accessibility checks of web pages as they are developed. These extensions include the ability to evaluate and fix some accessibility problems to meet the requirements of the W3C guidelines and the ADA 508 requirements.

There are tools available within Internet Explorer or as Windows utilities that might be used by people with disabilities and that are available to any PC user at no additional cost. So that, for instance, you can use the screen magnifier or switch off graphics to check what the site would look like to someone who either doesn't use graphics or can't see them.

Conclusion and Further Developments

Taking all of these themes into consideration, the legal and quality assurance obligations; the guidelines that are available for us to follow; awareness of and an ability to use some of the assistive technologies that people with disabilities use; particular attention to the design of learning environments; and being able to use the checking tools that are available, we have created a course which will give students of multimedia and staff developing online courses the opportunity to investigate and develop skills in each of these areas. At the end of the course the participants will be well equipped to both understand and undertake the development of accessible online courses. It is important that course designers both understand the need for accessible courses but also that they are equipped with the skills and resources necessary to be able to do that.

Further developments will include adapting the course to cater for the needs of the more technical web developer to encompass techniques in the development of accessible multimedia, such as video streaming; and understanding of the accessibility features, claims and limitations of software products such as Adobe and Macromedia.

The next stage of the process is to evaluate and compare the face-to-face workshops and the online course in practice to determine its effectiveness and requirements for enhancement.

References

A-Prompt, Adaptive Technology Resource Centre, http://aprompt.snow.utoronto.ca/, accessed 18/12/01

CAST (2001) http://www.cast.org/bobby, updated16 December 2001, accessed 17 December 2001

JISC (2001) "Disability Technology and Legislation: New Pressures and New Opportunities for Further and Higher Education Institutions and Staff", JISC Senior Management Briefing Paper, September.

Grimaldi C & Goette T, (1999), "The Internet and the Independence of Individuals with Disabilities", *Internet Research: Electronic Networking Applications and Policy*, Vol. 9 No 4, pp 272-80

Koppi, A.J. & Pearson E. J, (2002), "Design and development of a flexible online course for making accessible online courses", Paper submitted to ED-MEDIA, Denver, June

McLoughlin, C., & Marshall, L. (2000), "Scaffolding: A model for learner support in an online teaching environment", Paper presented at the Flexible Futures in Tertiary Teaching Forum, Proceedings of the 9th annual Teaching Learning Forum, 2-4 February 2000, Perth: Curtin University of Technology

Pearson E. J. (2001) "Strategies for Developing Inclusive Online Courses", WebCT Asia-Pacific Conference, Adelaide, Australia, April 10

Pearson E. J & Green S.J (1999) "Courseware –Engineering or Design?", proceedings, ALT-C conference, Bristol, UK, September.

Pearson, E and Koppi, T (2001), "Guidelines for Accessible Online Courses", Internal publication of University of New South Wales, http://www.edtec.unsw.edu.au

Web Accessibility Initiative (WAI) http://www.w3.org/WAI/

Winnips, K, (2001) "Scaffolding the development of skills in the design process of educational media through hyperlinked Units of Learning Material (ULMs)," University of Twente, Netherlands, (last accessed 9/11/01)

Guidance for a Learner Using an Aided Learning-to Read Software

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Abstract: The design of resource software intended for learning raises various problems. In this paper we shall deal with one problem in particular – the guidance for the learner. To illustrate our ideas we shall use as an example the Lexical Research Module, or LRM, of the AMICAL project.

In the first section of this paper, we shall introduce the AMICAL PROJECT. Then we shall describe the various functions of the LRM, as well as the various problems that it raises. Finally, in the third section, we shall look in more detail at the problems of such guidance, concentrating more specifically on the different uses this guidance can have.

1. The AMICAL Project

AMICAL[1] (Chambreuil, & al., 2001) is a theoretical research project, and one of its objectives is to think about the design of computer environments for helping learning in one particular area – reading.

In the computer environment of the AMICAL project, currently intended for five-year-old children beginning to learn to read, belong several types of software, which we call 'modules'. These modules are knowledge-based systems and correspond to specific types of learning situations and interactions with the student. We can separate these actions into three groups: "tutorial", "explanation" and "resource" modules. Modules in the tutorial group, also called tutorial modules, lead, in a controlled manner, to the pupil gaining knowledge. Their aim is to propose to the learner training courses in reading. These courses are the result of didactic activities. They are created dynamically by the system and adapted to a given learner at a particular stage of his/her training.

Modules in the 'explanation' group are interactive-learning environments in which a collection of components are put at the learners disposal. The pupil can thus combine them in order to make his own, more complex components. The system is interactive in the sense that it is capable of communicating, of reacting in real time to various actions carried out by the learner. The components are complex in the sense that they correspond to a combination of simpler elements – those provided by the system.

Modules in the "resource" group are environments which can be compared to resource-documents (CNDP, 1992) such as dictionaries or encyclopaedias which are already traditionally present in classrooms. Resource modules, in the environment of the AMICAL project, have – in comparison to resource-documents – the ability to provide specific information for the initial learning of reading, and offer guidance to the learner.

More specifically, we are interested in a particular module of the resource type– the LRM.

2. The LRM and its Problems

The goal of the LRM is to present, for each lexical element present in the system, information relevant to learning-to-read from scratch.

At the beginning, the system provides the learner, through various access methods, the possibility of selecting a lexical element, which we shall subsequently call a 'word'. Among these possibilities we distinguish between the access modes by text, by theme, and by a list of the words of the module in

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[1] AMICAL: Architecture Multi-agents Interactive Compagnon pour l'Apprentissage de la Lecture (interactive learning-to-read environment with a multi-agent architecture)

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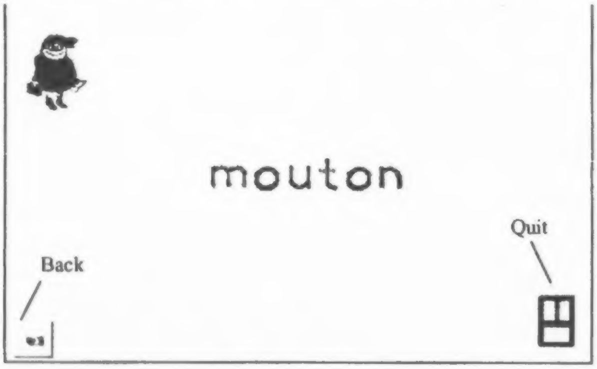
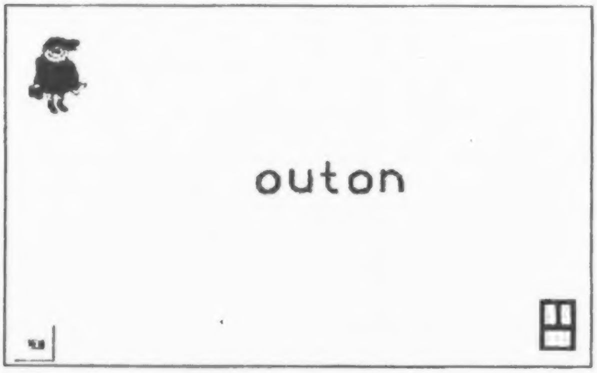
alphabetical order. The access mode by text allows the learner to select a word in the module, taken from a text that s/he has already seen in class. The system proposes, firstly, that the learner chooses the title of the text he wants. Then, to allow him/her to choose a particular word of the text, the system displays on the screen the entire text, and the name(s) of the author(s). The access mode by theme allows the learner to first of all select a theme such as 'animals', 'places', or even 'fruits', and then a word belonging to this theme such as 'cat', 'dog', or even 'hen', given that the learner chose the theme animals. Finally, the access mode by the list of words in alphabetical order allows the student to choose a word by initially selecting its first letter.

Afterwards, having selected a word, the learner can visit the various interfaces carrying information related to this word. These interfaces have the feature of being able to make use of knowledge linked to the field of learning (Pélissier, 2001).

A piece of knowledge linked to the learning domain with regard to reading is, for example, 'a word is a structure of letters'. This knowledge consists of making the child aware that a word can be broken up into letters, re-formed from these letters, and that these letters have a particular order in the word. For the learner to acquire this knowledge, many interfaces carrying information can be envisaged. We can quote, for example, the animation: 'The presentation of the splitting up of a word into letters using flashing letters'. In this animation, the word chosen by the learner initially appears on the screen [Screen 1]. Then, the letters making up this word flash in turn, one by one from left to right [Screen 2].



Screen 1: The word chosen by the learner initially appears on the screen



Screen 2: The letters making up this word flash in turn, one by one from left to right

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We should note that the term "knot", which will be used subsequently, indicates a collection of selection interfaces which allow a student, using the LRM, to select a word and the interfaces carrying information associated with this word.

To allow the learner to move, within the module, from one knot to another – i.e. to select a word and see the collection of interfaces carrying information linked to the word – a navigation and guidance specific to the learner are put into action.

Finally, in order to respect the various given functions of this type of module, a specific computational architecture ought to be envisaged.

Therefore, the design of a module of the 'resource' type, such as the LRM, raises the following problems:

- the identification of knowledge in the area
- the design of the interfaces carrying information
- the access modes
- the navigation
- the guidance
- the computational architecture of the system

Of these six problems, we shall focus more particularly on the guidance.

3. The Guidance

3.1 The Problem

According to Tom Murray (Murray, & al., 2000), the disorientation of the learner is one of the basic problems which seem to arise when designing a computer environment. This disorientation is, for Aude Dufresne (Dufresne, 1991), linked to the incapacity of the user, "who confuses one interface with another, unable to remember where he came from or what he wanted to do"; to be disorientated is also not to know where you are, not to know how to get somewhere you think you know exists (Conklin, 1987), to not know if there remain pertinent documents in the system which you would have forgotten to visit, to forget selections which you have previously taken or finally to be incapable of giving an overview or a summary of what you have just seen.

To prevent the user from being disorientated, guidance would seem to be necessary, even indispensable. It seems to facilitate learning at the same time as using a computer system (Bastien & Scapin 1993).

Bastien & Scapin define guidance in a technical report of the INRIA as being "the collection of the methods used to advise, orientate, inform, and guide the user when s/he is using the computer (messages/alarms/labels.......)".

Two problems linked to the guidance can therefore be distinguished:

- The functions of the guidance
- The methods implemented by the system to make use of these functions.

Of these two problems, we choose to present more particularly the problems with the various functions.

3.2 The various functions

Within the framework of designing a computer environment to help learning, we can cite three main functions that the guidance can have: the function to inform, the function to advise, and the function to position. These three functions pose three main types of problems, namely, the elements or types of elements affected by the function, the timing of their being presented and their ways of being presented to the learner.

Peter Brusilovsky (Brusilovsky 2001) points out two main items on which the guidance operates:

- The informational content of the knot
- The navigation links

We shall subsequently see that, depending on the functions, these two items can be regarded in a different way, and that other items, not presented by this author, can also be the subject of a guidance.

According to Kobsa (Kobsa, & al., 2001), three groups of data are taken into account when writing a guidance:

- the data related to the user's characteristics
- the data related to the interaction between the user and the machine
- the data of the environment which brings together all the aspects not related to the user.

We shall see, more specifically, how the first two groups of data can be used in the guidance. We shall also present other information, not listed by the author, which can be usefully used.

The Function to Inform

By this function, the system gives the learner a range of information linked to the knot that he is trying to visualise.

This function firstly raises the problem of the different types of information which the system can provide for the learner. These types of information can be different according to the knot. However, we can cite at least three types of elements about which the system can inform the learner:

- the type of knot involved
- the components of the knot

The system can provide the learner with information which permits him to identify the type of knot he is visualising, i.e, if the learner is before a selection interface or an interface presenting information. Information can also be carried by the components of the knot – which can be, in the case of the LRM, words, texts, images, graphics etc, on the different navigation links shown on the screen, as well as events such as transfers, colour changes, flashing etc – which can be associated with the information.

Among the various navigation links, we can distinguish between those belonging to intra-knot navigation and those belonging to inter-knot navigation (Pélissier 2002). Intra-knot navigation occurs within the same knot. In the selection interface for a theme, intra-knot navigation allows the learner to obtain the reading of each theme present on the screen. Inter-knot navigation refers to the movement from one knot to another. The student, from the selection interface for a title of a text, can reach the selection interface for a word within a text.

The system to guide the learner can inform him/her of the existence of these two types of navigation and their consequences. When selecting a link related to intra-knot navigation, the knot on the screen stays the same, whereas if the learner uses an inter-knot navigation link, the knot on the screen disappears and a new knot appears.

This function then poses the problem of the nature of the information presented. The system can inform the learner exclusively of the existence and/or position of the components on the screen. For example, in the LRM, the system can tell the learner that a reading button for the title of a text is at his disposal by specifying, or not, its position on the screen (at the top / at the bottom, on the right / on the left).

Thirdly, there is the problem of choosing the information and the timing of its presentation. In effect, all the information cannot be presented at the same time for fear of overloading the learner. The guidance should be able to provide information at an opportune moment during the session. It is therefore necessary to select the information to be presented for a given knot, and to choose the precise moment of its presentation.

The choice of information to provide can be made according to the type of knot, of its components, but also, as for the selection of the timing, partly from diverse hypotheses made about the learner – such as hypotheses regarding his level of knowledge, his behaviour, his habits, his motivation – and partly from a history made from different knots seen by the learner during the current session and/or during previous sessions. For example, if we draw the hypothesis that a learner has acquired one or several particular pieces of knowledge related to an area, we can chose whether or not to let the computer system present a navigation link allowing the user to access a knot, making use of his knowledge. Similarly, if the learner visits for the nth time the same knot, the system can, for example, avoid presenting the different components, such as the various navigational possibilities available, when the learner opens this knot.

The function to Advise

To advise is to encourage the learner to do one thing rather than another, a particular choice from a range of possibilities available to him/her.

First of all, this function poses the problem of the elements on which it operates. For example, the system can advise a learner, confronted with a selection interface for the title of a text, to choose one particular title such as the last title he has seen in class. The system can also advise him/her to use an intra-knot navigation link like a loud-speaker button, which allows the title to be read out loud.

Then there is the problem regarding the choice and timing of the presentation of different types of elements for a given knot during a session. For example, the system can advise the learner at one particular moment to choose an interface carrying specific information, and then, afterwards, recommend the same learner to choose another information-carrying interface in the same knot.

This choice of different elements and the timing of the advice can be made, as with the function to inform, according to hypotheses about the pupil and the history of the different knots already seen. For example, according to the history, if the learner is regularly confronted with one word in particular, the system can advise the learner to visualise one or several other word(s) of the module.

Advice can also be given according to pedagogical hypotheses. For example, the interfaces carrying information are characterised by the different areas of knowledge they utilise. Such knowledge can sustain a particular line of succession in relation to learning. In this case, rules can allow the system to encourage the learner to use one particular information-carrying interface before another.

The Function to Position

To position the learner in a computer environment is to allow him to have an overview of the items which he has already encountered in relation to the set of items left at his disposal.

This function can work, for example, on the level of:

- knots
- navigation links

The system can position the learner in relation to the various knots he has encountered. It can, for example, sum up the information-carrying interfaces associated with a specific word, seen by the learner during the course of one or several sessions, in relation to the collection of knots it is possible to access. The system can also show the student, for a particular knot, the set of links he has used in relation to the set of links available to him.

This function of positioning poses, firstly, problems such as that of the identification of knots which could be the subject of a positioning. For example, in the LRM, we can position the learner solely on the level of selection interfaces and/or interfaces presenting information.

Then, there is the problem of the determination of the positioning. For example, the system can take into account, in the positioning, the different knots that the learner has encountered since his entry into the environment, or since his first session.

Finally, there is the problem of choosing the elements of the knot from which the learner can be positioned. For example, the learner can be positioned in the selection interface of a title of text, in relation to the titles he has chosen and/or in relation to the navigation links used. The selection of these elements can be done in accordance with various theoretical and experimental hypotheses (Dufresne, 1991), but also in accordance with hypotheses formed about the learner. From the interactions between the learner and the machine, the computer system can determine the elements and the moment where a positioning seems necessary. For example, if the learner takes no action whatsoever, no longer clicks anywhere, the system can inform the user of the collection of interfaces he has seen since the beginning of the session, carrying information associated with the word, in relation to the collection of information-carrying interfaces it is possible to see.

Conclusions

We have just presented the different functions associated with a guidance in a resource module intended for learning, such as the LRM, the function to inform, to advise, and the function to position.

These different functions can be used in the system in one or more ways. That is the second problem linked to a guidance. We can distinguish several sorts of ways. Firstly, the visual methods such as the changing of colours and the flashing on the screen of the components of the interface. These methods can have, for example, the function of informing the learner of their presence. Next, we have audible methods such as commentaries which, for example, are able to advise the learner when making his/her choice. Finally, we have guidance knots which are specific interfaces for example, that show the learner, on the screen, the collection of interfaces carrying information associated with a particular word; among this collection the interfaces seen by the learner are presented in a specific way.

References

Bastien, J.M.C. & Scapin, D.J. (1993). *Ergonomie Criteria for the Evaluation of Human-computer Interfaces*, rapport technique, programme 3.

Brusilovsky, P. (2001). Adaptative hypermedias. In A. Kobsa (Eds.), *User Modeling and User-Adapted Interfaction* (pp.87-110), Volume n°11, Nos. 1-2, Special Issue.

Chambreuil M. & al., (2001). *Le projet AMICAL : Architecture Multi-agents Interactive Compagnon pour l'Apprentissage de la Lecture*, Chambreuil M. et l'équipe de recherche AMICAL, rapport interne, Laboratoire de Recherche sur le Langage, Université Blaise Pascal – Clermont-Ferrand 2.

CNDP, (1992). *La maîtrise de la langue à l'école*, Centre National de Documentation Pédagogique, Ministère de l'éducation nationale et de la culture – Direction des écoles, Savoir Livre.

Conklin, J. (1987). Hypertext : an introduction and survey. In *Computer* (pp.17-41), n°20, volume n°9.

Dufresne, A. (1991). Ergonomie cognitive, hypermédias et apprentissages. In B. de la Passardière & G.-L. Baron (Eds.), *Actes de colloque Hypermédias et apprentissages* (pp.121-132).

Foss, C. L. (1988). Effective browsing in hypertext systems. In *RAIO Conference User-oriented content-based text and image handling* (pp.21-24), March.

Kobsa, A. Koenemann, J. & Pohl W. (2001). Personalized Hypermedia Presentation Techniques for Improving Online Customer Relationships, *The Knowledge Engineering Review*, 16(2), (pp.111-155). Internet au 15/11/01 : http://www.ics.uci.edu/~kobsa/publi-all.html#A.%20Books%20authored

Murray, T. Condit, C. Piemonte, J. Shen. T. et Khan S. (2000). Evaluating the Need for Intelligence in an Adaptive Hypermedia System. Submitted to ITS 2000. Internet 15/08/01 : http://helios.hampshire.edu/~tjmCCS/papers/ITS2000/ITS2000subMurray.html

Pélissier, C. (2001). Le problème de la spécification des connaissances linguistiques mises en œuvre dans un logiciel d'apprentissage. Journée Jeunes Chercheurs en Linguistique Appliquée, *AFLA (Association Française de Linguistique Appliquée)*, Paris V, France

Pélissier, C. (2002). La navigation dans un logiciel d'aide à l'apprentissage de la lecture, Actes du colloque IV^{ème} Journées de l'Innovation « Quels services pour la formation », Foix, France

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Case Study. Oral Pathology Online: A Three-Year Experience in a Blended Course

http://ateneo.ctu.unimi.it/corsionline/odonto/

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Abstract: During the academic year 2001-2002 the Oral Pathology web-based course ran its 3rd edition. The site is the result of the collaboration between the Ctu – Centre of Technologies for Learning of the University of Milan and the University Unit of Oral Pathology. The aim of the site is to support traditional in-class teaching, to offer students an environment that enables them to communicate with teachers and other students, to give access to a wealth of teaching materials, to carry out self-evaluation of their learning and to favour the acquisition of a methodological approach to solve clinical problems. This paper describes the three-year development of the web-site, its conception and the basic rationale of the course: from a focus on the definition of the site itself to its smooth integration with face-to-face lessons.

Introduction

During the last three years problems in regulating student intake numbers in the Degree program in Dentistry at the University of Milan have led to an average of 250 students in every first year class with students' age ranging from between 20 to 50 years. With such a "scenario" some teaching[1] difficulties have also emerged: life histories, attitudes, interest in the subject and demands vary widely within the class; difficulties in establishing a student-teacher relationship have increased; the "lecture" format tends to be preferred; clinical instruction has become more or less impossible.

In an attempt to solve problems due to student numbers and support the face-to-face classroom, in 1999 a collaboration between the Centre of Technologies for Learning of the University of Milan (CTU) and the University's Unit of Oral Pathology[2] was set up: it led to the development of an online environment which could support teaching activity and give students the possibility to develop new skills in the use of technologies for their learning too. The project team considered it very important that students face their future professional activity with basic competence in the use of those tools that would allow them to benefit from a continuing self updating (internet search, database consultation, evidence based approach to learning), as well as from communication with colleagues and access to patient records. Moreover, multimedia and Information Technology now offer plenty of opportunities to support medical education effectively, especially for image

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[1] The traditional course of Oral Pathology starts in October and ends in May and consists of: a two-hour traditional face to face lesson once a week; weekly professor and tutor counselling; first official exam sessions (May – June – July).

[2] The Ctu is Milan University's centre devoted to educational technologies (www.ctu.unimi.it). In the joint project it was responsible for designing the software and the site, for methodological support to the teachers during the course, for technical help and the final evaluation of the online environment. The teaching team from the Unit of Oral Pathology, consisting of 1 professor and 6 assistants, was responsible for the site contents and the activities carried out in the site itself.

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intensive subjects such as Anatomy, Histology and Pathology (Dowker et al. 1997), (Lehmann et al. 1999), (Grimes 2001), (Hallgren et al. 2002), (Greenhalgh 2001).

Do students get this opportunity? Does the learning change with the introduction of a blended course? Some criticism has been reported about the methods that have been and are used to evaluate new computer-aided and web-based learning instruments, comparing their teaching efficacy with the so defined "traditional" methods (Keane *et al* 1991), and it is not an easy task to separate and evaluate the parts that play in an educational intervention (Hutchinson 1999).

Most of the studies that have been conducted to evaluate the effects of computer-aided packages or web-based courses collate information regarding the subjective rate of acceptance of the programs, of their usefulness and of the skills gained after their use, as well as give an overview of the informatic background of the users.

When more objective evaluations are conducted, many studies comparing online versus traditional in-class learning report no significant difference in terms of students' evaluation of performances and support the argument that the development of reasoning and positive attitudes toward the subjects being studied can take place in both online and classroom environments and that online instruction can be designed to be as effective as traditional face-to-face instruction (http://teleeducation.nb.ca/nosignificantdifference/.)

In our case, the website was designed to support and not replace the in-class learning activity. Moreover, it offered a wide range of web tools to complement the traditional learning.

Therefore, for the first two years of experience, we chose to base the evaluation of the quality and efficacy of the Oral Pathology web course, on the four criteria on which, according to the Cerfad classification (Cerfad 2001), quality can be measured:

1) *What did the students learn?*
2) *Were the educational demands for which the site was planned satisfactorily met?*
3) *The learning route: who takes part, how, when and what sort is it?*
4) *How does the system work?*

Data were recorded through two kinds of questionnaires. The first, distributed at the beginning of the academic year, aimed to trace students' computer literacy and the availability of computer/Internet facilities, the second focused on the attention of student opinions about the web support, and was distributed to students in the middle as well as at the end of the course. Interviews with both a couple of randomly selected students and teacher of the course were recorded each year. Moreover, the tracking system of the web site allowed the monitoring of files most downloaded, total number of accesses (per user) and number of messages sent per user.

In addition, during the still on-going third edition of the course, a pilot study with an experimental design has bee set up in order to include more objective information on the subjective data already existing.

The study aims to assess if the opportunities and learning aids offered by the web-course make any difference in the learning gain of students who have access to the web-support. Students were randomly divided into two groups. During a one month period the test group had access to the web site, while the control group did not. The web site offered material to integrate lessons: images and short videos, link suggestions and, most of all, exercises to stimulate students to search the web and try to develop a method to observe images and describe them. Pre and post tests were recorded as well as questionnaires about computer skills, attitudes and web course usage opinion (just for the test group). Moreover, an external observer (pedagogist) attended lectures "randomly" in order to record the teacher's behaviour during in-class teaching activities. Data analysis is currently study.

Structure

First and Second Editions (99-00; 00-01)

The site was organized into four main sections (classroom, resources, secretarial area, R & D) and 15 subsections. *Classroom* was composed of: *lessons* (text, graphs, tables, images); *case studies* (exercises based on "problem solving" or "role playing" methodology); *syllabus*; *material archive*; *web-boards* (one dedicated to counselling, the others to case study discussion); *self assessment*[3]; *professor and students* (details of the teaching team and a list of students registered with the site). *Resources* consisted of: *bibliography* and *links*.

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[3] The test - generator system, named "Mirror", is a property of Ctu software (http://mirror.ctu.unimi.it), it creates tests containing questions selected at random from question banks. Tracking is available for each student. Each question can be linked to a forum, to positive or negative feedback, and to teaching material to help answer the question.

In the Secretarial Area you could find: notice board; the explanation of the exams; help online (technical aid web-board); personal profile; e-mail. The R & D area, a part from the questionnaires, was visible only by the project team (statistics and project team web-board)

Third Edition 2001-2002

In the third edition of the course the site structure has been modified, reducing the number of sections from 15 to 6 by merging some aspects and eliminating those that in the previous versions had been indicated as not useful. According to the results of the previous courses, it is necessary to maintain a site structure that foresees not only a sequential usage supporting the logical progress of the learning route but also a free usage encouraging critical independence in the analysis and selection of sources. The web site includes: the home page of the course (latest announcements, important deadlines, the latest messages in the forums); syllabus; table of contents[4]; study area; self assessment and web-boards.

Evaluation Results

First Edition 1999-2000

What did the students learn? Only 65 students out of 151 sat the final examination in the summer session, 25 failed and 40 passed with an average mark of 27/30. Considering the answers to interviews and questionnaires to the question "Has the site made your learning more efficient?": 63% replied *YES*, 11% replied *NO* and 26% *did not reply*. Comments given to these replies were: *teaching material was abundant, precise, corresponding to the lectures and easy to consult, allows a better organisation of the studying; forum allows doubts to be cleared up, as well as an exchange with professors and fellow students*; *self-assessment provides practice*; *the wealth of images and case studies bring the clinical aspect of the subject closer.*
Even if clearly of a subjective nature, these latter data show appreciation for the learning experience yeilding a more positive stance towards the experience itself and thus an active and fertile attitude towards learning (Ananda 2001).

Were the educational demands for which the site was planned satisfactorily met? Students found it difficult to set up a correct diagnostic procedure; they frequently faced clinical problems in a disorganised manner. The section of the site dedicated to this skill was that regarding case studies. Only a few students participated in it. Most of the students focused on the self-assessment part (9000 tests done!) and on studying the lectures (the parts in which the examination consisted of).

The learning route: who takes part, how, when and what sort is it? Although few students actually took part in the forums, to the question "Did the online course allow for more direct contact with the teacher?" 3% replied *not at all*, 26% *not much*, 36% *a fair amount*, 24% *a lot* (11% did not reply). To the question "Did the online course allow for more dialogue with fellow students?" 24% replied *not at all*, 33% *not much*, 24% *a fair amount*, 8% *a lot* (11% did not reply).
From the messages it is possible to see that the communication within the forum took place mostly between teacher and students and came in the "question and answer" category rather than being an open debate.
A clear increase in the use of the site was registered during the pre-examination period.

How does the system work? Some of the students had insufficient computer skills to allow for adequate use of the site activities; the answers to the question "How much experience do you have of using a PC?" were: 15% *none*, 55% *little*, 23% *quite a lot*, 4% *a lot* (2% did not give an answer). Not all students had Internet access at home (only 31%) and the university did not have laboratories for individual use of the Internet for learning; the system was often slow in loading pages and downloading material.

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[4] The *table of contents* is sequentially organised, displaying together all the lessons in chronological order; specific materials for further study and practice exercises are linked to each lesson. The organization according to units of content was adopted in order to provide students with preparatory information, both for the understanding of the lesson itself and for doing the exercises. In the *study area* the student can access and use the materials according to his/her own interests or requirements, it contains content organized by type.

Consideration and discussion

The results of this first version of the course were quite satisfactory. The objectives established were not fully achieved, but, both students and teachers proved to be enthusiastic about the online environment. This aspect has also been found in other previous, similar studies (Pilcher 2001, Wegner *et al.* 2002).

Emphasis should be placed on the commitment and expertise demonstrated by the teaching team in creating appropriate teaching materials. Overall, students reported that the communication tool increased student-teacher contact more than student-student interaction. This is quite reasonable considering that students could meet every day in class. It could also be a characteristic of the blended modality of the course since lack of instructor's contact can also be perceived by students in completely on-line courses (Wegner *et al.* 2002, Gagne M. and Shepherd M. 2001),.

On conclusion of this first version of the course, we faced a dual challenge:

1) solving problems relating to the system and the use of the course: speed of the system, computer laboratories, teaching students basic computer literacy;

2) involving the students more actively: the site should be seen not as a sort of "super textbook" to get ready for the examination but as a proper learning place to acquire a methodological approach to diagnosis.

Second Edition 2001-2002

What Did the Students Learn? Only 28 out of 190 students sat the examination at the summer session: 21 passed, 7 failed with an average mark of 26.7/30. Considering the answers to interviews and questionnaires to the question "Did the site help your learning efficiency?": nobody replied *not at all*, 5% *very little*, 9% *quite a lot* in and 54% *a lot* (31% did not answer the question). To the question: "Do you think it is useful to have both lectures and website?": 60% said *YES*, nobody *NO* whilst 37% did not answer the question.

Were the Educational Demands for which the Site was Planned Satisfactorily Met? Students in the second edition stressed the value of the whole project from a methodological point of view (e.g. clinical cases, consultation with teacher or tutors, range of sources).

The Learning Route: Who Takes Part, How, When and What Sort Is It? Fewer messages than in the previous year were exchanged through the forum (104 instead of 120), but the quality of the content remained high (88 content messages out of 104): the same results were obtained for the case studies section. Sections most widely used were the lectures (files downloaded 4643 times) and the self-assessment (13082 tests done), while the teaching archive was little used (files downloaded 1351 times).

How Does the System Work? The difficulties and demands encountered by the students in the second version of the course were mainly of a didactic-organizational nature: too many demanding courses had to be followed. The majority of the students did not take part to the web-course activity probably because working on the site was left to the student's desire to go in depth with the material and not mandatory for the final examination; in addition, it seems there was an unreadiness of third-year students to approach the on-line exercises independently and critically: this was the first clinical course they had face and, despite having studied, the student had not yet fully grasped all the knowledge required to take part in discussion on case studies.

Consideration and discussion

In the second version of the course an attempt was made to meet the challenges raised by the first one: four computer laboratories were opened for the students; a seminar in basic computer skills for the whole class was organised; students' critical-analytical skills and their ability to establish correct diagnostic procedure was promoted.

Whilst during its first experience the didactic group was enthusiastic about educational technologies, after the first two months of the second edition of the course, a somewhat "cooler" attitude of the teaching team seemed to be recognizable. A decrease in enthusiasm and participation of the teachers was observed, probably because the "novelty effect" (Clark 1992), which could have lasted the whole of the first year, had worn off.

Face-to-face lectures seemed to be unrelated to the site and there was a lack of participation in online activities.

As reported in other studies (McNulty et al. 2000) peak in the access of web learning resources have been recorded during the pre-examination period. The site was mostly used as a teaching text and guide to the learning route.

From this second experience, reflections arose on the nature, usefulness and function of a web based-course supporting classroom lectures. Both students and teachers should be taught to reach beyond the concept of the site exclusively as a collection of teaching materials and the lecture room as the place where the real teaching takes place: the site has to be considered an environment for learning/teaching relations and activities that are complementary to the classroom course. We became aware that in it is far more difficult to "educate" students and teachers in the use of online teaching/learning methodology in a blended course than in fully online courses. In fact, as opposed to the latter, the classroom lectures provide a weekly contact during lessons, where students can exchange opinions and compare notes directly and where the professor teaches according to his own experience and customary approach. Thus, often the site is relegated to the status of a mere extra activity.

Third Edition 2001 -2002

The course in its third edition is only at an initial stage and it is not yet possible to give an overall assessment. However, on the basis of the first month's work, some considerations are emerging.

In this edition both the role and demands of the students and of the teachers have become the object of attention. Participation in the activities offered by the site has remained voluntary but this version foresees the skills acquired online being evaluated during the examination.

To accommodate any difficulties or hesitation relating to the use of the Internet on the part of the students, the tutors collect the considerations of the online debate at the end of each month and discuss the methodological organization of individual contributions in the classroom, leading students towards a correct approach to diagnostic procedure. Another new feature is that it is not only is the course online evaluated, but also the teacher's behaviour and the teaching activity since an external observer attends lectures "randomly" in order to record data.

Considerations and Discussion

Teaching in a web environment requires preparation of material in advance, attention to students' questions, facilitation of interaction among students and a continuous guiding of learners who value the input of the teachers (Binshan and Chang-tseh H. 2001). However, an initial analysis of the data about web usage of the third edition shows that teachers have still not yet grasped the concept of an integrated "classroom-website" system and concentrate all their teaching activity in the classroom, without linking classroom activity with the other side of the system.

Furthermore, since teaching activities offered by the site, such as the discussion of case studies and exercises, aiming to encourage and educate students to participate more actively in their learning, are not emphasised by the teachers who do not mention the web-site in the classroom, students mainly access the site to download lessons. One of the values of web-base support most reported by students still remains access to material and lectures. Handouts have been reported to be the most helpful features also in other similar studies conducted with dental students (Pilcher 2001), with only a small portion of them which take part in the case studies discussion.

Conclusions and Future Prospects

Much work remains to be done in working out the correct organization for a blended course in order to make it effective and efficient. The opportunity of access to computer laboratories and to a course in computer literacy, the efficiency of the system, technical aid, etc. are necessary but are not sufficient conditions for the success and effectiveness of a course. To reach success in running a blended web-course, the preparation of both teachers and students for this new type of educational interaction online is needed. In fact, this kind of environment requires a shift from "lecture-style" to "teacher-mentor" teaching, which guides and motivates students. It is a shift from passive students who mainly engage in listening to active students who ask questions, make suggestions, and write their observation and comments.

Our experience shows that, in a context of a correct and active learning relationship between teachers and students and amongst students themselves, the following factors are essential: careful and holistic planning of the curricula for classroom-website interaction and the training and education of both students and teachers in the use of educational technologies.

Future work will focus on training teachers to use educational technologies. The following projects are foreseen:

1) a survey regarding computer literacy and present knowledge and use of educational technologies;

2) a seminar to explain the educational technologies available at the Ctu at present;

3) a workshop on educational technologies for those teachers who prove to be particularly interested in the subject.

References

Ananda M. (2001). Developing a questionnaire to measure the effectiveness of computers in teaching. *Ed-Media 2001*, Association for the Advancement of Computing in Education, Tampere, VA

Binshan L and Chang-tseh H. (2001) Web-based teaching and learner control: a research review. *Computer & Education* 37 (37):377-386.

Cerfad (1999-2000). *Guida alla qualità dei servizi di erogazione e supporto della Formazione A Distanza.* Regione Emilia Romagna (http://www.regione.emilia-romagna.it/cerfad/index.htm?http://www.regione.emilia-romagna.it/cerfad/html/qualita/index.htm)

Clark RE (1992) Dangers in the evaluation of instructional media. *Acad.Med* 67 (12):819-820.

Dowker SE et al (1997) X-ray microtomography: 3-dimensional imaging of teeth for computer- assisted learning. *Eur.J Dent Educ.* 1 (2):61-65.

Gagne M. and Shepherd M. (2001) A comparison between a distance and a traditional graduate accounting class. *T.H.E.Journal* 28 (9):58-65.

Greenhalgh T (2001) Computer assisted learning in undergraduate medical education. *BMJ* 322 (7277):40-44.

Grimes EB (2001) Effectiveness of an online course in dental terminology. *J Dent Educ.* 65 (3):242-247.

Hallgren RC et al (2002) An interactive, web-based tool for learning anatomic landmarks. *Acad.Med* 77 (3):263-265.

Hutchinson L (1999) Evaluating and researching the effectiveness of educational interventions. *BMJ* 318 (7193):1267-1269.

Keane DR, Norman GR, and Vickers J (1991) The inadequacy of recent research on computer-assisted instruction. *Acad.Med* 66 (8):444-448.

Lehmann HP et al (1999) An ethnographic, controlled study of the use of a computer-based histology atlas during a laboratory course. *J Am Med Inform.Assoc* 6 (1):38-52.

McNulty JA et al (2000) Evaluation of Web-based computer-aided instruction in a basic science course. *Acad.Med* 75 (1):59-65.

Pilcher ES (2001) Students' evaluation of online course materials in fixed prosthodontics: a case study. *Eur.J Dent Educ.* 5 (2):53-59.

Wegner SB, Holloway KC, and Garton EM (2002) The effects of Internet-Based Instruction on Student Learning. *JALN* 3 (2):98-106.

Better Living Through Faculty Development? How Teachers Can Develop Better Practices by Using Multimedia to Document and Share Their Work

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Abstract: When teachers document their practice of teaching using technology, and share what they've learned with others by making their work public, they can effect important changes in faculty development, student learning, and pedagogical innovation. In particular, multimedia technologies allow teachers to document interactions and processes that don't easily lend themselves to text-only representations; they provide opportunities for faculty to relatively easily share one another's materials, assignments, and students' work in order to build on one another's research and reflections; faculty may critique each others' work to provide a peer review process akin to other academic disciplines. The production of more and more sites that document teaching will also make it possible to look across the experiences of many different faculty members working in many different disciplines and contexts, and to generalize from those experiences.

The Knowledge Media Lab at the Carnegie Foundation has been collaborating with K-12 and Higher Education faculty members to document and represent inquiry into their practice of teaching using multimedia and online technologies. Over the past three years, these faculty have participated in various cohorts of a 2-year program (CASTL) to share what they know (and do) about teaching. Their final products have constituted a diverse array of representations, ranging from dramatic presentations to more traditional academic genres such as books and journal articles. The diversity of the representations demonstrates the importance of using existing disciplinary genres and methods to invent new ones. The use of technology enables faculty to deepen their individual knowledge about previously unrevealed aspects of their pedagogy and curriculum; develop collective understandings of the practice of teaching and learning through sharing what they've observed with colleagues; and to enable others to build upon what they've learned by making their inquiry into teaching and learning public.

Deepening Knowledge about One's Practice

Once documentation is complete, the effort that goes into creating an engaging and compelling, and succinct website can lead faculty to deepen their knowledge about the representation of their practice and the central questions of their inquiry. Roberto Corrada, a professor of law at University of Denver, wanted to document his active learning course on Labor Law, one in which students may elect a union and negotiate a collective bargaining agreement with Corrada, their "employer." Working in collaboration with the Carnegie KML, Corrada has created an interactive timeline to illustrate the spread of union activity in his class, and has begun documenting his class to enrich the timeline with clips from his course, student work samples, and email communications from his student "union activists." This documentation process has transformed his perspective on his teaching; he commented, "Just thinking about how to represent the scholarship on the web has made me think differently about how I teach the class, how I present the class, and most importantly, how I document what I do in the class."

By choosing to represent his scholarship online, Corrada transformed his perspective on the unfolding of his course from one in which the course was largely unpredictable to one in which he was attuned to look for and document the "explosive moments," and in so doing, be able to tell the story of the "infestation" in his class by student-led union activity. By documenting his work through multimedia, he begins to be able to make his work public and, therefore, be able to share it with others.

Developing Collective Understandings

Some scholars have found that sharing what they've learned about their teaching leads them to develop deeper collective understandings of their practice, transforming artifacts of teaching into objects of knowledge that can be discussed and debated. Heidi Lyne, a teacher at the Mission Hill School in Boston, wanted to represent her school's portfolio graduation process through documentary film. She followed several students over the course of the year as they prepared their portfolios, all of which were expected to reflect the school's "Habits of Mind," and collected student work samples, notes from faculty meetings, her own reflections, and school assessment rubrics to support and extend the video.

As she began to select clips and share them with her colleagues at Mission Hill, Lyne commented that their conversations began to transform: "An interesting thing happened when I or other people, other staff members started watching [the videos]... the information was gathered in one place, whereas otherwise it would have been discrete people doing discrete pieces, and it would have taken years... to get to the point of knowledge about what we were doing, that we got to very quickly."

Lyne, her students, and her colleagues were all able to benefit from examining their collective practice—once the portfolio preparation process was transformed from ethereal, moment to moment interactions, to a set of documents and data that could be examined, debated, and reflected upon. Before she even got to the point of analysis (Lyne 2001), Lyne's multimedia documentation had already had an impact upon the school's plans to transform the portfolio graduation process for the coming year, when Lyne again plans to document their collective work through video.

Influencing Others

Particularly for novice and student teachers, professional developers, mentor teachers and teacher educators, having models and examples to look at may enable them to talk more deeply about and build more richly from their teaching experiences. For example, Deborah Smith, an Assistant Professor of Education at Michigan State University, has created a website to document a large course on the teaching of science for pre-service elementary teachers. While Smith hopes to use her site (Smith 2001) to discuss her inquiry-based approach with other faculty in her field, she also plans to use the site as a key means of support for the many teaching assistants who lead sections of the course. In her work with a local school district, she also planned to share her experiences with documenting her practice using multimedia with novice teachers, encouraging them to examine their own pedagogy, curriculum, and classroom documents, as well as sharing them with others: "I think the power of [multimedia representations of teaching] is a way to help pre-service and other practicing teachers get underneath and inside a teacher's practice and feel like it's accessible–and that, I think, is very heartening for people who want to learn to teach or change their practice."

Smith is able to use her website not only to show her own investigations into her practice, but to inspire others to do the same. These sites also create learning opportunities for the students themselves. Students taking Smith's course can see examples from previous years of students' work, and they can read the instructors' feedback to determine, before they begin work on their own projects, the kinds of questions and problems they may encounter.

Implications

The value of scholarship is determined in its use – in discussions, in critiques, replication efforts, responses, applications, deviations and adaptations. Thus, the evolution of scholarship online will go hand in hand with the development of the means for reviewing and exchanging scholarly work and the growth of the communities in which it is discussed and debated. Faculty who develop web galleries of "best practices," or interactive portfolios of teacher and student learning, can contribute to an advancement of the profession as a whole, particularly in the development of new teachers. However, websites that collect teaching materials and document teaching practice cannot advance the field without the language, criteria and forums for informal and formal assessment needed to examine them. In short, we know that we can put scholarship online, but it remains to be seen how online representations can be more effective in capturing the many aspects of teaching and learning that are often too ephemeral, too subjective and too fleeting to represent productively in print. We believe that the collective effort to produce, examine and use websites and other means of representing teaching will facilitate both the development of the scholarship of teaching and the growing professional and public understanding that can serve to advance the field.

References

Lyne, Heidi (2001). The Mission Hill School. <http://kml.carnegiefoundation.org/gallery/hlyne>

Shulman, Lee S. (2001). Inventing the Future. Conclusion to *Opening Lines: Approaches to the Scholarship of Teaching and Learning,* Pat Hutchings, Ed.

Shulman, Lee S. (1993). Teaching as Community Property: Putting an End to Pedagogical Solitude. *Change* 25 (6): 6-7.

Smith, Deborah (2001). Making a New Song About Science. <http://kml.carnegiefoundation.org/gallery/dsmith>

Student Roles in Online Learning Communities: Navigating Threaded Discussions

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Abstract

This paper discusses navigation strategies affecting the interactivity of a graduate level course's asynchronous online discussion with a focus on the development of a learning community and knowledge building. This qualitative analysis reports on an exploratory investigation of student interviews and observations while interacting with the online discussion board. The data was collected from students taking different online courses from the State University of New York Learning Network (SLN) in the 2001-02 academic year. Observations revealed that students are interacting with the content vicariously where the integration of multiple perspectives facilitate the construction of knowledge. Routines for reading and responding to discussion board messages also suggest that first students negotiate through the threads created, then based on personal criteria interact directly or vicariously with the content of messages.

Purpose

Quantitative researches provide valuable information for online teaching and learning however, the emphasis on grade/test score improvement does not really explore what is really going on in an online learning environment. How can we identify factors that increase participation and the quality of an online discussion? How can we evaluate the navigation patterns and their influence on the dynamics of the online community only assumed in an online discussion? This study presents the development and implementation of a research and evaluation protocol that analyzes online course participation for community building indicators and perceptions of learning.

Literature

Many believe that the defining characteristic of the computing medium is its interactivity (Bolter, 1991; Landow, 1992; Murray, 1997; Turkle, 1997). Recent research has focused on the general topic of student interaction within four defined categories: (a) learner-content, (b) learner-instructor, (c) learner-learner, (d) learner-interface (Hillman, Willis, and Gunawardena, 1994; Moore, 1989). And it has been more recently reported that a fifth interaction is that of (e) 'vicarious' interaction (Sutton, 2001), whereby students do not interact directly at all, but observe and process both sides of direct interaction between two other students or between another student and the instructor (Sutton, 2001).

The online discussion board of an asynchronous course requires students to navigate and interact with the discussion board thereby manipulating its structure. This research project examines these interactions, however, further investigates the interaction a learner has with the interface of the discussion board, as well as the instructor, course-mates, and content. The online discussion board is one tool students use to communicate with each other, where they are working together to reach course goals while providing feedback to one another. Working together produces the externalization of the thought processes, the comparison of alternative perspectives, social facilitation, better learning, high self-esteem and more positive attitudes toward the learning experience (Salomon & Globerson, 1989).

Methodology

This qualitative analysis involved interviews and observations. Students who were enrolled in online graduate courses volunteered to take part in this research. This exploratory study included a heterogeneous mix of eight students enrolled in online courses in education at a large research university in the Northeast. Their participation included an interview and an observation. Interviews included questions about their feelings, attitudes and beliefs about using the discussion board to build knowledge and community online. Observations were made using a camcorder and picture in picture monitor, where the student's image and computer screen were recorded onto videotape. The students were video taped to have a record of their interaction and their thoughts when participating in the discussion board. During this time, students were asked to 'think aloud.' The think aloud method was used to elicit any emotions, feeling or perceptions of the messages posted to the discussion board, from the perspective of the user.

Results

In the interviews, students responded that they felt a part of a learning community and described their routines for navigating the online discussion board. Examples for each are given:

Learning community	Knowledge building	Routines for Navigation
"I feel a part of the online community of all people who've taken online courses and also a part of the smaller community that is my online course I'm taking now."	"I am excited that the information in this module correlates with an ETAP course I took last summer! I have the opportunity to draw on prior knowledge."	"First I check to see if anyone has responded to any postings I have made. Then I check out new postings. I respond to several postings, sometimes I do this randomly as to not respond to the same person all the time."

In the observations, student interactions with the structure of the discussion board, the content, their peers and instructor were a result of the learning community's dynamics. As a result, an online discussion provides students with the opportunity to experience the interactions of others based on their own personal interests and goals. Observations and interviews indicated that students were more motivated to read and respond to a message with which they identified culturally, professionally, or personally; to meet course requirements; to make others feel a part of the course; to anyone who responded to them; to those messages that integrated multiple perspectives.

Similar to Salomon & Globerson (1989), students reported that learning took place in the comparison of alternative perspectives. Also, as indicated by Gunawardena & Zittle (1997) and others, students were aware of other student's social presence based on immediacy behaviors. During observations, students made mention of other's negotiation patterns (such as how where, when and to whom they posted), experiences and cultural backgrounds. In addition, students used the discussion board to 'prime' their thought processes when composing messages to others, where vicarious interactions were observed.

Conclusion

Bangert-Drowns & Pyke (1997) defined learning engagement as the strategic mobilization of cognitive, volition and affective processes to foster personal meaning making. For the context of an online learning environment, we will continue to conduct more interviews and observations to investigate the possibilities of cognitive processes in terms of the message content, volition (decision-making) as the student's rationale for reading and responding (or not), and affect as the integration of social presence. We will also examine strategies for facilitating a discussion that promotes the integration of multiple perspectives, as well as, learning engagement where community and knowledge are built.

References

Bangert-Drowns, R. L., & Pyke, C. (1997) *A taxonomy of modes of student engagement with electronic literature.* Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Bolter, J. D. (1991) *The Writing Space: The Computer, Hypertext and the History of Writing.* Chapel Hill, NC: University of North Carolina Press.

Gunawardena, C. & Zittle, F. (1997) *Social presence as a predictor of satisfaction within a computer mediated conferencing environment.* American Journal of Distance Education, 11 (3), 8-26.

Hillman, D. C., D. J. Willis., and C. N. Gunawardena. (1994). *Learner interface interaction in distance education. An extension of contemporary models and strategies for practitioners.* The American Journal of Distance Education 8 (2): 30-42.

Landow, G. P. (1992) *Hypertext: The Convergence of Contemporary Critical Theory and Technology.* Baltimore, MD: Johns Hopkins University Press.

Moore, M.G. (1989). *Three types of interaction.* American Journal of Distance Education, 3 (2), 1-6.

Murray, J. H. (1997) *Hamlet on the Holodeck: The Future of Narrative in Cyberspace.* New York: The Free Press.

Richardson, J. & Swan, K. (2001) *An examination of social presence in online learning: students' perceived learning and satisfaction.* Seattle, WA: Paper presented at the annual meeting of the American Educational Research Association.

Rourke, L., Anderson, T., Garrison, D. R. & Archer, W. (2001) *Assessing social presence in asynchronous text-based computer conferencing*. Journal of Distance Education, 14 (2).

Salomon, G., Globerson, T. & Guterman, E. (1989). *The computer as a zone of proximal development: Internalizing reading-related metacognitions from a reading partner*. Journal of Education Psychology, 89,620-627.

Sutton, L., (2001) *The Principle of Vicarious Interaction in Computer-Mediated Communications*. International Journal of Educational Telecommunications, 7(3), 223 – 242.

Turkle, S. (1997) Life on the Screen: Identity in the Age of the Internet. New York: Simon & Schuster.

KNOWLEDGE ENGINEERING IN MULTIMEDIA DESIGN AND THE USE OF TBT FOR SPECIAL NEEDS: EFFECTIVENESS?

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Abstract: Multimedia Technology is an excellent technology for training students with disabilities. Because multimedia is interactive and synthesizes sound, images, and text, it supports new methods of communication in the learning environment. Multimedia Technology, applied to education, typically involves the use of computer-assisted instruction (CAI) in conjunction with other media and is very helpful when incorporated in technology-based training (TBT). Although a computer cannot replace a teacher in the classroom, when used as supplement, multimedia use in the classroom provides undeniable benefits for both teachers and students. The purpose of this research is to examine the degree of effectiveness of multimedia technology in training, in comparison to traditional print-based training methods. The course content is the same in the print-based training methods as in the multimedia program; it is the method of delivery that is different. Another concern of this research is to measure the qualitative nature of learning using multimedia.

INTRODUCTION

This study will discuss knowledge engineering in multimedia design for training purposes. The specific training context for testing is the training of finger spelling in eighth grade high school student at the *School for the Deaf*, in Bangkok, Thailand. Finger spelling is different from sign language; sign language is a complex visual-spatial language that is used by the deaf in which meaning is conveyed by a system of articulated hand gestures and their placement relative to the upper body whereas finger spelling means a communication by signs made with the fingers (Merriam 2001).

A knowledge engineer is one who participates in building expert systems (Poulter, Morris, and Dow 1994). Knowledge engineers are specialists in eliciting knowledge from experts rather than necessarily being experts in the domain itself. A new professional specialty has emerged from the development of expert systems. The term *knowledge engineers* (Heinich 1999) has been coined to describe the people who work with experts in a field to assemble and organize a body of knowledge and then design the software package that makes it possible to train someone to become skilled in the area or to enable anyone to call upon the skills of experts to solve the problem. The work of a knowledge engineering is similar to that done by instructional designers in task analysis and module design.

The objectives addressed in this study are: (1) to examine the effectiveness of multimedia technology in the training of hearing impaired students. In particular, is multimedia technology effective in training those who wish to learn finger spelling? (2) to measure the qualitative nature of learning using multimedia technology.

EXPERIMENTS

To test the effectiveness of multimedia technology compared to traditional training methods, the testing involved two comparison groups of learners from eighth grade high school students from the *School for the Deaf* in Bangkok, Thailand. Group one (the first group), used the multimedia training program in CD-ROM format. The program called *Life in Saskatchewan*. Group two (the second group), learned from print material representing traditional methods. There were nine hearing-impaired students from the eighth grade who participated in this program. Four hearing impaired students were in the first comparison group and five students in the other group. All students in both groups were required to finger spell specific 30 English words.

ANALYSIS & RESULTS

- The results of the test have shown that most students improved their learning in both methods.
- The two methods of teaching and learning (multimedia training and print-based methods) impacted students about the same since the average scores of both groups of students were not much different.
- Most students (eighth grade high school students at the *School for the Deaf*) enjoyed learning from CD-ROM.
- Even though the result has shown that 67% of the students preferred computer, there were 22% felt more comfortable to learn from the instructor.
- In learning *English Finger Spelling*, the students preferred computer rather than instructor whereas 22% preferred both.

CONCLUSIONS

In this study we have been trying to examine the degree of effectiveness and potential benefits of multimedia technology and to measure the qualitative nature of learning using multimedia. The result of this study has shown that there were similar results in learning between multimedia technology and print-based methods. However, students enjoy learning from multimedia training more than from traditional methods. We found that the impact of multimedia was much more effective than print-based methods in motivating the students to *want* to learn and practice the lessons. The results have shown that almost 70% of the students accepted that learning with computer is *excited* and *fun*. In addition we would like to add that multimedia technology can be used as a *motivational tool* and as a *valuable supplement* in the training.

REFERENCES

Dow, Julie, Alan Poulter, and Anne Morris. (1994). LIS Professionals as Knowledge Engineers. *Annual Review of Information Science and Technology . 29*. New York: Wiley. 1-6.

Heinich, Robert, Michael Molenda, James D. Russell, and Sharon E. Smaldino. (1999). *Instructional Media and Technologies For Learning 6th edition*. New Jersey: Prentice Hall.

Webster's New Collegiate Dictionary. (2001). Springfield, G. & C. Merriam.

Pre-service Teacher Education Students Teach Their Teachers Technology!

Teaching to Learn: A Consultant/Client Model to Enhance Classroom Integration of Technology
1999 PT3 Implementation Grant Project

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Abstract

In its third year, this PT3 project places established professional educators and pre-service teacher education students with technology skills in a mutually supportive, collaborative, technology enhanced environment to enhance the modeling of classroom technology integration. Hear about lessons learned and how project activities will continue after the end of the grant period.

Description of Project

A recent national survey on the preparation of new teachers to use information technology (Moursund, 1999) reports that most college and university faculty do not model the use of information technology skills and most student teachers do not routinely use technology during field experiences. This integration factor, composed of items that addressed graduates' classroom skills and the actual use of information technology during college training was the best predictor of other scores on the survey. The "Teaching to Learn Project" offers a model, which provides a long-term solution to the "lack of modeling and use of technology in pre-service teacher education" problem in university classrooms and in field placements. The project's consultant/client model places pre-service teacher education students with technology skills and established educators (university faculty and K-12 teachers) in a mutually supportive, collaborative environment which itself is enhanced through information technology.

The central focus of our project is a 4 semester hour elective course entitled "Consultation: Technology Applications in Education" which is open to pre-service teacher education students who have successfully completed a required hands-on Educational Applications in Technology course. During the Consultation course the students are taught consulting skills in a real world, project-based learning situation. A required component of the course is an 80-100 hour commitment to serve as a technology consultant to a K-12 classroom teacher (client) in an urban or suburban district which serves as a field placement site for our education program, or to a university professor (client) in any discipline which might serve teacher education students. This consultant experience provides "behind the scenes" experience with the actual problems classroom teachers face when they try to integrate technology into their daily classroom activities.

The primary goal of each student consultant is to help the client (experienced educator) enhance the modeling of technology integration in his or her classroom. The secondary goal is to learn "classroom wisdom" from the experienced educator. After establishing and piloting the course in the first year of our PT3 grant, during the second year we refined the course, determined more specifically what support the student consultants need to successfully carry out their charge, developed enhanced support mechanisms and materials in the form of:

- major additions to the project website (http://pt3.oakland.edu)
- major additions to print and software resources available in our Educational Resource Laboratory
- improvements in identified areas in the recruitment, selection and preparation of the clients (experienced educators)

We have also begun the process of identifying and developing alternative systems for carrying on various components of the project after the end of the grant.

Major findings

Persistence pays off. As we enter the third and final year of our grant period we are very much aware of one of our original goals, which was to develop a strong following for the consultant course, the cornerstone of our project. Because it is an elective for our undergraduate teacher education students and is very demanding, if the course is not considered "worth the effort" students will not continue to enroll in the course. We have now offered the course 5 times, including the pilot, and it appears that the word is out among the students that the course is definitely one of the highlights of the undergraduate program. We have averaged approximately 13 students in each class after the pilot offering, and already have students on the waiting list for the Fall 2002 course after the end of the grant. We have received permission and have begun to develop a major and a minor

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in Instructional Systems Technology for which the Consultant course will be the capstone experience. This program begin going through the approval process in Fall of 2002.

Quotes from Project Evaluators Report

Qualitative types of information are being collected during the evaluation process. A summative evaluation has been conducted at the end of each semester beginning with the pilot semester and will continue in the years after the project has ended in order to assess the project's outcomes and long-term impact. Using both individual interviews with the consultants (students) and the clients (faculty members, K-12 teachers), observations, and surveys, the impact of the project will be measured.

Client: All clients highlighted the benefits of having a consultant who can cater (one-to-one) to their needs and can accommodate their own personal pace of learning. Some of them have already participated in technology related training and described how difficult it was to keep pace with all the other participants and after the training to find the time to practice what was learned. The client-consultant relationship allowed them not only to learn at their own pace, but also to practice under the guidance of their consultant. One of the clients described her experience in the following way:

> It is a wonderful program. To me it was a tremendous support, because you see, I love the one-to-one thing, and the fact that the consultant is a student, because then you don't feel intimidated. Every time, I tried taking classes, but most of the people who go there, some of them are really good, and I was always three steps behind, and I would feel completely stupid, because I didn't know what they were doing, and I did it a couple of times, and it didn't work for me, because it was too far, or I got lost, and I was embarrassed to ask questions. This way is great, because the student comes and if you have any questions, she goes and asks and the next time she has the answer, so it's perfect. I think it is a perfect situation. I love it. To me it was great. Whoever invented this had a great, great idea and I think the people are doing a wonderful job. And I commend them, and I'm very thankful that I learned about this [PT3 program] because I could never have done this by myself. So to me it was very, very helpful.

Consultant: The primary reason for participation in the project by the pre-service teacher consultants was to increase their knowledge of how to integrate technology into their classroom teaching. A majority of the consultants did not consider themselves to be highly skilled in technology as they began the Consultant course. For this reason, a majority of consultants felt discomfort and apprehension at the beginning of the project. The principal source of this apprehension was a perception of not being an expert in technology. However, as the project proceeded, eighty percent of the consultants indicated that they had crossed a confidence threshold or competency threshold with regard to the use of technology. One of the consultants described her experience in the following way:

> I think of all the things that I learned, the most valuable is just get out there and play around and just give it a try, rather than be scared. I used to always want somebody over my shoulder when I did it. Now, I am willing to get out there and try it and fail a little bit. But I just keep pushing away at that and I don't think I had that before. Because that's, to me, that's a lot more important because I can try every program now and I can get my way through it.

References

Moursand, D. (1999). *Will new teachers be prepared to teach in a digital age? A national survey on Information Technology in teacher education.* Santa Monica, CA: Milken Family Foundation.

Savery, J. R. & Duffy, T. M. (1995). Problem based learning: An Instructional model and its constructivist framework. *Educational Technology*, 35(5), 31-38

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Understanding Participation in Online Courses: A Triangulated Study of Perceptions of Interaction

Abstract

This presentation reports the results of a study that explored instructor and learner perceptions and attitudes toward interaction in online courses. Participants included faculty and learners involved with an online course as well as other faculty and learners who have expressed reluctance toward participating in online courses. Analysis of data revealed that although perceptions regarding interaction varied among all interviewed, upon reflection all course participants agreed that the interactivity was at least adequate in learning.

Purpose

The purpose of this study is two-fold. First, our goal was to gain a deeper understanding of the perceptions shared by learners and faculty that are reluctant to enroll in online courses or those who withdraw early in the experience. Second, we wanted to explore instructors' and learners' attitudes and perceptions of interaction after they had experienced an online course.

Research Questions

1. How do learners and faculty (both participants and non-participants of the course) perceive the value of interaction in online courses?
2. What is the nature of the relationship between learner-learner and learner-instructor in the online class?
3. What strategies did the instructional team design to promote interaction?
4. In what ways did the instructional team address learner-interface interactions, and how did the learners perceive this form of interaction?
5. What pattern of interaction developed?

Methods

This study was based on data gathered from interviews, online course documents, and computer transcripts. Participants included 3 faculty (1 course instructor and 2 non-course participants) and 15 learners (11 learners who were enrolled in Engaging with Technology (EWT) and 4 who either chose not to enroll or withdrew after the first session).

The online course documents included an analysis of the course syllabus, a participant's guide and other materials that supported each of the learning activities. Transcripts of online communications captured threaded and chat discussion among learners and the instructor.

The analysis of the transcripts used a 5-step discussion analysis technique devised by Henri (1992).

Analysis and Preliminary Results

The interviews revealed the following about the four types of interactions: Interaction between the learner and the course content—most of the learners found that the course content was appropriate for the stated objectives of the course and was presented in a clear and concise manner.

Interaction between the learner and the instructor—most of the learners found their online interactions with the instructor (through the chat room and discussion board) to be very helpful.

Interaction between the learner and other learners—most of the learners thought that interactions with their fellow learners were very helpful in doing assignments, and clearing up questions and doubts.

Interaction between the learners and the interface—most of the respondents said that they were for the most part satisfied with the interface of the online course.

Computer Transcripts Analysis

We analyzed the average length of a student's post. For example, in Week 2, the learners replied to the instructor's messages and posted on average 55 words or about 5 sentences. For later weeks, learners seemed to post more than the average of the first week because they were looking for help in terms of course projects, and computer and technology-related problems. Also, some of them needed help in order to implement technology in their teaching in their school districts.

We found that most of the messages that were posted involved the course content, computer and technology skills, and the course projects. Not only did the learners share knowledge, but content analysis indicated that the learners were posting messages at a very high cognitive level. Furthermore, after reviewing the messages each week the researchers were able to distinguish some of the learners' characteristics in both the discussion board and the real-time chat room. For instance, many learners who are sociable in nature posted more messages and demonstrated high cognitive skills. Moreover, they added the comparison of the messages between themselves and the other classmates. Some learners, however, posted quite short messages.

Summary

Analysis of data revealed that although perceptions regarding interaction varied among all interviewed, upon reflection all course participants agreed that the interactivity was at least adequate. Detailed discussion analysis substantiated these perceptions, showing that deep levels of processing and interactivity were achieved.

Reference

Henri, F. (1992). Computer conferencing and content analysis. In A. R. Kaye (Eds.), Collaborative learning through computer conferencing: The Najaden paper (pp. 115-136). New York: Springer.

Internet Work Strategies and their Influence on Learning Outcome

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Abstract: This paper is a report on the findings of an exploratory study investigating students' use of the WWW and the corresponding learning outcome in a school related setting. 45 students aged around 17 were asked to perform research on a topic in physics in order to write an essay. The only help provided was access to the Internet and a word processing program. A pre-post-testdesign captured learning outcome, and log files were used to follow user activities.

First results show that we are able to describe and distinguish different strategies of students using the Internet. Beside other factors like prior domain specific knowledge, computer literacy, and writing skills navigation strategies do have a significant impact on students' posttest scores: there are favorable and unsuitable Internet-Work-Strategies.

The identification and description of effective strategies and their influencing factors will lead to a better understanding of students' work with the WWW and hence can improve their Internet performance for the purpose of learning.

Introduction

The Internet plays an important role in schools nowadays and is seen as an essential tool to support teaching and learning. Much credit is given to this new medium pointing out that the WWW opens a set of new options which teachers haven't had before the times of the Internet. In the past, much euphoria about the Internet itself concealed the basic idea of any media, to provide a *tool* to support *learning*. We like to draw the attention on aspects of learning by identifying and evaluating Web-Work-Strategies of students. By analyzing both these strategies of students' work with the Internet and the gained knowledge, we investigate the dependence between these two aspects (see Priemer & Schön 2001).

The Study

The main objectives of the investigation are:

1. an identification of Web-Work-Strategies and factors influencing and describing these strategies,
2. the assessment and analysis of domain specific knowledge gained by students working with the WWW, and
3. an approach in detecting dependences and correlations between strategies and gained knowledge.

In December 2001 and January 2002 we asked 45 students of German high schools to participate in a laboratory pre-post-test investigation. The students had to write an essay on a topic in physics: the description of the generation of tides. For the corresponding research and text editing the students were allowed to use computers only, which provided Internet access and word processing programs. The students were selected in a way that they had sufficient prior knowledge in general physics and the mechanical laws behind the complex phenomenon of tides. About tides in particular the students had almost no knowledge at all. In the pre-evaluation this proved to be ideal to connect the Internet work with students' learning outcome. A data mining program collected all activities of the users: webpages visited, time on webpages, words typed, local actions aso.

Findings

On a five level rating-scale students specified in a self-assessment how much their work strategy matches with the navigation strategies defined by Canter et al. (1985).

In addition, the posttest contained questions about tides to assess learning outcome.

Navigation Strategy	Correlation with Posttest
Scanning: users seek to cover a large area without great depth.	- .066
Browsing: users go wherever the data takes them until their interest is caught.	- .367*
Searching: users are motivated to find a particular target.	.357*
Exploring: users are seeking the extent and nature of the field.	.504**
Browsing: users amble along and inevitably revisit nodes in an unstructured journey.	- .424**

Tab. 1: Navigation strategies (Canter et al. 1985) and their relation to posttest scores

The left column of table 1 summarizes the strategies. Students' strategies do not necessarily exclude each other, e.g. a person can see himself as an "Explorer" and as a "Searcher". In addition, strategies do not have to be stable attributes of students but may depend on the task they are working on. Table 1 shows the correlations between navigation strategies and posttest scores. We can conclude on one hand that "Searching" and "Exploring" seem to be favorable strategies since they correlate significantly with the posttest. On the other hand "Browsing" and "Wandering" seem to hinder learning with the WWW. Between the self-assessment of working as a "Scanner" and the posttest scores no significant correlations were found.

Log file data is used to verify these results by objective measurements and the help of a mathematical model (a first approach is outlined in Zajonc & Priemer 2001) that differs between three categories (see as well Choo, Detlor & Turnbull 2000): moves (visits of single webpages), patterns (clusters of moves that are directly connected to each other), and strategies (clusters of patterns that sequentially performed describe a complete Internet-session). This will allow us to collect and process user data in order to describe and evaluate Internet-Work activities without having to rely on subjective assessments.

Conclusions and Outlook

Our investigation shows that indeed Internet work strategies do have a veritably influence on learning outcome. "Searching" and "Exploring" can be seen as helpful strategies while "Browsing" and "Wandering" hinders learning with the WWW at least as far as a specific given learning objective is concerned. The identification and description of effective Web-Work-Strategies (or combinations) enables teachers to support students' work with the WWW. An objective and automated collection of user data with log files can identify and evaluate Web-Work-Strategies (in addition to those described by Canter at al. 1985). In a long run we aim to set the base for an adaptive help tool that reads, analyses, and evaluates log files of students' who work with the Internet, detects weaknesses and gives suggestions to improve the working style.

References

Canter, D., Rivers, R. & Storrs, G. (1985). Characterizing user navigation through complex data structures. *Behaviour and Information Technology*, Vol. 5, No. 2, 93-102

Choo, C. W., Detlor, B., & Turnbull, D. (2000). Information Seeking on the Web: An Integrated Model of Browsing and Searching, *First Monday*, Vol. 5, No. 2

Priemer, B. & Schön, L.-H. (2001). Students' Use of the Internet as a Help to Write Essays. In Montgomerie, C.; Viteli, J. (Ed.) *Proceedings of ED MEDIA 2001 Tampere Finland*, Norfolk, VA/USA: AACE, 1522-1523

Zajonc, R. & Priemer, B. (2001). Time – Logfiles' Neglected Data. Paper distributed at the *Annual Meeting of the American Educational Research Association (AERA)*, Seattle, USA

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Daskom On-Line: Implementation Distance Learning On Basic of Computer Course

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ABSTRACT

Recent developments in the WWW have brought major changes in distance learning practices. With the connectivity advantage, distance learning through the web can now be conducted on-line to support both instructional aspects and technical aspects. The Department of Electrical Engineering, University of Indonesia has started the implementation of such distance learning mechanism called The "Daskom On-line". One of the supporting functions the the Daskom On-line is the Online Test System.

This paper will discuss the implementation of the computer-based testing in the way the Daskom On-line been developed with. The type of computer-based testing adopted in the system is a linear testing method. The system used for computer-based testing is called "Kuis Dasar Komputer On-Line" ("Daskom On-Line Quiz System"). By implementing the software, lecturers can better manage evaluations on student's performance, thus resulting more objective scores.

Keyword: *Daskom On-Line, Quiz On-Line, Web Based Learning, Distance Learning.*

1. INTRODUCTION

The Internet with all its infrastructures spread all over the world has proven to be a very effective and efficient tool to provide any requirements and services. Its revolution of information transfer capacity attracts many people to immediately participate in its utilization [1]. Internet is the superhighway of information network also known as the Web Based System (WWW) [2]. Among many fields utilizing the internet, the education is one of the most that has been taking advantage of the internet community in the form called *web-based learning* or *distance learning*. Some systems developed for such distance learning environment were EDLIN [3] and PASSENGER [4].

Whenever there is a learning process, there will also be an assessment process to evaluate the level of student's understanding and capability. In a distance learning environment, computer based testing or online testing is an environment where students participating in distance learning can take their exam or quizzes through out their own computers technically without making the use of papers or any other writing tools.

This paper will discuss some aspects found in the implementation of distance learning project developed in the Electrical Engineering Department, University of Indonesia which is called the Daskom-Online. The focus of this paper will be on the learning evaluation process.

2. THE DASKOM-ONLINE [2]

The Daskom On-Line is using a strategy called collaborative learning strategy. Collaborative learning has proven to be a unique and important strategy in online learning. Collaborative learning is the learning strategy that relies strongly on the concept of interactivity between teacher and the class [5]. In this research, interactivity can be implemented through all media in the Internet.

Another consideration of using collaborative learning strategy is that it provides greater chance of achieving best result rather than other strategies [6]. The concept of distance learning and Daskom On-Line incorporates the collaborative learning strategy in this research through the utilization of computer network media to access the material.

The course's material is developed for the web based learning implementation based on materials provided by the teacher of basic computer course. Material was developed using HTML and was placed in a web server that is connected to the campus wide network. This type of material distribution has several advantages such as easy to update, can be access from almost every places through Internet connection and can be provided with interactive basis. Links from the syllabus to a web page for each class session or each chapter can be added to this kind of material.

Daskom On-Line use several types of media to communicate, which are e-mail, mailing list, bulletin board, and discussion board. The students can use these communication media to solve problems or to communicate with the teacher or assistant.

3. THE DESIGN OF DASKOM ON-LINE QUIZ SYSTEM [1]

Daskom On-Line Quiz System is a computer-based testing implemented to support the Daskom On-Line Distance Learning environment. It support the multiple choice questions on the topics related to the Daskom materials (Introduction to Computers). Students participating in the Daskom On-Line can take quizzes as part of the evaluation process required for them to pass the course. The participation in this system also benefits the analysis of the computer-based testing implementation that being developed.

The Daskom Online Quiz Process

The Daskom On-Line Quiz System performs several steps from the beginning of the quiz until the end. All the processes are sequential processes that required to be executed exactly the same way. To ensure that the system will work in the exact sequential manner, pages delivered to the student's browser is managed by a scripting language. This scripting language will also enables some overrides in the system whenever needed.

4. SYSTEM'S IMPLEMENTATION AND TESTING

Entering Questions and Answer Options

The Question's type currently supported is the multiple choice questions. A radio button is used to provide answer selection among options. This will prevent duplicate answers.

Quiz Result's Analysis

After a quiz has ended, the results in forms of score cards of all the participants can be analyzed. There are two analysis modes provided in the system:

- Simple Mode
  Using this mode, a lecturer can easily observe the scores each students got in their quiz. All the results are shown in pages.
- Expert Mode

This mode support advanced filtering technique and detailed view of the quiz results. It is intended to provide in depth analysis of the quiz performance and the quality of questions.

Question's Analysis

The purpose of question's analysis is to determine whether the question is correctly stated and whether the students can answer it correctly. Questions are displayed with their hit scores. The hit scores are the number of right answers the students choose on that specific question.

This tool is a very useful tool especially in detecting faulty questions and in the long run can detect the depth of overall student's achievement that may require improvements in specific part of the course material. The tool can also rank the level of difficulty of topics being examined. Figure 1 shows the screen capture of Question's Analysis interface.

Advantages and Weaknesses of theDaskom On-Line Quiz System

The Daskom On-Line Quiz System has several advantages and weaknesses.

The Advantages are:

- Provide isolated environment

  The scrambling technique can minimize cheating especially since no students got the same presentation of question

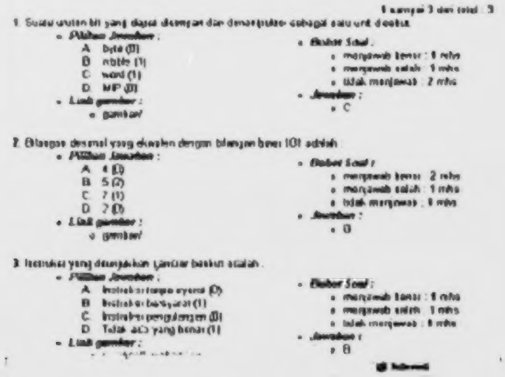

Figure 1. Question's Analysis in
Daskom On-Line Quiz

- User Interface
  The user interface is designed to provide simple operation with interesting displays using specific colors to differentiate parts of the questions presented.
- Figures and graphics support
  Figures and graphics support can improve the understanding of the question presented.
- Facilities
  There are three facilities provided to students when taking their quiz which are question's navigation, checking answers before grading occurred, and retaking the quiz whenever permitted.

The Weaknesses are:

- The radio button prevents students to cancel their answers. Any selection will indicate that an answer has been performed and the user can only change the answer but cannot cancel the process.
- Since the answers cannot be cancelled, the only grading mechanism supported is the correct answers calculation mechanism. Implementing negative scores in wrong answers will not be fair since the students are forced to choose any options presented whenever they have committed the answer.
- The current database design can only support a one time quiz session. Any re-examination will result overwriting the existing data.

Analysis on the Online Quiz Execution

Through a field observation in an environment where the quiz takers are performing their exams, there are several problems identified.

The problems are closely related to the behavior changes in exam environment. Some of the students felt inconvenient taking exams from the web using a very limited screen size. This problem leads to impatience that induces them to become careless when answering the questions.

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Generally, the Daskom On Line Quiz system satisfied the requirements. Comparing the results of the online Quiz with the conventional ones (in this case these same questions have been implemented in different environment), it shows no significant difference between the two. Most of the students acquired similar scores and statistically the results are identical.

6. CONCLUSION

- The Daskom On-line Quiz System has proven to satisfy the standards of exam requirement and worked well under the circumstances in the department of Electrical Engineering, Faculty of Engineering, University of Indonesia.
- The evaluation results show that the Online Quiz has similar results when compared to the conventional exam environment.
- There are some weaknesses in the system, but most of the problem can be overcome when the students got enough practice with the new learning environment of distance learning through the web and its multimedia network.

7. ACKNOWLEDGMENT

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8. REFERENCES

[1] Donna Iwan, Anak Agung Putri Ratna, " Penerapan Tes Berbasis Komputer pada Kuis Daskom On-Line", Skripsi Universitas Indonesia, Depok, 2001

[2] Anak Agung Putri Ratna, Luhur Bayuaji and Muhammad Salman, "Design And Implementation of Distance Learning in Basic Computer Course", *IMSA '01 IASTED Proceeding*, pp. 51-55, Hawaii, 2001

[3] Makoto Nakayama, Yusuke Yanagida, Shinichi Fujita, ShunChen, and Seinosuke Narita, "Integrated CAI System for Language Education", *Web Net Proceedings*, San Antonio, October-November 2000.

[4] Stefan Werner, Axel Hunger, Frank Schwarz, "The PASSENGER Approach to Conduct a Software Engineering Lab via Tele-cooperation over the Internet", Proceedings of 7th International Conference on Computers in Education 1999, Chiba, 1999.

[5] Patricia Comeaux, Richard Huber, James Kasprzak, Mary Anne Nixon, "Collaborative Learning in WEB Based Instruction", *Web Net Proceedings*, Orlando-Florida, USA, 1998

[6] Mario Allegra, Giuseppe Chiazzese, Maria Rita Lagana, "An Internet Service to Develop Cooperative Learning Environments", *IMSA '00 IASTED Proceeding*, Bahamas, October, 2000

Using Computer-Based Learning Environments to Offer Collaborative Opportunities to Engage Students: One Case Study Using the Program "Alien Rescue"

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Abstract: A project was initiated to study computer-based learning environments as they relate to collaboration and engagement. In a sixth-grade classroom, five pairs of students were observed while they worked through a computer-based program called "Alien Rescue". The main research questions were: 1) what aspects of the program "Alien Rescue" in a classroom environment support collaborative efforts to engage students? and 2) what behaviors are exhibited by the students that could indicate engagement? It was observed that time pressures and complexity of the problem were two factors that supported full engagement of collaborative efforts.

Theoretical Perspective

The CD-ROM based program, "Alien Rescue", developed and designed under the supervision of Dr. Min Liu at the University of Texas at Austin, is designed to offer a meaningful learning experience by combining a realistic, authentic environment with problem-based learning meant to incorporate collaborative activities. Students must learn about several alien species as well as the planets and moons in our universe in order to find suitable homes for each alien species. To obtain the information, the students have access to several databases, as well as a simulated base from which a student can retrieve information from probes.

For students to be successful in completing the program in the time allotted, the students must consistently collaborate with each other and stay engaged in the task of finding the aliens homes. Yet, what does it mean to be engaged? One way to look at engagement is to break it down into a combination of two ideas: user involvement and user participation (Hwang & Thorn, 1999). Csikszentmihalyi (1997) looks at user involvement in his theory of "flow." One becomes so mentally involved that "the sense of time is distorted, hours seems to pass by in minutes" (p.29). It is this complete psychological immergence within the experience that characterizes a state of flow (Foshay, 1991). Metros (1999) feels that such involvement depends upon the user's perception of the information, or the "value" as Metros says it, that keeps a user engaged. One could speculate that a problem-based learning activity, in which students found value of information-gathering activities, combined with interesting interactive tools and a collaborative format, would lead to a high level of user participation. Furthermore, the instructional design of the activity would need to incorporate a high level of concentration as well as collaboration to lead to an engaging experience. Therefore, the questions this study hoped to answer included: 1) what aspects of the program "Alien Rescue" support collaborative efforts to engage students? and 2) what behaviors exhibited by the students could indicate engagement?

Method

This study was done in one sixth-grade classroom in a middle school in the Greater Austin, Texas area. Students were tasked to work in pairs to decide, based on evidence they collected through the computer program "Alien Rescue", where each of six species of aliens should be placed in our solar system. Each pair of students had one computer to use for 45 minutes a day for a total of three weeks. The researcher observed five sets of students, four from one table and one from a separate table for approximately two weeks. The pairs of students were chosen based on preliminary observations of the class as a whole, and the decision to choose both students who seemed to collaborate well together and students who did not. The pairs of students were labeled A, B, C, D and E. Pairs A through D were at one table, and pair E was at a separate table. Data was taken in the form of observations of the class as a whole and the five pairs of students, questions asked of the students, and the place each pair stood when the teacher checked the databases.

Results

At first, the students read and took notes about the fictitious aliens, a relatively simple task. During this time, the students seemed relaxed, and sometimes made jokes among them that were not topic-related. Of the five pairs chosen for study, only four of the groups seemed to work well together. As the days went by, students became more aware that they would soon need to be finished with the program. At the same time, most groups progressed to the point of creating probes to find out information about the Solar System. Creating a probe incorporated complex thought processes that included matching data needed to appropriate instruments to probe mechanics. Groups A, B and C frequently asked questions of each other concerning probe design. However, group D did not participate in the table discussion. Group E continued a pattern of not discussing the program with each other and often not exhibiting behaviors consistent with being engaged in the assigned task.

Four days before the end of the project was due, the teacher looked at each pair's database to assess where each pair was in relation to finishing the program. Groups A, B, and C were allowed to continue, while Groups D and E were told to stop. During the last four days, pairs A, B and C worked together more and more often, to the point of delegating responsibilities among themselves with the idea of sharing what each had found with the others. Furthermore, in these last four days, the students of pairs A, B and C rarely made jokes or talked of anything besides the topics at hand. They seemed to lose tack of the time in class, and they commented on how fast the classes seemed to go by. These comments support the idea that these pairs of students became engaged to the point of "flow" (Csikszentmihalyi, 1997; Foshay, 1991).

Discussion

If Metros (1999) is correct about how perception is related to engagement, then the activities held more value as the deadline neared (a point of extrinsic motivation) and the complexity of the tasks increased (a point of intrinsic motivation). Furthermore, the more successful each group was in collaboration within the group and with other groups, the farther the group progressed in the program. It would seem that the collaborative aspect of the activities created a more engaging environment, as such an environment led to the shared value of the activities.

However, this study has several limitations. The scope of the study was very small, and it may not be possible to reproduce the results. Furthermore, as this is a newly-initiated project, more observations need to be done to better determine the relevance of the data collected during this study. Factors that may have contributed include student perception and self-efficacy as they related to the task, and the depth of teacher facilitation. Further studies regarding teacher facilitation and motivational factors, such as time-limitations and complexity of technology-enhanced tasks, need to be implemented so as to better understand how a constructivist paradigm fits into a technology-enhanced instructional design. However, it is hoped that this study can begin investigations to lead instructional designers of multimedia programs, as well as those who use such programs, to consider factors relating to the collaborative engagement of their intended users.

References

Alien Rescue: A Problem Based Learning Environment for Middle School Science Version 2.0). (2000-2001). [Computer Software].

Csikszentmihalyi, M. (1997). *Finding flow: The psychology of engagement with everyday life.* New York: Basic Books.

Foshay, A. (1991, Summer). The curriculum matrix: transcendence and mathematics. *J. of Curriculum & Supervision*, 6(4), 277-293.

Hwang, M. & Thorn, R. (1999). The effect of user engagement on system success: A meta-analytical integration of research findings. *Information & Management*, 35, 229-236.

Metros, S. (1999). Making Connections: A model for on-line interaction. *Leonardo*. 32(4), 281-291.

NEW DEVICES

CD-ROM Drives & Their Working:

CD-ROM is the abbreviation for Compact Disk – Read Only Memory. A CD-ROM is actually a thin piece of aluminum oxide with a little added gold or silver. This disk is covered both on the top and bottom by a transparent piece of plastic. Data is stored on to these disks by "burning" holes on the disk. These holes are called "pits". Depending on how deep they are, the data is read in as a '1' or a '0'. To store data on these disks, we need a CDR drive. There are also disks called CD-RW where data may be burned on to the disk, erased and re burnt later on with new data. These disks are however, costly and are beyond the scope of our discussion.

To read from a CD-ROM, the LASER hits the area to be read, and reflects of the disk to a miniature scanner, which translates it to the machine language. The difference that actually occurs in the reflected light is that, the intensity is lower due to diffraction when the LASER falls on a deeper pit.

Tape Drives and their Working:

Tape drives are very much similar in working when compared to that we use on our music systems. Both have a thin plastic strips with a magnetic coating. This magnetic coating is what is responsible for the data storage. Data is stored by actually magnetizing a few parts of the tape to indicate the 'on' state or the '1' in machine language.

As you can see that the winding up increases the access time. This is what is the greatest disadvantage of the tape drives. These drives are still existent in a few companies. Despite a lot of advantages, the tape drives are in the verge of extinction due to their speeds.

Our Model:

As discussed earlier, our model uses the same mechanism of the CD-ROM drives and the Tape drives. Each of those technologies contributes a significant part in our device.

DESCRIPTION:

The device contains a similar casing as that of the tapes with a small modification. The casing is transparent on the top and the bottom near the middle. A small shutter, like the ones in the floppy drive, covers these places. They can be opened and closed at will inside the tape drive. The rolling mechanism is the same as the magnetic tapes. The tape that holds the data is a thin strip of plastic in which another strip of aluminum oxide is sandwiched. This tape is rolled up and placed inside the casing. Data is burned into our tape by the use of a LASER as in CD-ROM drives. This data is stored in the tapes one after another in the data strips, as we shall call them. These strips are the thin layers of aluminum oxide. The data access time may be a little better that that of the tape drives as the reading of our device user a LASER rather that an magnetic head which takes considerable time to position itself. The fine LASER should be capable of *emitting light at multiple frequencies and should be able to focus at various distances. This shall enable us to store data on both sides of the tape thus increasing the amount of storage space available. As in a CD-ROM, a deeper pit is read in as the 'off' state and the less deep pit is read in as the 'on' state.*

WORKING:

The tape moves along the LASER beam and the scanner at the other end reads the data. This data is then decoded to machine language. The data may be stored on the tape in the same way as given below. The ASCII value of the codes are converted to their respective 8 bits or 16-bit binary code and stored in a sequence. Say we want to read the data on a particular strip at a particular position; the tape drive mechanism moves the tape first to the position and then seeks the strip on that position. This is similar to the floppy and hard disk mechanism where the data is retrieved by first moving to the sector from where the data is to be retrieved and then to the track from which to retrieve. The codes that may be used for storage, is given in the next page. The shutter of the casing opens automatically due to the use of some mechanical device like the ones on the floppy drive. The Laser is focused on the tape drive directly and also by making it reflecting over a mirror place inside the casing. This allows the LASER to scan both sides of the tape. This adds to more data storage. The LASER should be capable of multiple frequencies for the sake of security purposes. The default frequency as in the CD-ROM disks is used to store the code which resembles the frequency at which to read the rest of the drive if the data to be stored is to kept universal or available to all else the code for the frequency has to be entered by the user in order to read from the tape as the data is stored at that frequency and reading it using other wavelength of light will return meaningless data called Junk in computer jargon.

ADVANTAGES:

Most of the advantages of this disk have been discussed earlier. But for the sake of summing things up, here is what it has to offer

- *No loss of data due to scratches*
- *No problem of absolute data loss due to breakages*
- *Larger storage space than other storage media*
- *Better access time than tapes though inferior to CD-ROM's in that aspect*
- *Better security for the data*
- *No contact between the head and the tape as in tape drives thus no problem of the tape getting rolled up*
- *Can be used to store data, video or sound as in the case of other storage media.*

REFERENCES: -*This is our idea for our research work*

BEST COPY AVAILABLE

Computer based investigative laboratory experiences for distance learners in biology

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Abstract: In an effort to fill the need for lab-like experiences for distance learners, we have developed the 'BiologyOne' CD-ROM series. The CD series provides students with a series of open ended computer simulations that mimic the laboratory investigations commonly encountered in a traditional course. Assessments of the effectiveness of these simulations have shown student comprehension comparable to students in traditional courses.

Offering a general biology course in a distance learning format has presented instructors with the problem of providing the students a laboratory experience. To include this experience, instructors have often relied on compromising the course's outreach by having students attend an on site lab periodically, by investing in materials to be sent individually to students or by relying on the numerous computer based tools which generally offer a 'interactive' narrative of the text material but fall well short of investigative lab experiences. In an effort to fill the need for lab-like experiences for distance learners, we have developed the 'BiologyOne' CD-ROM series.

Material in the BiologyOne CD is organized into four primary sections. There are a Tutorial section, a Glossary section, a Laboratory section, and a Testing section. In addition, to aid and or speed up a users navigation through the CD, a 'Site Map' of the material is also available.

Within the BiologyOne CD, Tutorial Units have been developed which provide the student with dynamic visual and descriptive introductions to concepts and processes commonly covered in an introductory biology course. Visual resources include illustrations, animations, photos, and video. If the student is enrolled in a traditional course, these resources provide a means of reviewing material seen in lecture or lab. For the distance learning student, these units allow the student to view the material in a format that resembles the experience they would have in the actual laboratory.

For many of the topics covered in a general biology course, the BiologyOne CD provides an investigative laboratory simulation. The goal of these laboratories is to provide the student with an experience that mimics the laboratory experience they might have in a traditional course. For many of these simulations, the student has control of multiple variables that offers the opportunity for greater experimentation than is typically available in an introductory biology laboratory. Additionally, as we have developed these simulations, we have tried to expose the student to some of the equipment they might encounter in a 'live' course but at the same time have tried to keep the interface with the computer straight forward.

In addition to these sections, the BiologyOne CD also provides the student a glossary and a selftesting section. The glossary currently contains approximately 2,000 terms that the student may encounter during a general biology course. The student may access this glossary from any point within the program to review or clarify the meaning of a term. The Testing Section is designed as for the student to use to self assess their mastery of the material. Questions within the Testing Units include crossword puzzles, multiple choice and matching formats.

Accompanying the CDs are web based resources that provide the student a 'laboratory manual' as well as a short introductory biology textbook. The laboratory manual provides the students with directed activities to complete using the simulations and a location to record their observations.

Feedback from students that had used the BiologyOne CD in a distance learning course has been quite positive. Comments include: "The lab simulations were fun and educational. I was wondering how well the labs would be for this online class, and I was pleasantly surprised."; "I was very impressed with how real some of the lab simulations seemed. I learned a little more than I thought would be possible."; "I think the lab simulations are a really neat way to get the point and experience across conveniently. I wondered before I took the course how the lab was going to be done. I think it is great."; "The labs were my favorite part of the course."

Of primary importance is the effectiveness of the BiologyOne CD in allowing the students to learn the course material. An assessment of the effectiveness of these simulations was performed through comparisons with students in tradition courses. Student groups were either not exposed to the BiologyOne CD, used the BiologyOne CD in addition to their traditional course work, or used the BiologyOne CD as an alternative to their traditional course work. When students used the BiologyOne CD only, their comprehension of the course material was found to be comparable to those students in the traditional course. When students received both the computer simulations as well as the traditional laboratory, comprehension appears to increase with test scores increasing between two to ten percentage points.

"Citizen Jane": Rethinking Design Principles for Closing the Gender Gap in Computing

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Abstract: This paper identifies three rationales for closing the gender gap in computing – economic, cultural and political – in the relevant literature. Each rationale implies a different set of indicators of present inequalities, disparate goals for creating equality, and distinct principles for software and web site design that aims to help girls overcome the gap by increasing their interest and knowledge about computing. It is argued that designers should pay greater attention to the political rationale for equity, conceiving software and web sites that cultivate girls' civic uses of computers, so that women can exercise equal control over the architecture and policy of the information age.

In the recent literature on the gender gap in computing, arguments for pursuing greater equity among males and females may be urged for economic, for cultural, or for political reasons. Each rationale is significant, and often they are entwined in practice, but they are worth disentangling because each suggests different goals for achieving equity, distinct measures of current inequalities, and disparate design principles for media that aim to help girls overcome the gap. Focusing exclusively on one rationale is likely to obscure designers' understanding of the gender gap and how to address it. This paper compares each strand of thinking, and considers their implications for designing educational and recreational multimedia and hypermedia aimed at attracting girls to computing. Although many reasons have been offered for the gender gap, the lack of suitable software and web sites for girls is often cited as a cause (American Association of University Women 2000; Cottrell 1992; Furger 1998; Schofield 1995). Finally, it is argued here that the political rationale for equity has been neglected and that designers should devote greater attention to fostering the civic uses of computers by girls.

Economic Rationales

Traditional liberal feminist concerns about gender equity in schooling and the workplace underlie economic arguments for ameliorating inequalities of access to, uses of, and attitudes about computers (Fig. 1). Indeed, there is continuing cause for concern about girls' preparation for technical careers, according to the measures employed in this approach. Compared to boys, girls still report less experience with computers (Schumacher & Morahan-Martin 2001), less confidence in their computing abilities (Young 2000), and less interest in the technology (American Association of University Women 1999). In higher education, women's share of bachelor's degrees in computer science declined from a high of 37 percent in 1983 to 28 percent in 1996 (Camp, Miller & Davies 2000) and women earned just 17 percent of the doctorates in the field in 1998 (U.S. Bureau of the Census 2000). In 2000, UCLA's annual survey of first year college students nationwide found that 1.8 percent of women, compared to 9.3 percent of men, said they planned to pursue a career in computer programming, the biggest gender difference since the survey first posed the question in 1971 (Higher Education Research Institute 2001). In the workforce, women hold an estimated 20 percent of information technology (IT) jobs, and are especially underrepresented in systems analysis, software design, programming, and technological entrepreneurship (American Association of University Women 2000).

Arguments for educational and economic equity often lead to calls for software and web sites that feature women role models in the technical professions (e.g., Furger 1998), such as Cascade Pass's *You Can Be A Woman Engineer* CD-ROM or web sites for girls about careers in the field (e.g., www.backyard.org). It is hoped that this strategy will counteract many girls' image of technical work as masculine, dull, sedentary and anti-social (Garnett Foundation 1997), sucking more females into the educational "pipeline" toward higher

Argument	Type of Equity	Gender Gap Measures: Proportion of Females	Design Strategies
Economic	• Educational • Occupational	• In computer clubs, camps • In computer science and engineering classes, degrees • In technical jobs in IT • As equal earners in field • In entrepreneurial leadership	• Role models: corporate technical professionals, managers
Cultural	• Expressive • Aesthetic • Relational	• As internet users • As software consumers • As software entrepreneurs, designers	• Gender-Traditional • Gender-Nontraditional • Gender-Neutral
Political	• Civic	• As decision-makers, framers of computer design, regulation	• Ethics, law • Constructivist, feminist pedagogy • Critical thinking with and about technology

Figure 1: Arguments for Gender Equity in Computing

degrees and jobs in computer science and engineering. However, sole pursuit of the economic rationale can narrow designers' vision in ways that may be counterproductive, even for girls' economic interests. Too often, the range of role models provided is limited to professional and managerial roles in corporate IT settings, where employment is notoriously unstable. Moreover, as computer skills become central to many fields, from medicine and law to auto mechanics, these fields should exert more influence over technology design and uses (American Association of University Women 2000). Even if gender parity in IT jobs were achieved tomorrow, the vast majority of girls (and boys) would not work in this sector. Thus, girls would be better served by media that demonstrate the relevance of computing skills to a broader range of work than systems analysis or programming, which are not the only paths to molding technology and may be rejected by many girls.

The larger problem with the economic argument is that it tends to reduce the goal of technological fluency, indeed of education and play, to vocational training. The rhetoric of "keeping up" or "achieving equality" with males in technical careers rarely encourages girls to question the norms of the high technology workplace or the purposes of technology design. Nor does this approach ask girls to consider how women could transform those norms in ways that might benefit everyone, such as by making high tech careers more compatible with family life. Focus group research suggests girls are not necessarily fearful of computers but disenchanted with a masculine computer culture that they associate with obsessive work, materialistic motives, trivial and unethical uses of technology, and a false sense of control over the world (American Association of University Women 2000). For these girls, appeals to join such a culture that do not acknowledge how it might be changed and why it would be worth making the effort are likely to fall on deaf ears.

Cultural Rationales

Cultural arguments for equity focus on increasing females' opportunities to use and adapt technology to explore and express their identities, create and communicate, and maintain relationships. Here, the gender gap appears to be closing in some ways, according to the indicators used or implied by this approach. Men and women entering college now report that they use computers frequently in almost equal numbers (Higher Education Research Institute 2001) and women have gained parity with men in using the Internet, with teenagers accounting for the fastest growing segment of female users (Hamilton 2000). Women take greater advantage of email to maintain relationships with friends and kin across distance than do men (Boneva, Kraut & Frohlich 2001). In accordance with females' tendency to view the computer as a tool to accomplish tasks rather than an object of interest to be explored in its own right, females are more likely to use computer applications for word processing, graphic design and communication instead of play, programming or systems design (American Association of University Women 2000). There are more multimedia games designed by women-led companies for girls, although girls still buy only 12 percent of games (Gorriz & Medina 2000).

Cultural arguments emerged in discourse about the gender gap in the 1990s, especially in the debate over how to design multimedia games for girls (see Cassell & Jenkins 1998). One camp appealed to girls' traditional interests in cooperation, collaboration, glamour, bright colors, multiple paths through stories and environments, and so on. This "game girls" strategy suggests that the most effective way to increase girls' interest in computers is to show how the technology can be used to explore conventionally "feminine" activities, endorsing traditional aspects of girls' culture. It is indebted to cultural feminism, which posits a separate women's culture of nurturing and knowing (e.g., Gilligan 1982). This approach extends to web sites for girls that primarily feature information on dating, friendships, shopping and communication.

A second strategy urges girls to become more comfortable playing aggressive games designed for boys, in hopes of fostering girls' assertiveness. The "game grrls," as these teens and young women call themselves, appropriate the formerly male domain of computer games, embracing its images of feminine warriors and potent female sexuality as self-empowering (Wakeford 2000). Game grrls reject constricting images of females as passive victims or supportive helpmates, which they accuse girl games, boy games and prior feminist thinking of perpetuating. From this standpoint, the optimal way to boost girls' interest in computers is not to pursue a separatist design strategy, but to demonstrate the relevance of nontraditional gender interests to girls' lives, appropriate them as legitimately feminine, and beat boys at their own games. The game grrls share "third wave" or postfeminist rejections of earlier feminisms, seen by grrls as "constricting (politically correct), guilt inducing, essentialist, anti-technology, anti-sex, and not relevant to women's circumstances in the new technologies" (Wilding n.d.) The game grrl strategy extends to the web on sites that offer discussion forums and articles on games, sex, and culture.

A third approach calls for creating gender-neutral content based on non-violent interests common to boys and girls. This software may include mystery games (such as Myst) and puzzle games (such as Tetris) that do not feature recognizably gendered protagonists and villains, or that employ characters (including animals) of indeterminate sex. Justine Cassell (1998), one of the foremost advocates of this strategy, has designed software that appeals to boys' and girls' shared interests in self-expression and self-construction by embedding computers in familiar objects such as blankets and stuffed animals that children can use to record and share their own stories. Her games and toys apply feminist pedagogy's call for sharing power more equitably between teacher and student to the relationship of designer and user, and an emphasis on validating and learning from children's own subjective experience. Under this approach, the best way to interest girls in computers is to show their relevance to all children's interests in acting as detective or storyteller, with no intervening protagonists and overt gender preferences with which to identify.

One danger of the cultural approach is its exclusive thinking about how to address girls' identities and gender socialization. Thus far, the debate over game design for girls seems to have been won in the marketplace by gender-traditional advocates, as evidenced by the commercial dominance of *Barbie Fashion Designer* and other "pink software" (Gorriz & Medina 2000), and in academic and policy circles by gender-neutral proponents (see American Association of University Women 2000). However, recent experimental research suggests designers can increase girls' interest in computers, even in programming techniques, by demonstrating their relevance both to girls' non-traditional and traditional interests (Lynn, Raphael, Olefsky & Bachen forthcoming). Approaches that offer a single way of constructing girls' identities, including those that reflect only the interests they share with boys, are bound to feel limiting for some girls.

In addition, cultural rationales require a great leap of faith that girls' use of current multimedia games, regardless of how they construe users' identities, can serve as a gateway to technical skills and careers. Almost none of the current multimedia games foster an understanding of programming, systems or network design, where the gender gap is widest. Rather, they treat computers as a means to design clothes, disembowel aliens, or disclose stories. If we want to introduce girls to what is compelling about working with computers, none of these design strategies reveals much that is compelling about how computers work. If we want girls to have equal opportunity to shape the hardware and software of the future, multimedia design needs to encourage girls more overtly to explore how they might design or adapt the technology and to what ends.

Political Rationales

Political arguments for equity stress the need for women to be fully informed and enfranchised citizens of the information age. This approach suggests that girls and women need to know how technology works to participate in democratic processes of designing, implementing and regulating what Lawrence Lessig (1999) has called "code." By "code" Lessig means both the design of computer architecture (software, hardware and systems) but also relevant codes of law, policy and ethics. Girls need hands-on experience writing both kinds of code according to this rationale, which surfaces occasionally in policy discussions about technology in education (e.g., Committee on Information Technology Literacy 1999; Alliance for Childhood 2000), but almost never in the literature on gender equity and computing.

Is there a gender gap in the civic aspects of computing? We know far less about this gap than the economic or cultural ones, largely because we have not developed indicators that would allow us to measure its dimensions. Doing so requires thinking about who shapes technology design and regulation within corporations, government, academia and civil society. We could begin by assessing the amount and quality of women's participation in making decisions about code as corporate managers, directors, market researchers and designers; as members of relevant congressional committees and executive branch agencies that control research and development funding, marketing subsidies, military procurement, and the like; as managers of government IT projects; as members of the judiciary that frequently hear high tech law cases; as academic researchers and publishers on technology issues (not only in computer science and engineering, but in law, medicine and other disciplines); as program officers, presidents and trustees of foundations and nonprofit organizations involved in technology policy and research; as organizers of technology-related ballot initiatives; and so on.

From the civic standpoint, girls need to know how computers work, both their capabilities and limits, primarily to develop personal and public codes of technology ethics, law, and policy. Girls need confidence in their own ability to effect change in computerized settings, democratize technology design, reflect on their own choices about computers and get feedback on their social impacts. They need to develop critical thinking and ethical reasoning skills both *with* computers and *about* them. A single piece of educational software might allow them to do both, for example, by simulating the impact of different methods of computer donation, recycling or disposal on a town's schools, environment and economy. A game might be built around the challenges of keeping and communicating secrets in a school where web and email monitoring software is deployed, spurring exploration of how such programs work and their legal and ethical dimensions.

Gender-Specific Features	Gender-Neutral Features	"Code" Issues
• Exploring realistic social relationships • Role playing in familiar settings • Nurturing • Negotiation and conflict resolution • Creativity and art • Exploring worlds rather than conquering them • Complex characters • Rehearsing teen and adult issues	• Customizability (ability to create own characters, narratives, objects, pace) • Strategy and skill development • Multiple levels, areas, narratives • Ability to use collaboratively, socially • Puzzles and mysteries • Focus on a goal	• Privacy (especially of children online) • Access, digital divide • Security • Virtual communities (and their relationship to physical ones) • Educational technology investment and uses • Commercial pressures on the Internet • Open and closed source software; monopolistic practices • Environmental impacts of computing

Figure 2: Some Engaging Design Features for Girls and Contemporary Issues of "Code"

Media designers concerned with boosting female participation in writing the larger code of the information age would be well-served by design principles common to constructivist (Papert 1993) and feminist pedagogy (Cassell 1998). Designers would foster users' active construction of games and web sites rather than laying down fixed rules and rigid structures. Designers could develop content from the start in consultation with girls about meaningful problems of interest to them, showing girls how computing is relevant to the sources, solutions and arenas for exploring these problems. Media could encourage users' autonomous experimentation and discovery with the computer itself rather than leading them down narrow paths toward predetermined conclusions or lessons. Design might foster greater cooperation and interactivity among users. This kind of approach aims to inspire ongoing, reflexive consideration of girls' own experience with computer technology, "incorporating and coordinating considerations of self, others, and society" (Kahn, Jr. & Friedman 1998, p. 165). It asks girls to write not only programming code, but regulatory code.

Fig. 2 presents some design features that research has found are specifically compelling for girls (Beato 1997; Kafai 1996), and for girls and boys (American Association of University Women 2000), as well as some of today's most widely debated issues of code in technology law, policy and ethics. To serve girls' needs and rights as citizens, we can start drawing more lines between the columns, employing design features that work for girls to encourage them to explore questions of code and discover how they might shape the politics and architecture of computing.

Conclusion

This review of the literature suggests three distinct rationales for closing the gender gap in computing, indeed three different gaps: economic, cultural and political. It argues that scholars and policymakers have neglected the political gap and urges software and web designers to devote greater attention to addressing it. There are a number of good reasons for doing so. First, the cultural divide in computing already appears to be narrowing, as women go online in equal numbers and use the internet for communication. Second, by pursuing the approach suggested here, designers would more overtly foster girls' understanding of computing architecture, contributing to closing the economic gap as well by helping to familiarize girls with how the technology works as well as the social choices encoded in the hardware and software we use. Finally, and perhaps most important, this kind of design strategy would develop the kind of skills that all girls, and boys, need for effective citizenship in the information age: critical thinking with and about computing's impacts on our lives, and an appreciation of the relevance of information technology ethics and policy to gender-traditional and nontraditional interests.

References

Alliance for Childhood (2000). *Fool's gold: A critical look at computers and childhood*. Retrieved December 19, 2001 from the Alliance for Childhood web site: http://www.allianceforchildhood.net/projects/computers/computers_reports.htm

American Association of University Women (1999). *Gender gaps: Where schools still fail our children.* Washington, DC: American Association of University Women Educational Foundation.

American Association of University Women (2000). *Tech savvy: Educating girls in the new computer age.* Washington, DC: American Association of University Women Educational Foundation.

Beato, G. (1997, April). Girl games: Computer games for girls is no longer an oxymoron. *Wired, 5.04.* Retrieved December 20, 2001 from http://www.wired.com/wired/archive/5.04/es_girlgames_pr.html

Boneva, B., Kraut, R. & Frohlich, D. (2001). *Using email for personal relationships.* Retrieved September 3, 2001, from Pew Internet & American Life Web site: http://www.pewinternet.org/papers/paper.asp?paper=6

Camp, T., Miller, K., & Davies, V. (2000). *The incredible shrinking pipeline unlikely to reverse*. Retrieved September 18, 2001 from http://www.mines.edu/fs_home/tcamp/new-study/new-study.html

Cassell, J. (1998). Storytelling as a nexus of change in the relationship between gender and technology: A feminist approach to software design. In J. Cassell & H. Jenkins (Eds.), *From Barbie to Mortal Kombat: Gender and computer games* (pp. 298-327). Cambridge, MA: MIT Press.

Cassell, J. & Jenkins, H. (1998). Chess for girls? Feminism and computer games. In J. Cassell & H. Jenkins (Eds.), *From Barbie to Mortal Kombat: Gender and computer games* (pp. 2-45). Cambridge, MA: MIT Press.

Committee on Information Technology Literacy Committee, National Research Council (1999). *Being fluent with information technology*. Washington, DC: National Academy Press.

Cottrell, J. (1992, Mar.) I'm a stranger here myself: a consideration of women in computing. *ACM conference proceedings on user services* (pp. 71-76). Cleveland, OH: Association for Computing Machinery.

Furger, R. (1998). *Does Jane compute? Preserving our daughters' place in the cyber revolution*. New York: Warner Books.

Garnett Foundation, The Backyard Project (1997). *Encouraging young women to pursue careers in computer science*. Burlingame, CA: Global Strategy Group, Inc.

Gilligan, C. (1982). *In a different voice: Psychological theory and women's development*. Cambridge, MA: Harvard University Press.

Gorriz, C.M. & Medina, C. (2000). Engaging girls with computers through software games. *Communications of the ACM*, 43 (1), 42-49.

Hamilton, A. (2000, Aug. 21). Meet the new surfer girls. *Time*, *156* (8), 67.

Higher Education Research Institute, UCLA Graduate School of Education and Information Studies (2001). The American freshman: National norms for fall 2000. Los Angeles: Higher Education Research Institute.

Kafai, Y. (1996). Gender differences in children's construction of video games. In P.M. Greenfield & RR. Cocking (Eds.), *Interacting with video* (pp. 39-66). Norwood, NJ: Ablex Publishing.

Kahn, Jr., P. & Friedman, B. (1998). Control and power in educational computing. In H. Bromley & M.W. Apple (Eds.), *Education/technology/power: Educational computing as a social practice* (pp. 133-156). Albany: State University of New York Press.

Lessig, L. (1999). *Code and other laws of cyberspace*. New York: Basic Books.

Lynn, K-M., Raphael, C., Olefsky, K., Bachen, C. (forthcoming). Bridging the Gender Gap in Computing: An Integrative Approach to Content Design for Girls. *Journal of Educational Computing Research.*

Martinez, M.E. (1994). Access to information technologies among school-age children: Implications for a democratic society. *Journal of the American Society for Information Science, 45*, 395-400.

Papert, S. (1993). *Mindstorms: Children, computers and powerful ideas*. New York: Basic Books.

Schofield, J.W. (1995). *Computers and classroom culture*. Cambridge: Cambridge University Press.

Schumacher, P. & Morahan-Martin, J. (2001). Gender, Internet and computer attitudes and experiences. *Computers in Human Behavior, 17*, 95-110.

U.S. Bureau of the Census (2000). *Statistical Abstract of the United States: 2000*. Washington, DC: U.S. Government Printing Office.

Wakeford, N. (2000). Networking women and grrrls with information/communication technology. In D. Bell & B.M. Kennedy (Eds.), *The Cybercultures Reader* (pp. 350-359). London and New York: Routledge.

Wilding, F. (n.d.) *Where is feminism in cyberfeminism?* Retrieved September 17, 2001 from http://www.obn.org/cfundef/faith_def.html.

Young, B.J. (2000). Gender differences in student attitudes toward computers. *Journal of Research on Computing in Education, 33*, 204-16.

Usability and Instructional Design Heuristics for E-Learning Evaluation

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Abstract: Heuristic evaluation is a methodology for investigating the usability of software originally developed by Nielsen (1993, 2000). Nielsen's protocol was modified and refined for evaluating e-learning programs by participants in a doctoral seminar held at The University of Georgia in 2001. The modifications primarily involved expanding Nielsen's original ten heuristics (developed for software in general) to fifteen heuristics (designed to be more closely focused on e-learning programs). The application of this evaluation protocol to a commercial e-learning program supported enhancements in the usability of the program.

Introduction

Heuristic evaluation is a methodology for investigating the usability of software originally developed by Jakob Nielsen (1993, 2000), a widely acknowledged usability expert. According to Nielsen (1994), heuristic evaluation "involves having a small set of evaluators examine the interface and judge its compliance with recognized usability principles (the "heuristics")." Nielsen's original protocol for heuristic evaluation can be found on the Web at: http://www.useit.com/papers/heuristic/.

For this study, Nielsen's protocol was modified and refined for evaluating e-learning programs by the participants in a doctoral seminar held at The University of Georgia between August and December 2001. The modifications primarily involved expanding Nielsen's original ten heuristics (developed for evaluating software in general) to fifteen heuristics (developed for evaluations of e-learning programs). This paper describes the set of fifteen e-learning heuristics as well as the protocol that guided the evaluation process. In addition, the results of the application of this heuristic evaluation protocol to a commercial e-learning training program are illustrated.

Method

Figure 1 presents the protocol we developed for the heuristic evaluation of e-learning programs. Figure 2 presents a set of fifteen usability and instructional design heuristics which should be viewed as a work in progress. Further refinements are likely to be made based upon the application of the heuristics to various e-learning products as well as the feedback we receive from others who use this tool for their own heuristic evaluations.

Seven instructional technology doctoral students and two faculty members (one from cognitive psychology and one from instructional technology) were involved in the development and initial application of these heuristics and the accompanying protocol. There were twenty heuristics in our initial set. These were generated through a critical analysis of Nielsen's (1994) heuristics as well as several small and whole group "brainstorming" sessions aimed at identifying additional heuristics for the usability evaluation of e-learning programs.

The initial twenty heuristics and the protocol were first applied to a commercial e-learning program called "GMP Basics" designed for the American Red Cross by LearnWright, an award-winning company located in Rockville, Maryland, USA (http://www.learnwright.com). LearnWright specializes in the development of e-learning programs for regulated industries such as pharmaceuticals. Training for these industries is mandated by the U.S. Food and Drug Administration (FDA). From the perspective of the FDA, the collection of blood and plasma products is a regulated activity. While not everyone at the Red Cross is involved in collecting, processing, or distributing blood or plasma products (e.g., some workers are involved exclusively in disaster relief), all workers in blood services must learn the principles encompassed in the FDA's regulations for Good Manufacturing Practices (GMP) The courseware we evaluated was presented on a CD-ROM, although it will eventually be accessible via a Web-based intranet.

Protocol for E-Learning Heuristic Evaluation

This instrument and protocol are intended for use by instructional designers and other experts engaged in heuristic evaluations of e-learning programs. The instrument itself lists fifteen heuristics for e-learning programs, some of which are based upon Jakob Nielsen's widely used protocol for heuristic evaluation of any type of software (http://useit.com/papers/heuristic/), and the rest of which are based upon factors related to instructional design. Although we have tried to be comprehensive, experts may decide to add new heuristics deemed relevant to the types of e-learning programs being evaluated or to the expert's specific expertise.

Steps:

1. An expert should review the heuristics and accompanying "Sample questions to ask yourself" in the instrument before reviewing an e-learning product. The expert should modify the instrument if needed, by adding, deleting, or changing heuristics.

2. It is important that the expert spend substantial time exploring the e-learning program before beginning the actual heuristic evaluation. Ideally, the expert will assume the role of typical learner who would use this e-learning program. Before beginning the review, the expert should be given (or try to discover) background information related to the e-learning program such as:

a. *Target audience and learner characteristics*: A thorough description of the intended audience and their learner characteristics (e.g., education level, motivation, incentive, and computer expertise) will enable the expert to judge the appropriateness of the user interface and other aspects of the program's usability in an informed manner.

b. *Instructional goals and objectives*: The expert should know as much as possible about the needs that the e-learning program is intended to address, ideally in terms of clear goals and objectives.

c. *Typical context for using this program*: Realistic scenarios for when, where, and how the e-learning program will be used should be known by the expert.

d. *Instructional design strategies used in the program*: If possible, a description of the design specifications used in developing the e-learning program should be provided to the expert so that the expert's judgment of the appropriateness of the instructional design strategies are informed with respect to the instructional designer's intentions.

e. *The status of the program's development and possibilities for change*: The expert should be informed as to where the program is in the development cycle (e.g., an early prototype, beta version, or older version under consideration for redesign).

3. After spending enough time to become familiar with the program, the expert should go through it from beginning to end to conduct the actual heuristic evaluation. (With lengthy programs, the expert may only review a representative sample of the program.)

4. The expert should make note of every usability problem found. For each problem, the expert should identify the heuristic it violates, and then give it a severity rating using the severity scale below. If the problem cannot be attributed to a violation of a specific heuristic, the expert should make a note of this. (If a number of problems are found that cannot be associated with specific heuristics, this may suggest the need for the development of new heuristics.)

Severity Scale

1. cosmetic problem only; need not be fixed unless extra time is available
2. minor usability problem; fixing this should be given low priority
3. major usability problem; important to fix; so should be given a high priority
4. usability catastrophe; imperative to fix before this product is released

5. After all the usability problems are found, the expert should go back though them and give each one an extensiveness rating using the extensiveness scale below.

Extensiveness Scale

1. this is a single case
2. problem occurs in several places in the program
3. this problem is widespread throughout the program

6. Most heuristic evaluations involve 4 to 5 experts. Once all experts have completed their evaluations, they may be brought together for a debriefing led by a moderator. The discussion of the usability problems may be videotaped for further analysis. If major differences appear in the problems found or the ratings given, the moderator may try to get the experts to resolve their differences and reach consensus. The experts may also be asked to suggest strategies for resolving the major usability problems found.

7. A heuristic evaluation report should then be compiled. Bar charts, tables, and other illustrations should be used to display the results. If feasible, screen captures should also be incorporated into the report to illustrate major problems as well as suggested enhancements.

8. The most important component of the heuristic report is a set of recommendations for improving the usability of the e-learning program. These should be as specific as possible to provide the designers with the information they need to eliminate the problems and improve the e-learning program.

Figure 1. Protocol for heuristic evaluation of e-learning programs.

1. **Visibility of system status:** The e-learning program keeps the learner informed about what is happening, through appropriate feedback within reasonable time.

Sample questions to ask yourself:

a. When modules and other components of the e-learning (e.g., streaming video) are downloading, is the status of the download communicated clearly?

b. Is the user provided with information that indicates that the e-learning program is operating correctly?

2. **Match between system and the real world**: The e-learning program's interface employs words, phrases and concepts familiar to the learner or appropriate to the content, as opposed to system-oriented terms. Wherever possible, the e-learning program utilizes real-world conventions that make information appear in a natural and logical order.

Sample questions to ask yourself:

a. Does the e-learning program's interactive design utilize metaphors that are familiar to the learner or related to the specific content of the program?

b. Is the interface "user friendly," given the content of the program and its target audience?

3. **Error recovery and exiting:** The e-learning program allows the learner to recover from input mistakes and provides a clearly marked "exit" to leave the program without requiring the user to go through an extended dialogue.

Sample questions to ask yourself:

a. Does the e-learning program distinguish between input errors and cognitive errors, allowing easy recovery from the former always, and from the latter when it is pedagogically appropriate?

b. Does the program allow the learner to leave whenever desired, but easily return to the closest logical point in the program?

4. **Consistency and standards:** When appropriate to the content and target audience, the e-learning program adheres to general software conventions and is consistent in its use of different words, situations, or actions.

Sample questions to ask yourself:

a. If appropriate to the content and target audience, does the e-learning product adhere to widely recognized standards for software interactions (e.g., going back in a Web browser)?

b. If the e-learning program does not utilize common software conventions for interactions, are the novel interactions appropriate for the content and target audience?

c. Does the program maintain an appropriate level of consistency in its design from one part of the program to another?

5. **Error prevention:** The e-learning program is designed to prevent common problems from occurring in the first place.

Sample questions to ask yourself:

a. Is the program designed so that the learner recognizes when he/she has made a mistake related to input rather than content?

b. Is the e-learning program designed to provide a second chance when unexpected input is received (e.g., "You typed "bat" in response to the question. Did you mean "tab?"")?

6. Navigation support: The e-learning program makes objects, actions, and options visible so that the user does not have to remember information when navigating from one part of the program to another. Instructions for use of the program are always visible or easily retrievable.

Sample questions to ask yourself:

a. Does the interface of the e-learning program speak for itself so that extensive consultation of a manual or other documentation does not interfere with learning?

b. Does the e-learning program provide user-friendly hints and/or clear directions when the learner requests assistance?

c. Does the e-learning program include a map or table of contents that allows the learner to see what has been seen and not seen?

7. Aesthetics: Screen displays do not contain information that is irrelevant, and "bells and whistles" are not gratuitously added to the e-learning program.
Sample questions to ask yourself:
a. Are the font choices, colors, and sizes consistent with good screen design recommendations for e-learning programs?
b. Does the e-learning program utilize white space and other screen design conventions appropriately?

8. Help and documentation: The e-learning program provides help and documentation that is readily accessible to the user when necessary. The help provides specific concrete steps for the user to follow. All documentation is written clearly and succinctly.
Sample questions to ask yourself:
a. Is help provided that is screen or context specific?
b. Is help or documentation available from any logical part of the e-learning program?
c. Is help or documentation written clearly?

Figure 2. Usability and instructional design heuristics for evaluation of e-learning programs.

9. Interactivity: The e-learning program provides content-related interactions and tasks that support meaningful learning.
Sample questions to ask yourself:
a. Does the e-learning program provide meaningful interactions for the user, rather than simply presenting long sections of text?
b. Does the e-learning program engage the learner in content-specific tasks to complete and problems to solve that take advantage of the state-of-the-art of e-learning capabilities?

10. Message Design: The e-learning program presents information in accord with sound information-processing principles.
Sample questions to ask yourself:
a. Is the most important information on the screen placed in the areas most likely to attract attention?
b. Does the e-learning program follow good information presentation guidelines for organization and layout?

11. Learning Design: The interactions in the e-learning program have been designed in accord with sound principles of learning theory.
Sample questions to ask yourself:
a. Does the e-learning program follow an appropriate learning design to achieve its stated objectives?
b. Does the e-learning program engage learners in tasks that are closely aligned with the learning goals and objectives?

12. Media Integration: The inclusion of media in the e-learning program serves clear pedagogical and/or motivational purposes.
Sample questions to ask yourself:
a. Is media included that is obviously superfluous, i.e., lacking a strong connection to the objectives and design of the program?
b. Is the most appropriate media selected to match message design guidelines or to support instructional design principles?
c. If appropriate to the content, are various forms media included for remediation and/or enrichment?

13. Instructional Assessment: The e-learning program provides assessment opportunities that are aligned with the program objectives and content.
Sample questions to ask yourself:
a. If appropriate to the content, does the e-learning program provide opportunities for self-assessments that advance learner achievement?
b. If appropriate to the content, do assessments provide sufficient feedback to the learner to provide remedial directions?
c. Wherever appropriate, are higher order assessments (e.g., analysis, synthesis, and evaluation) provided rather than lower order assessments (e.g., recall and recognition)?

14. Resources: The e-learning program provides access to all the resources necessary to support effective learning.
Sample questions to ask yourself:
a. Does the e-learning program provide access to a range of resources (e.g., examples or real data archives) appropriate to the learning context?

b. If the e-learning program includes links to external World Wide Web or Intranet resources, are the links kept up-to-date?

c. Are resources provided in a manner that replicates as closely as possible their availability and use in the real world?

15. Feedback: The e-learning program provides feedback that is contextual and relevant to the problem or task in which the learner is engaged.

Sample questions to ask yourself:

a. Is the feedback given at any specific time tailored to the content being studied, problem being solved, or task being completed by the learner?

b. Does feedback provide the learner with information concerning his/her current level of achievement within the program?

c. Does the e-learning program provide learners with opportunities to access extended feedback from instructors, experts, peers, or others through e-mail or other Internet communications?

Figure 2. Usability and instructional design heuristics for evaluation of e-learning programs (continued).

All seven doctoral students and the cognitive psychology faculty member served as the experts for this heuristic evaluation and followed the protocol during a one-week period in October 2001. After an initial group review of the findings, another week was allowed to refine the individual reports that each expert compiled. Next, the instructional technology (IT) professor led a debriefing session during which copies of all the reports were made available to all experts. During this session, an acceptable level of consensus was reached concerning the major usability and instructional design problems, their severity, and their extensiveness. After the discussion, the IT professor synthesized the findings of the individual heuristic evaluations into a succinct report that was provided to the client.

Findings

The results of the heuristic evaluation of the GMP Basics courseware identified a number of important, but resolvable, problems with the e-learning program. For example, one of the heuristics violated in the initial version of the GMP program was Number 3, Error Recover and Exiting. In Figure 3, the screen capture on the left is from a timeline game within the GMP Basics course that did not allow the learner to exit easily, short of quitting the program altogether. The screen capture on the right illustrates the same game in the new version of the e-learning program after being redesigned based upon the results of the heuristic evaluation described in this paper as well as the findings of a field evaluation conducted by the first author in December 2001. In the revised version of the program, the learner can easily go back to the previous screen or exit this part of the program.

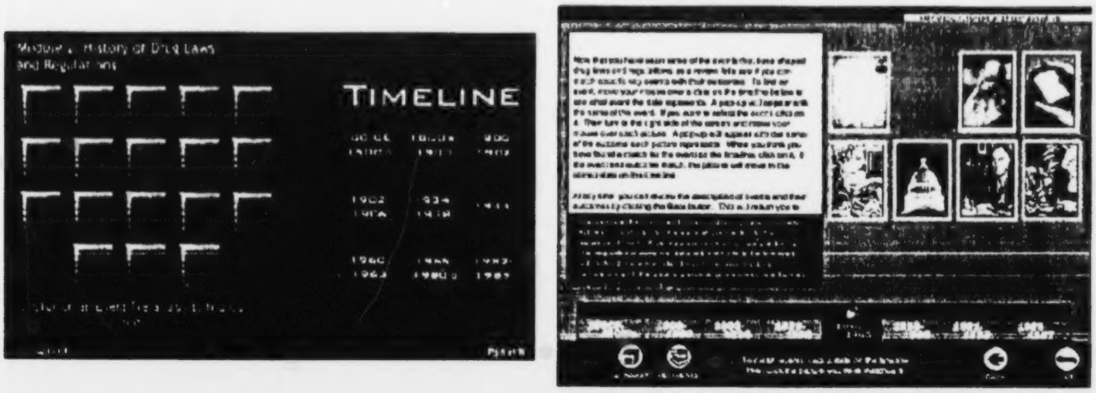

Figure 3. GMP Basics timeline game screen captures before (left) and after (right) evaluation.

Another heuristic violated in the early version of GMP Basics was Number 7, Aesthetics. In Figure 4, the screen capture on the left is from a quiz show game within first version of the GMP Basics course. The screen capture on the right illustrates the same game within the revised program. The aesthetics as well as the professional look-and-feel of the e-learning program have been enhanced in the new version.

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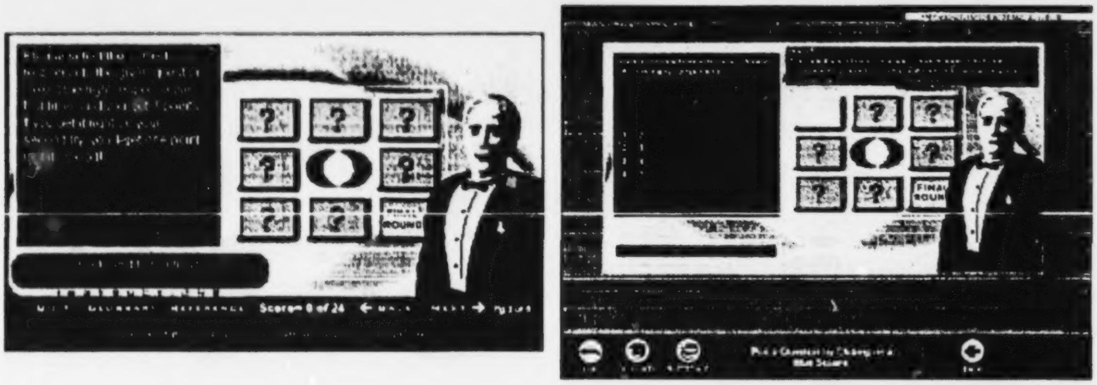

Figure 4. GMP Basics quiz show game screen captures before (left) and after (right) evaluation.

As a final illustration of the results of this heuristic evaluation, the Message Design (Heuristic Number 10) of the e-learning program was enhanced. In Figure 5, the screen capture on the left is from a typical instructional segment within the GMP Basics course that some learners found difficult to read because of the extensive use of light text on darker backgrounds. The screen capture on the right illustrates the same screen with the primary text appearing in a dark font on a lighter background. The screen on the right also illustrates improvements in the Navigation Support (Heuristic Number 6) that were made after this evaluation.

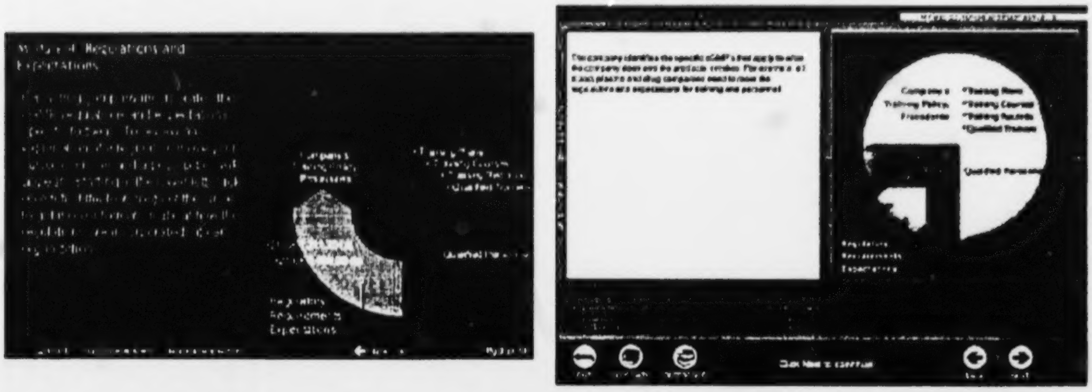

Figure 5. GMP Basics instructional screen captures before (left) and after (right) evaluation.

Interestingly, both the heuristic evaluation and the field evaluation revealed relatively few instructional design problems of the kind that would be represented by Heuristics Numbers 9 – 15. In other words, the original GMP program represented sound principles of instructional design, but the usability of that version of the program needed to be strengthened. Of course, usability is critical to a learner's experience with an e-learning program, and the effectiveness of even the most instructionally sound programs will be decreased if the learner's experience suffers from problems related to navigation, orientation, visual appeal, and other usability criteria (Reeves & Carter, 2001).

Discussion

There are limitations to this study that must be clarified. This heuristic evaluation took place over more than two weeks whereas most heuristic evaluations generally last only one or two days. There were eight experts involved instead of the usual four or five recommended by Nielsen (1994). In addition, changes made in the GMP Basics program were informed by a field evaluation conducted by the first author at a pharmaceutical manufacturing plant with real

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workers, not by the heuristic evaluation alone. It is impossible to attribute exactly which enhancements were based upon which of the two evaluations. Nonetheless, LearnWright expressed great satisfaction with the results of the heuristic evaluation protocol and has requested that the protocol be applied to other programs being developed.

Although heuristic evaluation is fast, convenient, and economical, it is not sufficient for evaluating e-learning programs, and usability testing is advised (Nielsen, 2000). Heuristic evaluation and usability testing usually detect different types of usability problems (Nielsen, 1994). Heuristic evaluation is often conducted as a supplement to usability testing or when usability testing is not feasible. Through this study, we found that Nielsen's original ten usability heuristics were insufficient for e-learning programs, and we developed and refined the fifteen heuristics presented in Figure 2. We encourage others to adapt our e-learning heuristics to their own evaluation needs. We only request that, if possible, the results of subsequent evaluations be shared so that we can further refine this tool.

References

Nielsen, J. (2000). *Designing web usability: The practice of simplicity*. Indianapolis, IN: New Riders Publishing.

Nielsen, J. (1994). Heuristic evaluation. In Nielsen, J., and Mack, R.L. (Eds.), *Usability inspection methods*. New York: John Wiley & Sons.

Nielsen, J. (1993). *Usability engineering*. New York, NY: Academic Press, Inc.

Reeves, T. C., & Carter, B. J. (2001). Usability testing and return-on-investment studies: Key evaluation strategies for web-based training. In B. Khan (Ed.), *Web-based training* (pp. 547-557). Englewood Cliffs, NJ: Educational Technology Publications.

The Role of the Facilitator in Active Learner Support

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Background

The SOCRATES/ODL project FACILE (FACIlitated open distance Learning for continuing Engineering education, 1998-2000) was a starting point for universities' centres for continuing engineering education to complement continuing education by e-Learning provisions with active learner support. The experiences made during the project are currently applied for e-Learning in university continuing education and in training for companies.

e-Learning for Practitioners and Professionals

In continuing education, learners acquire knowledge for a variety of different reasons. Practitioners and professionals come to a course as learners with already a high level of expertise. Motivation to learn is generally high, but does not regard "formal" completion of the course. Instead, participation in such a course generally is driven by the need to solve a specific problem at the work place. This specific need varies widely among individual learners, as does the familiarity with the subject and the level of mastery of the skills necessary [Payr/Reichl/Csanyi/Vierlinger 2001].

The learner's motivation and needs or demands to learn determines the contents and type of learning. Following Bloom's taxonomy [Bloom 1954], Sparkes distinguishes four different types of learning:

- learning factual knowledge;
- learning mental or physical skills;
- learning understanding or comprehension;
- learning attitudes and values [Sparkes 1985, pp.4-10; Rowntree 1992, p.46].

Sabine Payr complements these learning and knowledge types with "mastery", i.e. transfer of knowledge and skills to personal practice [Payr/Reichl/Csanyi/Vierlinger 2001; Baumgartner/Payr 1999; Payr 1999].

Learner Support by Facilitation

Individual learners in continuing education learn for different reasons, want to achieve different objectives, have different previous knowledge, have developed different strategies to acquire knowledge, etc. It is neither appropriate nor economically feasible to deliver completely different learning packages to meet all these different learning needs. Thus, an appropriate educational method and delivery system has to provide the flexibility necessary to apply general learning material in heterogeneous learning situations.

Reflection, group learning, consultation and guidance, as well as interaction are of utmost importance for the success of any learning activity. Especially in such a heterogeneous learning situation, the effectiveness of learning significantly profits from interaction between individual learners who may gain different viewpoints from discussing the subject with their colleagues. Learner support services thus constitute an indispensable complement to packaged distance learning materials to ensure interactivity and feedback.

Especially in continuing education, self-directed learning is most effective. Significant learning is much improved if learners can be given the opportunity to discover laws, concepts and theories – they should not be tought but can be coached [Sparkes 1985, p.9; Schön 1987, p.17, quoting Dewey 1974, p.151]. A facilitator should be willing and interested in helping the learners; facilitators should not repeat the contents or immediately answer the learners' questions; they shall help the group of learners to discover the answers by themselves [Gibbons 1977, pp.18-19; Rowntree 1992, pp.79-80].

Experiences with Tutored Video Instruction [Gibbons/Kincheloe/Down 1977] and with facilitated e-Learning show that people do not learn directly from learning material – the learning material rather acts as an "organiser" of the learning process. For the success of the learning process, the best results occur when the participants can bring problems, examples and experience from their own work into the learning process. Thus, it is important to integrate real life experience and problems into the process [Reichl 1996].

Experiments with different Models for Facilitation

Typically, "facilitation" in ODL (Open&Distance Learning) is understood as the support of learner activities at a remote learning site [Sherry 1996]. The facilitator is the one and often only person involved in a course with whom the learners are in face-to-face contact. The role of a facilitator is to ensure communication between faculty and students, to ensure smooth running of technical equipment, to respond to students' questions concerning course administration, learning facilities, but rarely on the subject itself [Payr/Reichl/Csanyi/Vierlinger 2001].

In the FACILE project, on-site facilitation was replaced by distance facilitation. While in most ODL courses the role of support, tutoring, coordination and contact at a distance is taken over by the teacher/trainer him/herself, this model did not work out satisfactorily for this new type of networked ODL. The first approach taken in the project was to make the author of each module responsible for its delivery. Different content areas would be facilitated by different persons. Learners experienced problems with this approach, for several reasons:

- Each author brought his/her own concepts and methods of ODL to the undertaking.
- Learners did not know any of the authors personally and did not have time to get to know (and to adapt to) their differing methods and pedagogic backgrounds.
- The individual authors of the modules were "bound" to the specific contents they wanted to deliver, so that no continuous course activities could develop.

For the following attempts, the project partners thus separated the role of the facilitator from the role of the content providers and experts and to assign one single person as the facilitator. During the pilot run of the FACILE course, the role of the facilitator was a "passive" one, being available for questions and problems when needed, but the facilitator did not intervene actively in their learning process. The drop out rate of this pilot run was around 80%.

Experiences showed that learners need to be guided actively through the course. In consequence, the project partnership developed a didactical and pedagogical concept to provide effective online facilitation. The (tele-)presence of a single facilitator in the FACILE course as delivered in its final form turned out to be a substantial factor in providing stability and continuity in this networked ODL environment.

The facilitator did not only co-ordinate learners' activities, but also became a mediator between the learners and the different authors and experts in the field. While the modules still were authored by different people, learner activities were designed and monitored centrally and over the whole duration of the course. This active facilitation has turned out to be the key to success in the FACILE courses. The drop out rate of the second course run was only 15% [Reichl/Payr/Csanyi/Vierlinger 2001].

Roles and Tasks in Facilitated ODL

In our approach for learner support through active facilitation, it is important to clearly distinguish between the different roles of actors involved, the most important being:

- Learners;
- content providers or authors of learning material;
- experts in the subject area;
- facilitators.

It is not necessary that these different roles be "played" by different persons – the roles of expert and content provider can be played by one and the same person, as can be the roles of expert and facilitator, and as in peer tutoring even one of the learners could take over the facilitator's role –, but for the success of our approach to e-Learning, it is important to have these different roles represented.

The central and most important role in our approach is the one of the facilitator. The facilitator's role could best be compared to a "spider in the web", tying together the most diverse persons, interests and activities. The most important task of a facilitator is to take "motivating" action, not by re-enforcing extrinsic motivation (e.g. by sanctions), but by building a learning group that develops its own social dynamics and commitments:

- the facilitator is the primary contact person for all the participants and contacts authors and experts;
- the facilitator has to take the initiative e.g. in soliciting questions, contributions or personal information from participants; (s)he elicits questions from participants and acts as moderator between the learning group and the authors/experts;
- the facilitator keeps track of and monitors each participants' activities, e.g. by reminding them of their tasks;
- the facilitator creates a social learning environment within a virtual learning group, using the available technology.

In short, the facilitator has to react timely to every input by a participant, triggers self help and group support instead of answers by facilitator or expert, and keeps the team learning going by setting tasks and deadlines, by ensuring information flow among participants, by being supportive and communicative [Payr 2000].

While a content provider or expert has to be qualified in his/her subject area, the facilitator – unless (s)he is the same person – does not have to be overly qualified in the subject area (but should have enough insight into the content to decide whether a question from a learner can be solved within the learning group or needs the advice of an expert); the facilitator has to be technically and socially competent in communication technologies and communication processes. If this role is played by one of the experts, this person also has to hold this necessary qualification.

Conclusions

Since the most important type of learning (as described above) that can take place in an ODL course for practitioners is learning mental or physical skills, intensive assistance for the learners by active facilitation from a socially competent person has turned out to be the key to success in e-Learning courses.

References

[Baumgartner/Payr 1999]: Peter Baumgartner, Sabine Payr: Lernen mit Software. 2nd ed., Studienverlag, Innsbruck, 1999.

[Bloom 1954]: D.S. Bloom, ed.: Taxonomy of Educational Objectives, Cognitive Domain. McKay Co Inc, New York, 1954.

[Dewey 1974]: R.D. Archambault (ed.): John Dewey on Education: Selected Writings. University of Chicago Press, Chicago, 1974.

[Gibbons 1977]: James F. Gibbons: Tutored Videotape Instruction. Paper presented at the Conference on Educational Applications of Satellites, Arlington, Virginia, February 1977.

[Gibbons/Kincheloe/Down 1977]: J.F. Gibbons, W.R. Kincheloe, K.S. Down: Tutored Videotape Instruction: A New Use of Electronics Media in Education. Science, Vol. 195, 1977, 1129-1146.

[Payr 1999]: Sabine Payr: Tele-Training on the Job. Experiments and Experiences in Media Integration. Paper presented at EdMedia/EdTelecom, Seattle, 1999.

[Payr 2000]: Sabine Payr: FACILE – concept for facilitation and role of facilitator. Working document for the SOCRATES/ODL project FACILE.

[Payr/Reichl/Csanyi/Vierlinger 2001]: Sabine Payr, Franz Reichl, Gottfried S. Csanyi, Ursula E. Vierlinger: Networked Facilitated Open and Distance Learning in Continuing Engineering Education. Paper presented at IEEE International Conference on Advanced Learning Technologies (ICALT), Madison/Wisconsin, August 6-8, 2001. Okamoto T., Hartley R., Kinshuk & Klus J. (eds.): Advanced Learning Technology: Issues, Achievements and Challenges. IEEE Computer Society Press, Los Alamitos, CA.

[Reichl 1996]: Franz Reichl: Educational Design for the Support of Distance Learners. Joseph S. Greenberg, Mary S. Bonhomme (editors): Compendium on Uses of Distance Learning Technologies in Engineering Education; Continuing Professional Development Division, American Society for Engineering Education, January 1996, pp. 35-47.

[Reichl/Payr/Csanyi/Vierlinger 2001]: Franz Reichl, Sabine Payr, Gottfried S. Csanyi, Ursula E. Vierlinger: Joint European Continuing Education Courses with Facilitated Open Distance Learning. Industry & Higher Education, Vol. 15, No. 5, IP Publishing Ltd, Letchworth/UK, October 2001.

[Rowntree 1992]: Derek Rowntree: Exploring Open and Distance Learning. Kogan Page Ltd., London, 1992.

[Schön 1987]: Donald A. Schön: Educating the Reflecticve Practitioner. Jossey-Bass Publishers, San Francisco, 1987.

[Sherry 1996]: L. Sherry. Issues in Distance Learning. International Journal of Educational Telecommunications, 1 (4), 1996, pp. 337-365.

[Sparkes 1985]: John J. Sparkes: On the Design of Effective Distance Teaching Courses. Paper presented at the Annual Conference of the International Council on Distance Education, Melbourne, Australia, August 1985.

Designing online quiz questions to assess a range of cognitive skills

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Abstract:This paper discusses the design and pedagogy underpinning the use of online quiz items in which students are presented with a range of questions designed to enhance understanding of complex linguistic constructions. It explores the design of different types of quiz question from the perspective of pedagogy and cognitive demand. The particular types of questions presented in this online learning setting demonstrate a formative approach to assessment, closely integrated with learning processes. A matrix of questions is presented using Bloom's taxonomy showing the type of question, pedagogical underpinnings and cognitive skills required. The implication of the paper is that automated quiz type questions do not necessarily imply a narrow focus on recall, but can be designed to assess a range of learning processes.

Theoretical background: CAA

Educators can be in no doubt of the demands of society for lifelong capable learners who are able to perform cognitive, metacognitive and metacognitive tasks and demonstrate competencies such as problem solving, critical thinking, questioning, searching for information, making judgments and evaluating information (Reeves, 2000; Oliver & McLoughlin, 2001). Figure 1 represents the changing nature of assessment, showing a transition from a focus on testing to a focus on learning and transfer of understanding. The traditional approach to assessment was largely a form of objective testing which valued students' capacity to memorize facts and then recall them during a test situation. Testing was concerned with measuring a range of cognitive skills, though many of these tests relied on quantifiable approaches rather than qualitative displays of skills and knowledge. Magone et al (1994) called this the *one right answer mentality*.

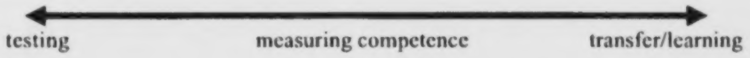

Figure 1: Continuum of assessment

The next form of assessment depicted in the continuum is the measurement of competencies, or what we call 'sequestered problem solving' (Schwartz et al, 2000). In these contexts students are asked to solve problems is isolation and without the resources that are typically available in the real world such as texts, Web-resources and peers. Often these tests of aptitude are single shot, and summative rather than formative. In contrast, assessment that supports learning and knowledge transfer provides the basis for future learning, and continuing motivation to learn (far right of the continuum in Figure 2). This approach is sometimes called the alternative assessment movement, as it is concerned with authentic performance (Cumming & Maxwell, 1999). Both testing and measuring competence as forms of assessment have been critiqued as being controlling, limiting and contrary to student centered teaching and learning. Morgan and O'Reilly (1999) add the following criticisms of traditional assessment practices:

- a lack of variety and autonomy and student choice;
- lack of applied work-based and project based learning;

- overuse of summative forms of assessment;
- limited use of peer and self-assessment strategies.

Other indicators of the need to rethink online assessment have come from Bull & McKenna (2000) who argue that "the development and integration of computer-aided assessment has been done in an ad hoc manner". In a similar vein, Angelo (1999) maintains that we need a more compelling vision of assessment, research-based guidelines for learner-centered assessment, and a new mental model of assessment.

Online assessment: Are multiple choice items appropriate?

Computer-based assessment using a range of question types has been shown to have positive effects on student learning, as students appreciate the speed of marking and the feedback provided (Thelwall, 2000). Multiple choice items can be designed to assess a range of competencies relating to student performance rather than concentrate on 'objective' questions that text recall of discrete facts (Brown et al, 1999). Multiple choice items can be used for both formative and summative assessment, and thus to broaden the range of skills that is assessed. This paper describes the use of a system of computerized assessment utilising a variety of question types to assess higher order skills. Despite the skepticism surrounding the use of multiple choice items as a means to assess the skills of analysis, synthesis and evaluation, carefully crafted questions can overcome this limitation (Haladyna, 1997).

Context: Extending the use of multiple choice items

The context of the study was a 2nd/3rd year level university course of study in Linguistics delivered online. In this unit students are required to develop and apply skills in analyzing the grammar of a language which they have not encountered before. Intended learning outcomes are analytical skills, the capacity to synthesise conceptual knowledge and

It was decided to use the quiz feature of WebCT and to create a database driven item bank of questions to assess student learning and provide feedback. The learning objective was for students to develop skills in linguistic analysis and synthesis. Students are given a database of 84 sentences in *language X*, beginning with simple sentences (like 'The woman is going home'), and increasing in complexity until they involve quite complex sentences involving constructions like relatives and passives (as in 'The woman who cooked the meat is sitting down.') Students are supplied with English translations for each sentence, but they do not receive any indication of which words mean what, and which of the meaningful subparts of words (morphemes) are represented. Using prior knowledge of linguistics, students have to make inferences about words parts and combine these in order to interpret the language. Students were required to satisfy assessment requirements by completing two separate activities; the construction of a dictionary of this language and the completion of a grammatical description of this language. This required higher order thinking skills and the capacity to analyze and synthesize language elements.

Bloom's taxonomy was used to categorise questions according to cognitive skills required. See Table 1 for the matrix summarizing question types.

Question type	**Link with learning outcome**	*Level in Bloom's taxonomy*
Multiple choice	Learn about and understand how to use the lexicon	Knowledge, Analysis
Matching items	Apply new knowledge	Comprehension, Analysis
Short answer	Synthesise new knowledge in order to create new sentences	Application, Synthesis

Table 1: Matrix showing question type and cognitive skill required

Design of the quiz questions

The quiz items were constructed with three different question styles, designed to assess a range of learning outcomes.

Multiple Choice Questions were used to test skills in the cognitive domain, focusing on comprehension and analysis of the grammatical patterns evident in the data. For example in the sample question below, students are asked to select variables true of a word class type.

Question 5 (3 points)
Which of the following characteristics are true of the class of nouns in this language? [You need to select all the characteristics which are true to score full marks, and there may be more than a single correct answer]

Nouns can occur;
1. as a bare stem (unaffixed root)
2. with the prefix 'ma?-'
3. with the possessive suffixes
4. with the definite suffix '-e'
5. with the suffix-ka?

Multiple choice items were extended in several ways;
- multiple variables could be true
- all true variables had to be selected for full marks
- all untrue variables were negatively weighted, so that selection of all variables gave 0%.

Matching Questions were also used to test the skills, focusing on comprehension and analysis of the grammatical patterns evident in the data. For example in the sample question below, students are required to demonstrate their understanding of word class characteristics by matching each word class type with a sample sentence which only that wordclass could fill. Note that the sample sentences are not necessarily in the database, and are untranslated. In WebCT Quiz mode, students see all four matching variables randomly listed for each subpart of the question.

Question 2
Match each word class category listed on the left below with the Lg X structural frame that could only be filled by a word of that class.

noun:	u-ita-i ____-e
verb :	____-i tau-e
adjective:	tau _____-e pole-i
preposition:	lao-ka? ___ marege

Short Answer Questions were used to test students' ability to synthesise and apply concepts. Application and synthesis, as cognitive objectives, are demonstrated by students' ability to apply general grammatical rules they have learned to the creation of new sentences. In other words, students were required to go beyond the database given to them, and make up new sentences in *Language X* which were fully grammatical in terms of the grammatical rules they had already worked out.

The Short Answer style of question allows students to translate a language item and to enter a response, as in this sample question.

Question 36
How would you say the following sentence in Language X?
[Use lower case only, use no punctuation, leave only a single space between words, leave no spaces between morphemes within a word].

The woman who cooked the meat is hit by her father.
Answer:

The marking of questions of this type is also automatic using the *Regular Expression* syntax feature built, into WebCT's Short Answer shell. This compares students' responses against a specified string, but unlike the *Equals* and *Contains* functions, *Regular Expression* allows predictable variables (is the first letter capitalized or not?, has the students put a double space between two word?) to be catered for. It additionally allows, still in automated mode, for a range of less than perfect responses to be awarded partial marks, for example:

100%= [M|m]akunrai/s+tunungengngi/s+jukkue/s+ripeddiriwi/s+ri/s+ambo?na
50%= [M|m]akunrai/s+tunungengngi/s+jukkue/s+peddiriwi/s+ri/s+ambo?na
50%= [M|m]akunrai/s+tunungengngi/s+jukkue/s+ripeddiri/s+ri/s+ambo?na
40%= [M|m]akunrai/s+tunungi/s+jukkue/s+ripeddiriwi/s+ri/s+ambo?na
20%= [M|m]akunrai/s+tunungengngi/s+jukkue/s+peddiri/s+ri/s+ambo?na

Task 1: Building the dictionary

Firstly students had to work out the meanings of each of the words and word parts in the data provided to them on *language X.* This was achieved as a collaborative task whereby students contributed their analyses of word meanings to an online dictionary available on the unit homepage. This dictionary begins as an empty shell with 4 fields of information for each entry. Students are free to add any text to the 'headword' and 'meaning' fields. The 'word class' field offers a fixed menu of choices. The 'name of contributor' field is generated automatically. The dictionary required the development of a specialized tool which does not come as a standard feature of WebCT. This tool enables an online class of students to contribute entries to a database, and those entries are viewed on screen as though they were a single document. An extract of the dictionary looks like Table 2:

Word	**Class**	**Definition**	**Person**
buaja	Noun	crocodile	Janice L [edit | delete]
c@mme	Verb (tr)	wash	Sharon E [edit | delete]
de?	Particle	negative	Sharon E [edit | delete]
galung	Noun	field	Ruth D [edit | delete]

Table 2: Dictionary extract

The unit co-ordinator has the capacity to edit and delete any entry, while each student has the capacity to edit and delete only the entries that they themselves have contributed. The class as a whole is responsible for the accuracy of all entries, so students must negotiate changes to other students' contributions through discussion on the Bulletin Board. This form of collaborative negotiated learning is highly conducive to co-construction of meaning and self-directed learning (Coomey & Stephenson, 2001).

During the semester there were hundreds of postings to the Bulletin Board renegotiating such changes. A sample exchange is included below;

> •*Hi Joanne et al! I have been mulling over all the 'ng's that are placed in differing amounts on various words! When,earlier,I had analysed the verb 'drink', I had thought of it as 'menung' rather than 'menungng'. This is because,from the available data, both verbs and nouns that end in 'ng' seem to only have it as a single sound. Where further instances of 'ng' appear on a word they seem to be added as suffixes (e.g.'tedong' - 'tedongnge'). However, I may be entirely wrong! What do you all think?*
> *cheers, Sally.*
>
> •*Sally, I think the verb is definitely menung, but all words ending in -ng reduplicate this cluster before certain suffixes,for instance the suffix -i and the suffix -e. (Anna)*

•Dear Sally, Anna, Joanne & all,
I agree with Anna about the verb menung. The 'ng' is reduplication before a suffix. (Eileen)

•Hi guys,
Yes I can see now that you're right. . I'll change this straight away in the lexicon.(Joanne)

The construction of the dictionary was not formally assessed. Each student was asked to contribute, and a cap of 5 entries per student was specified to encourage involvement by all students. Students were highly motivated to assemble the dictionary as soon as they could, in order to facilitate their capacity to tackle the higher level grammatical analysis. All words were entered within the first 3 weeks of the semester, with subsequent tinkering, as negotiated on the Bulletin Board, over several more weeks. The lexicon was essentially completed by week 6 of the semester.

Task 2: Completing the grammar

After analyzing the grammatical structure of this language, students were required to demonstrate their understanding of it by completing an online Quiz consisting of 39 questions. Students had the option of submitting their Quiz twice. On the first submission, they received back only a grade, but no indication of which answers were right or wrong. This mechanism had several advantages;

- it was reassuring to those students who were apprehensive about the technology, and who felt uncomfortable with opening a new tool and submitting a Quiz in a single go. These students took comfort from a practice run.
- it gave students some means to check that they were on the right track, but without explicitly highlighting their weak spots. Most students reported that they found this spurred them on to do better. So that on learning that they scored 72% on their first submission, they were motivated to do for some further study before the second submission in order to better their score.

Results

Analysis showed that the short answer items were the most demanding as it was these questions that required students to transfer their knowledge of the lexicon into more abstract forms of understanding. The items also required students to synthesise and apply knowledge to create new lexical items, and there was a greater range of responses and grades than for the other items. Without a doubt, students who successfully completed task 2, (creating the dictionary) demonstrated the desired learning outcomes of analysis and synthesis. In all three types of questions, the automated quiz tool and feedback mechanisms provided learning support. The pedagogic rationale for the use of these forms of assessment was to align learning objectives with assessment tasks, while providing feedback and performance data to learners. The quiz questions provided individual and group feedback, allowed students to check their responses and enter an alternative answer, and compare their scores with others. In addition, it fostered self-regulated learning as learners would access the tests at a time and place convenient to them.

Conclusions and further research

Computer-based assessment may suffer an 'image problem' as some assume it is capable only of summative testing using multiple choice tests derived from item-banks. Increasingly, computer-based assessment is enabling innovative approaches to formative assessment that close the gap between actual and desired levels of performance'. A number of factors can be cited concerning the potential value of online learning environments and computer-based assessment. Among these are its potential to cater for individual needs, foster self-regulation, increase motivation for learning by giving student more control over when and how often they test their own knowledge. Current software development and the interactive capabilities of the Web enable the creation of procedural, conceptual, cognitive and collaborative assessment tasks and can tap students' prior knowledge, and assess learning in personally meaningful ways that are flexible and learner-centered.

References

Angelo, T. (1999). Doing assessment as if learning matters most. *AAHE Bulletin, May 1999* (http://www.aahe.org/Bulletin/angelomay99.htm)..

Bloom, B. S. (1956). *Taxonomy of educational objectives: Handbook 1. The cognitive domain*. New York: David McKay.

Brown, S., Race, P., & Bull, J. (1999). *Computer-assisted assessment in higher education*. London: Kogan Page.

Candy, P., Crebert, G., & O'Leary, J. (1994). *Developing lifelong learners through undergraduate education*. Canberra: Australian Government Publishing Service

Bull, J., & McKenna, C. (2000). Computer assisted assessment centre update. *Proceedings of the 4th International Conference on Computer Assisted Assessment, http://www.lboro.ac.uk/service/ltd/flicaa/conf2000/pdfs/jbull.pdf.*

Coomey, M., & Stephenson, J. (2001). Online learning: it's all about dialogue, involvement, support and control- according to the research, *Teaching and Learning online* (pp. 37-52). London: Kogan Page.

Cumming, J. J., & Maxwell, G. S. (1999). Contextualising authentic assessment. *Assessment in Education: Principles, Policy and Practice, 6*(177-194).

Harvard, M., Hughes, M. & Clarke, J. (1998). The introduction and evaluation of key skills in undergraduate courses. *Journal of Further and Higher Education, 22*(1), 61-688.

Laurillard, D. (1993). *Rethinking University Teaching*. London: Routledge.

Haladyna, T. M. (1997). Writing test items to evaluate higher order thinking. Needham Heights, MA: Allyn Bacon.

Magone, M. E., Cai, J., Silver, E. A., & Wang, N. (1994). Validating the cognitive complexity and content quality of a mathematics performance assessment. *International Journal of Educational Research, 21*(317-340).

Morgan, C., & O'Reilly, M. (1999). *Assessing open and distance learners*. London: Kogan Page.

Oliver, R., & McLoughlin, C. (2001). Exploring the practice and development of generic skills through Web-based learning. *Journal of Educational Multimedia and Hypermedia, 10*(3), 307-325.

Schwartz, D. L., Biswas, G., Bransford, J. D., Bhuva, B., Balac, T., & Brophy, S. (2000). Computer tools that link assessment and instruction: Investigating what makes electricity hard to learn. In S. P. Lajoie (Ed.), *Computers as cognitive tools: no more walls* (pp. 273-307). 2000: Lawrence Erlbaum.

Reeves, T. C. (2000). Alternative assessment approaches for online learning environments in higher education. *Journal of Educational Computing Research, 23*(1), 101-111.

Thelwall, M. (2000). Computer-based assessment: a versatile educational tool. *Computers and Education, 34*(2), 37-49.

Using computers to evaluate teachers' understanding of physics concepts

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Introduction

The video "A Private Universe", a production of Harvard-Smithsonian Center for Astrophysics, Science Education Department, Science Media Group, was considered an important eye opener in the history of Science Education. The interviews with Harvard graduates revealed students' misconceptions in science among the best students of the country. According to Mazur (1997) another eye opener was the release of the Force Concept Inventory (FCI) developed by Hestenes, Wells, & Swackhamer (1992). It was called an eye opener because he realized that students' misconceptions could not be diagnosed through the conventional standard or teacher-made tests or even problem solving strategies that he used to use for many years of his teaching at Harvard University. Research in the area of science education has repeatedly shown that only certain types of questions can evaluate the ability of students to resolve concepts from one another and to apply them to real situations. However, successful construction of such conceptual tests is hardly ever reported in the literature. So far FCI and a few other conceptual tests have been used exclusively to evaluate students' misconceptions rather than teachers' misconceptions.

Misconceptions are not limited to students. They are also very common among teachers (Mestre, 1994). For example, after a comprehensive study on 159 science teachers' misconceptions, Kruger, Palacio, and Summers (1992, p. 344) concluded that " virtually none of the primary school teachers had a correct (in the Newtonian sense) view of the instances involving forces and motion with which they were presented". According to Mestre (1994) some significant changes in teacher education programs are necessary. He suggests that the science content knowledge of elementary and middle school teachers has to be upgraded, but this does not mean that in-service and pre-service teachers need to take an inordinate number of science courses. Therefore, there is an urgent need to investigate teachers' misconceptions in science targeting the concepts that they are supposed to teach in the future. The authors believe that the best way to evaluate teachers' misconception is to develop more conceptual tests similar to FCI. However, there are many scientific conceptions that could not easily be evaluated with paper-pencil tests such as FCI. In an attempt to make a more sophisticated evaluation and instructional tool the authors have developed an instructional model (Inventive Model) and a physics CD and an on-line physics course based on the model. Using such multimedia and/or Internet tool with sophisticated interactive simulations to investigate teachers' misconceptions is considered to be very important and ultimately could be a third eye opener in the area of science education.

Goals and objectives

In this paper the authors introduce two educational software that have been used in conceptual physics instruction. First, a multimedia CD targeting common misconceptions in physics based on a new instructional model (Inventive Model) developed by the authors. Second, an ongoing collaborative project among several universities in Canada using the Inventive Model. The project is called Modular Approach to Physics (MAP). The goal of this paper is to propose a project in which the physics CD and the on-line physics course will be used to investigate teachers' misconceptions in physics. Although this investigation will deal specifically with examples from physics, the authors believe that our model and conclusions would have enough validity to be used in other areas of science and perhaps beyond. The focus will be on concepts that teachers are supposed to teach in their future teaching career.

Cognitive learning theories such as discovery learning or constructivism have focused on students' learning and students' cognitive processes. Generally in student-centered science education the focus is on student rather than teachers (Roblyer, & Edwards, 2000). In these approaches the teachers play a role as facilitator rather than instructor or lecturer. However, the authors believe constructivist teachers should have a much deeper understanding of scientific concepts than traditional teachers. Therefore, evaluation of teachers' misconceptions could have significant implications for the quality of science teacher training programs.

Theoretical Background

The quality of current educational software

The quality of educational software particularly for the purpose of conceptual learning has been the subject of so many studies since early 1980s. Komoski (1989) estimated that 1500-2400 new packages are published in the United States each year and that the proportion of good quality software is something between 5 to 10 per cent. Even today U.S. Department of education reports that a significant proportion of computer software in schools is obsolete by today's standards. Results of a survey of educational software shows that regarding the criteria they use to guide software development 67 percent have no formal guidelines (Roth & Petty, 1988). According to the literature, low quality of educational software has many reasons including lack of a theoretical model for the instructional design. After reviewing hundreds of research papers in the area of instructional design, and dozens of educational software, the author developed the "Inventive Model" as a theoretical framework for science instruction and particularly for software development in science education. (Rezaei & Katz, 1998) The Inventive Model is developed to pave the way from edutainment or infotainment toward high quality educational software.

Even if teachers find good quality software, the problem is they often find it difficult to integrate it into their lesson plan. In other words some parts of the software does not match with the goals and objectives of the course. The Modular Approach to Physics has been developed to overcome this difficulty. This approach provides customized instruction for teachers. Teachers usually prefer to make their own instruction rather than fitting themselves into somebody else's design. This on-line navigation and arrangement tool provides modules instead of units of instruction. Therefore, teachers can easily select the modules that they want to use and arrange the modules in their own way. All modules are designed based on the "Inventive Model" (i.e., each single module is designed based on research findings on students' difficulties in understanding scientific concepts). Lack of interest and perhaps lack of a good background in science, has caused a great decline in North American students' enrollment in science related fields at the undergraduate and especially graduate levels (Halpern, 1992). With the integration of technology, however, it is possible to make it easier for teachers to teach and for students to learn. (Katz, Rezaei, 1999)

Previous research on the Inventive Model

The Inventive Model has been developed as a theoretical model for educational software development and also as a conceptual change model to improve conceptual learning. Research findings consistently show that students' misconceptions are deeply seated and likely to remain after instruction, or even to resurface some weeks after students have displayed some initial understanding immediately following instruction (Halloun & Hestenes, 1985; Mazur, 1997; Mestre, 1994). Research also shows that instructional approaches that facilitate conceptual change are more effective than other approaches that disregard students' cognitive structure (Mazur, 1997). However, teachers and educational software developers rarely build their instruction on a valid measure of students' misconceptions. The instructional design used in the Inventive Model is based mainly on such a longitudinal and systematic evaluation of students' misconceptions.

Theoretically, the inventive model has four phases. The first phase starts with a systematic analysis of students' preconceptions. Although students' conceptions are unique and private, most of their concepts are similar and public. Therefore, in the instructional design of the inventive model both kinds of misconceptions are addressed. The simulations and the videotaped experiments are developed based on literature on students' common misconceptions. However, the feedback offered by the teacher or the software is based on the individual student's answers to the conceptual questions. It should be noted here that the piece of software based on this model could be used either by the teacher in the class as an instructional tool or by students after class individually or collaboratively.

In the second phase, advance organizers or other cognitive strategies such as, concept maps and/or analogies, are used to activate the students' prior knowledge and bridge it to the new concepts to be learned. How these cognitive strategies are integrated into the inventive model is explained in an earlier paper. (Rezaei, Katz 1998) Both in this second phase and in the last phase, students' acceptable concepts are refined and reinforced in a guided discovery manner. This means that, if the majority of students have a deep misconception, the teacher will move to the third phase processes to rectify the misconception. However, if the answers are close enough to the scientific conceptions, the teachers will move directly to the forth phase were they refine students' conceptions.

The third phase includes different activities, such as having students:

a. test their preconceptions through hands-on activities or computer-based simulations.
b. compare their preconceptions with natural phenomena and related scientific theories and identify any conflicts between their misconceptions and the scientific theories.
c. become dissatisfied with their misconceptions through a multi-perspective demonstration and problem-solving situation and feel the need for a new concept; or, explore plausible alternatives by themselves or as suggested by their classmates or the teacher, and choose the more convincing one.

In the fourth phase, the teacher explains the correct answer and demonstrates the advantages of the conceptions currently accepted by the science community through a multi-perspective demonstration. The teacher may also help students to summarize what they have learned.

The basic rationale of the Inventive Model is the belief that conceptual change does not occur simply because students see a conflict between their preconceptions and the scientific realities; rather, students, after testing their preconceptions, will gradually realize the advantages of scientific explanations. This will happen only if the teacher and technology supply the required cognitive tools, and provide a clear contrast between the student's conceptions and scientific conceptions through a variety of demonstrations.

The key factor in the Inventive Model is the multi-perspective presentation. The author believes that generalizations based on a single experimental design might be misleading. However, considerable time is required to probe students' conceptions and to present new concepts from different perspectives via a variety of demonstrations. An effective way of dealing with the time limitations in formal science classrooms and many inquiry approaches is to empower the instruction and the inquiry processes by using computers. Rezaei (1999) developed the multimedia physics CD based on the Inventive Model as a practical way to achieve this goal. Videotaped or simulated science experiments were designed, developed, and presented based on the best scripts of teachers' probes in longitudinal studies. Dozens of science experiments, animations, sound clips, simulations, pictures, graphs, tables, concept maps, analogies, metaphors, and advance organizers were saved in a multimedia program, available on a single CD-ROM.

Modular Approach to Physics

The Modular Approach to Physics (MAP) project is a multi-institution venture funded by the Province of Alberta in Canada under the Learning Enhancement Envelope (LEE). The project is currently in its 3rd year of funding and coordinates the efforts of groups at 6 college and universities in Alberta, Canada. There is a need for being able to efficiently and easily collect and organize Web-based content into a package such that others can easily find in the package what they are looking for. A program with this capability has been developed at the University of Calgary. CANU (Content Arranging and Navigating Utility) is a Web-based Java program with which one can arrange and deliver structured content. The program has been designed at the University of Calgary as part of a LEE-funded MAP project. Although currently CANU is being used to arrange and deliver physics content, it could just as easily be used to arrange and deliver many other kinds of content, e.g., materials for other courses or descriptions of the programs of a faculty or an entire university. Minor changes only would be required, e.g., a change to a new title page. The principle investigator of MAP, Dr. Hans Laue, has a strong interest in conceptual difficulties in learning physics and has been involved since 1987 in the creation of tutorial software at the introductory physics level aimed at helping overcome such difficulties. Hicks, R. B., & Laue, H. (1992) have developed an extensive computer tutorial system to support some first and second year university level courses. Their Computer Assisted Learning in Physics (CALiPH) provides 40 tutorial modules. Dr. Laue, together with Dr. B. Martin, the present author, and several other Alberta physicists, are currently involved in the evaluation process of MAP.

Finally, as mentioned before, in the MAP project, two versions of the software have been developed both based on the Inventive Model. One version is the customized version and the other one is the sequential version. Although both versions are based on the Inventive Model and both focus on conceptual learning they are not quite similar. One purpose of the ongoing project is to compare the effectiveness of these two versions. The results of such a comparison could be very important for the future of on-line course development. The Modular Approach is currently under its evaluation process

and the results will be published later. Two versions of the course are provided. One is pre organized or sequential and the other is the customized version. Teachers and/or students could choose if they want to follow up the sequential version or they want to customize their own units. The on-line courses based on this model are available at
http://www.ucalgary.ca/MAP/
http://ugl-gw.phys.ualberta.ca/~alphy/meltp/

The proposed project

The Inventive Method was used in a two-year experimental research by the first author. One hundred and forty three "grade10-12" high school students from three high schools were randomly assigned to three groups. The Inventive Model was compared with a radical constructivist approach and the conventional physics instruction. The results showed that the Inventive Model group scored significantly higher than the Radical Constructive group on the conceptual posttest. It was also concluded that only the Inventive Model led to conceptual change in the students' understanding of Newton's laws of motion. Finally it was observed that 3 hours of working on the Inventive Model CD was as effective as 16 hours of conventional physics instruction. The qualitative analysis indicated that most students actively interacted with the software during the whole program. In terms of rectifying students' misconceptions it was found that the model was effective for about more than 50% of the students. This should be noted that successful report of conceptual change is very rare in the literature.

The author surprisingly observed some misconceptions among teachers while they were previewing the CD and while they were teaching their students. Therefore, it was decided to perform a new research to investigate teachers' misconceptions in physics. A detailed analysis of teachers interactions with the computer (e.g., keeping log files of which items are chosen, which buttons are clicked, the amount of time spent on a question) could be an invaluable source of information on teachers' cognitive processes.

To start the research the authors will contact American Association of Physics to locate and call high school physics teachers in Los Angeles, California. Only volunteer physics teachers will be called to participate in this project. Either the physics CD or the On-Line physics course will be used to evaluate teachers' misconceptions. The CD version is limited to Newton's laws of motion and will be used by teachers who do not have access to Internet. The On-line course is a comprehensive advance physics course for high school teachers. Although both software have been developed for conceptual physics instruction the investigators plan to use them as a means to evaluate teachers' misconceptions. As an Incentive to encourage teachers to participate in the project they will be paid to evaluate free educational software (i.e., the physics CD or the on-line physics course). The plan is to ask teachers to preview the software to see if they would like to use it in their teaching. However, teachers' interaction with software will be saved in a log-file that later will be used by the investigators to evaluate teachers' misconception. The teachers will be informed that their interaction with the software will be saved. They will also be asked not to input their real name or other kinds of identifying information. Therefore, the anonymity of the participants will be guaranteed.

References

Halloun, I. A., & Hestenes, D. (1985). Common sense concepts about motion. American Journal of Physics, 53(11), 1056-1065.

Halpern, D. F. (1992). Enhancing thinking skills in the sciences and mathematics. Hillsdale, New Jersey: Lawrence Erlbaum Associate.

Hestenes, D., Wells, M., & Swackhamer, G. (1992). Force concept inventory. The Physics Teacher, 30, 141-153.

Hicks, R. B., & Laue, H. (1992). "CALIPH: A computer-Based Tutorial". Physics in Canada, 48(5), 293-296.

Katz, L., Rezaei, A. R. (1999). The potentials of modern Tele-learning tools for collaborative learning. Canadian Journal of Communication, 24 (3), 427-448.

Komoski, Ket. (1989) The quest for quality software: Information technologies in education. Paris, France: Center for educational research and information.

Mazur, E. (1997). Peer Instruction: A User's Manual. NJ: Prentice Hall Series in Educational Innovation, Upper Saddle River.

Mestre, J. P. (1994). Cognitive aspects of learning and teaching science. In S.J. Fitsimmons & L.C. Kerpleman (Eds.). Teacher enhancement for elementary and secondary science and mathematics: status, issues, and problems. Washington, D. C.: National Science Foundation.

Rezaei, A. R. (1999). Computer assisted instructional approaches to conceptual change in science education. Unpublished doctoral dissertation, University of Calgary, Calgary, Canada.

Rezaei, A.R., & Katz, L. (1998) A cognitive model for conceptual change in science instruction. Journal of Educational Computing Research.

Roblyer, M.D. & Edwards, J. (2000). Integrating Educational Technology into Teaching. New Jersey: Printice Hall.

Roth, S. K.; Petty, B. A. (1988). "Educational Software: Why Are Teachers Dissatisfied?". Educational Considerations, 15 (2), 24-26.

Assessing out-of-the-box thinkers: Professional development for IT support staff

Background

Since its inception in 1996, the Center for Instructional Technologies (CIT) has offered leadership and assistance to educators in integrating technology into instruction throughout the UT Austin campus and beyond. It serves as a training, consulting, and resource center, and an incubator for projects using promising new technologies—all aimed at enriching the teaching and learning experience.

Internal knowledge and skills gap analysis

The CIT has traditionally focused on technology implementation and consultation. Recently, The CIT has been engaged in activities designed to move the center from a production shop toward a systems-approach to support. As a necessary first step, an internal team of three, supplemented with feedback from the rest of the CIT staff, developed a tool to help staff members self-assess their knowledge and skills in teaching, learning, and technology. When the team analyzed the results, they found a large section of technically cross-trained staff members throughout each unit. However, only three staff members out of 18 believed themselves to be expert in instructional design and only two assessed themselves as experts in learning theory. After the results of the self assessment were presented, the CIT challenged itself to increase it's staff's comfort and use of instructional design and learning theory with minimal financial cost and without sacrificing needed staff production time.

Training goals

Based on findings from the skills gap analysis, Joe Sanchez and Suzanne Rhodes developed a curriculum based on engaged constructivist learning principles to meet the following goals:

- Provide ongoing training to increase internal staff awareness and comfort level regarding use of instructional design techniques and strategies to improve faculty support
- Increased faculty client satisfaction with CIT support services
- Motivate staff to create new workshops with creative and solid engaged-learning principles at the foundation.

Training strategy

We are employing a blended approach of classroom computer lab-based instruction and online resources and collaborative tools. The training curriculum components include:

- Classroom-based presentation and collaborative activities

  The concepts were first presented, using multimedia where appropriate as well as examples of best practices. Questions and whole-group discussion are integrated with the presentation. Second, using a problem-based learning-by-doing approach, participants work in small groups with

facilitation from the two trainers. The groups select a real-life scenario and develop solutions by answering guiding questions about instructional goals and approach and the best application of a variety of technologies. The small groups then present their solutions to the whole group, leading to whole-group discussion targeted around current faculty consultation opportunities. This format varies depending on the content and the current needs of the participants, but always employs a hands-on approach to learning that is personal and relevant to the participants.
Topics have varied from Bloom's Taxonomy to John Keller's ARCS Model. Each of the classroom-based presentations not only exposed the users to instructional design principles, they also served as a demonstration of different teaching techniques and styles. Gaming, simulation, discussion, group activity, experiential learning, and the Socratic method were all teaching styles used as examples of effective teaching. Each session included a debriefing explaining the reasons for selecting a particular teaching style followed by a discussion of the planning process.

- Online resources

Using Blackboard courseware, we created an online course site to provide digital versions of the presentations and handouts, additional links and resources related to the training for extending learning, and a message board to extend the session discussions. In addition, online surveys allowed participants to provide feedback for each session.

Project plan and timeline
Month 1-begin curriculum and content development for training sessions
Month 2- conduct and evaluate in-house training
Month 4-modify and expand training to include UT faculty and TAs
Month 6-CIT staff to participate in skills gap analysis #2

Assessment approach
This project is ongoing and currently under deployment with short-term goals completed in November 2001. We plan to use CIT internal training as a pilot that, with modifications, will expand to reach other audiences such as other IT staff, teaching assistants, UT professors, and possibly even students. Another goal of the project is for CIT members to use the instructional design models they have learned to create new or improved workshops. The workshops have also served as a testing ground for new technologies such as Horizon Live, a synchronous streaming video presentation tool, and the department's new smart board.

This project employs an iterative design, development, and assessment process. Data will be collected before and after each training session and by online means through tracking, observation, and surveys. Past training activities will be revised and presented to new audiences as well as converted to become completely online for those interested in learning the material on a self-paced, just-in-time basis. New activities will be designed and developed each month as needed.

We hope that the materials and strategies used for internal CIT training in instructional technology will result in the following outcomes:

- Increased comfort-level and awareness of instructional design techniques
  Staff members, while unable to draw directly from instructional design theory, have been using systematic design process with each project they develop. The workshops will identify the processes and provide a broader range of design principles to draw from.
- Increased use of instructional design principles during faculty consultations
  CIT staff members will be able to quickly identify the needs of faculty members during consultations and place their needs in an instructional design framework.
- New innovative workshops created by staff with sound ID principles
  Using working knowledge of instructional design principles will allow for creation of hands-on, user-centric based workshops for faculty clients. Previous workshops maybe re-evaluated for instructional soundness.
- Enhanced student learning and engagement
  Application of sound instructional design principles will lead to hands-on, interactive workshops that will enhance student learning.

Conference attendees interested in the following concepts would find this demonstration to be of interest:

- Training strategies for constructivist learning with technology
- Building community within an organization
- Integrating new or existing IT support organizations
- Assessment and evaluation techniques
- Skills gap analysis techniques
- Moving IT support to a systems approach

Flexible Learning: Latest International Research Discoveries as a Part of High School Curriculum

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Abstract: Many high school science teachers will retire in the ten years and unfortunately so many new ones will not become graduated science teachers in Finland. In addition, the amount of high school and university students who are interested in physics has decreased dramatically during the last decades but now, this is turning slowly to the better direction. Anyway, the situation can lead to serious lack of physics researchers, physics teachers. Web University, an international research pilot of the Open Learning Environment project in Finland, has created a new model how the research discoveries of the European Organisation for Nuclear Research, CERN, can be integrated into high school curriculum in Finland. The activities are targeted for both the students and the teachers of Finnish high schools. A great part of the activities is based on exploiting the capabilities of information and communications technology and the Internet. We apply, for example, web-based learning for high school students and we have created an Internet community for the network of high school teachers. In addition, we organise intensive physics training for high schools students and in-service training for high school teachers. Both of these activities take place at CERN, where the visitors are guided and instructed by particle physics researchers. The long-term goal is to permanently raise the status of physics studies and physics-related occupation in the society.

The European Organisation for Nuclear Research, CERN [8], situated in Geneva, Switzerland, is one of the largest particle physics research organisations in the world. CERN tries to find out what happened in the big bang when the universe was born by studying the origin and the structure of the matter and antimatter. As a physics research organisation, CERN supports initiatives of the member states that are aiming at improving the level of knowledge in natural sciences.

Web University [9] was launched already in 1995. In the beginning, Web University co-operated with Finnish universities and promoted CERN and physics studies by enabling remote audiences to participate in lectures and seminars held at CERN [1], [2]. Only recently, the activities of Web University have been extent to cover also the high schools [3], [4], [5], [6], [7].

Inspired by positive experiences of the first visits of Finnish high school student groups at CERN in autumn 2000, Web University has initiated a model aiming to integrate the research discoveries of CERN into the high school physics curriculum. The objective is to increase the amount of talented high school students who are interested in physics. The flexible learning consists learning periods both in the own school in Finland and at CERN in Switzerland.

Learning in the own high school

Learning takes place in modern physics period in the physics curriculum. Students must have completed their modern physics course or, at least, they are on the course in parallel with the intensive training period at CERN. It is recommendable that the students have familiarised themselves with the CERN research topics already before coming to CERN. There are several options how to prepare before travelling to CERN. The students can, for example, study CERN-related digital material on the web produced by Web University or they can attend an introductory lecture on CERN activities given by a local university professor. The students can also given preparative research tasks or project works, which they prepare beforehand and continue at CERN. However, the science teachers, who are responsible for the class, carry also the responsibility of the students' preparation for the training period at CERN. Web University provides them with electronic material and instructions how it is recommended to prepare. In addition, Web University has created an Internet community for science teachers to help them when they are teaching the students about CERN research topics.

After training at CERN, the students publish their personal research work, for example, on the net or in newspapers. Some high schools have organised events, where students can present the results to journalists, school board, parents and other students.

Intensive physics training period at CERN

The intensive three-day physics training has been planned in collaboration with Finnish physics researchers. The researchers give lectures, guide trips to physics experiments and discuss their research topics with the students. At the same time, the researchers can share their enthusiasm and knowledge with the students.

The objective of the first day is to give a general outlook of CERN and its most important experiments and research goals of the future. On the second day, the students get familiar with the structure of the matter and nuclear physics. On the last day, they get acquainted with particle physics and antimatter research. The researchers guide the students at different experiment sites. Before each site visit, the students are informed about the theoretical background of the experiment. At the end of the training, the students give feedback about their visit CERN. The results are used for refining the intensive physics training for the next group.

Conclusions

Altogether, five training periods for Finnish high school students were organised during the school year 2000-2001. The school year 2001-2002, eight student groups of about 20 students will visit CERN.

Both the parents and the teachers of the students, who have visited CERN, have given us positive comments on the influence of the flexible physics training on the students. However, because our activities are relatively recent, we cannot yet report how they have affected the status of physics studies among the high school students or the amount of candidates for physics studies in universities.

At the same time, the teachers have been able to improve their knowledge on modern particle physics. This should have a positive impact on the education. The teachers have also networked with other teachers and university professors in order to get more information how their school classes can prepare for the training period at CERN. For this reason, during the school year 2001-2002, it has been started the in-service training for high school physics teachers at CERN. Furthermore, we are developing net-based applications and tools to advance communication and networking between those who are interested in developing physics education in high schools.

References:

- Proceedings references:

[1] Rinta-Filppula R & Korhonen A-M. 2000: Meaningful Learning in a Virtual University by using High Speed Internet Connections. ED-MEDIA, World Conference on Educational Multimedia, Hypermedia / Telecommunications. Montreal, Canada, June 26-July 1, 2000.

[2] Rinta-Filppula Riitta & Mick Draper. 2001. Net-based Learning. ED-MEDIA, World Conference on Educational Multimedia, Hypermedia / Telecommunications. Tampere, Finland, June 25-30, 2001.

[3] Rinta-Filppula Riitta. 2001. Kansainvälistä joustavaa oppimista (International Flexible Learning). ITK 2001 eOppia ikä kaikki! Interaktiivinen teknologia koulutuksessa 19-21.4.2001. Hämeen kesäyliopiston julkaisuja, sarja B. Aulanko, Hämeenlinna. s. 45

BEST COPY AVAILABLE

[4] Rinta-Filppula R. 2001.Fysiikan tutkijat lukiolaisten oppaina (Physics researchers as guides of high school students). Ote, opetus & teknologia 1/2001 s. 31-32. The Magazine of the National Board of Education.

[5] Rinta-Filppula Riitta. 2001.CERN-yhteistyö. Fysiikka lukiossa. Matemaatisten Aineiden Opettajien Liitto MAOL ry. ISBN 952-91-3908-X s. 61-63. (Physics in the High School, Co-operation with CERN published by the Finnish Assosiation of the Science Teachers).

- *Journal references:*

[6] Rinta-Filppula R. 2000. Tutkimustuloksia opetukseen suoraan CERNistä Ote, opetus & teknologia 4/2000 s.24-25. (Research discoveries into teaching of the high school curriculum. The Magazine published by the National Board of Education.)

[7] Rinta-Filppula Riitta. 2001. Tulevaisuuden huippututkijoita etsimässä. ARKHIMEDES Fysiikan ja matematiikan aikauslehti 5/2001. (Looking for world class researchers of the future. The magazine of physics and matematics published by the Finnish Assosiation of the Physics Researchers.)

- *Web references:*

[8] CERN [online], 2001. European Laboratory for Particle Physics, kotisivu [viitattu 25.9.2001]. <URL:http://www.cern.ch/>.

[9] Web University, homepage http://cern.ch/webuniversity/

Supporting the Claims of Campus Transformation Through Assessment of Southeast Missouri State University's "Technology Serving Learning Institutes"

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Abstract: The Technology Serving Learning Institutes have provided instructional technology training to 73% of Southeast Missouri State University faculty since 1997. The Institutes were perceived to be at the center of a major transformation of campus culture, in which both faculty and students embraced technology in teaching and learning. In an effort to assess the role of the Institutes in this transformation, and to validate the transformation itself, we defined "transformation" and developed instruments to probe the role of technology in teaching and learning on campus. We will briefly outline our assessment effort, describe our instruments, and show how the results support our claim that the Institutes have contributed to campus transformation. We conclude by summarizing ways to use assessment to guide future faculty development efforts and to influence campus policies.

The instructional technology revolution has attracted attention and funding for several years. Many programs, products, and experiences have been generated to facilitate both teaching and learning. But educators, administrators, and funding bodies are not sustained forever by excitement; calls for objective assessment of the effectiveness of technology efforts have increased. On the campus of Southeast Missouri State University, assessment of our faculty development program for instructional technology began in earnest when we applied for a Hesburgh award for excellent faculty development programs. Our application focused on evidence of campus transformation resulting from our "Technology Serving Learning" (TSL) faculty development Institutes.

The TSL Institutes have been offered to faculty at Southeast Missouri State University since Summer, 1997. In that time, 73% of faculty have attended at least one Institute session. The Institutes were developed in response to the University's 1995 Strategic Plan, which placed strong emphasis on implementation of information technology in teaching and learning. Prior to 1997, the University considered itself to be at the trailing edge of technology adoption, with no online courses, incomplete infrastructure, and a faculty quite deficient in the skills and understanding necessary to successfully implement technology in courses. The Institutes provided needed technology training in a context of sound pedagogy, targeted primarily to faculty who were technology novices.

Faculty used the training to develop 80 online courses in only three years, and in so doing, began to address a critical need for enhanced student access to University courses in our large, rural service area. Faculty use of instructional servers greatly increased, so that today 275 faculty maintain an instructional server account, and 500 courses have a Web presence. Faculty interest in technology also increased, as indicated by faculty attendance at technology conferences and greater willingness to take part in campuswide technology planning.

The rapid embracing of technology by the faculty led us to believe that we had achieved a fundamental transformation of the campus culture. We set about to define "transformation", as it would be understood by faculty, administrators, students, and the public. We then investigated the drive for assessment on our campus: Who is interested in knowing if transformation has occurred, and what difference does it make if it has occurred? We then developed survey instruments for both students and faculty to collect data from both groups on the role of technology in teaching and learning. We designed questions to probe the effectiveness of online instruction, especially as compared with face-to-face courses. The survey results became an integral part of the award application, but they have also found application in other venues on- and off-campus.

In this session, we present our definition of "transformation" as we briefly outline the history of our assessment effort. We then describe the instruments that we developed, and show results for our campus. A total of 1250 students enrolled in Southeast Online courses over the past two academic years were asked to complete the student instrument; 265 students (21.2%) responded. A total of 52 faculty who taught online in the same time period were asked to complete the faculty instrument; 35 faculty (67.3%) responded. Results from both instruments indicated widespread acceptance of online courses, and a perception that online courses were effective vehicles for teaching and learning. For example, we found that 75% of student respondents felt that the online instructor was knowledgeable, encouraged participation, provided helpful feedback, and was responsive to student concerns. Sixty-five percent of these students rated the instructor's overall performance as high or very high as compared to on-campus courses, and 70% would recommend the instructor to other students. Clear course objectives, well-organized materials, and effective communication were seen by 70-80% of students. Sixty percent of students said that interest in the course subject had been increased, 85% rated their level of learning as medium to very high, 70% felt the academic quality was on par with traditional courses, 70% agreed that they have learned as much as in a face-to-face course, and 80% said that the online course was as good as or better than a face-to-face course. Ninety-three percent of surveyed students in face-to-face courses felt that course Web pages improved their learning experience in the course. In the faculty survey, 80% felt that the TSL Institutes prepared them well to *develop* an online course, with 70% saying the Institutes prepared them well to *teach* online. Also, 90% felt that online instruction increases student access, 65% thought that students find online courses as good as or better than face-to-face courses, and 90% would teach online again.

We will show how the results support the claim that our Institutes, offered since 1997, have indeed made a major, measurable contribution to campus instructional technology transformation. We will conclude with a summary of some of ways that the assessment information has been and might be used to guide future faculty development efforts, and to influence policy on campus.

Learner-Centric Online Teaching for Non-Computer Science Students

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Abstract: This paper reports on two key elements of successful online teaching: learner-centric design and harmonization of content and facilities. We show how these two crucial requirements could be fulfilled with great success in a project that involves a non-computing related subject matter (civil engineering) and thirty-one educators from five European countries. We explain the context of the project, called WiBA-Net, and introduce the L^3 system chosen for providing content access and navigation. We also outline key decisions in designing and building WiBA-Net, emphasizing the two crucial aspects mentioned above. This outline can serve as a guideline for projects in other subject matters and context, and is thus regarded as valuable for a general audience.

Introduction

Many online learning materials suffer from two common drawbacks: the lack of learner-centric design and display disparities in content by different authors. The first drawback especially touches the offered learning path which often comes in either of two extremes: statically fixed or nearly absent. Fixed learning paths are encountered for example in lecture slides which are placed in a certain order and may be restricted to forward and backward navigation. Mostly unstructured HTML documents with cross-references, on the other hand, do not provide any clear path by giving too much leeway to the user.

Neither approach is helpful for the student. As has been shown in various research projects, not all learners are the same! Providing a single type of access for all students is therefore unlikely to result in optimum learning and retention. Learner-centric navigation requires guiding the learner to a learning path tailored to his or her individual preferences and learning style. However, the learning path should not be enforced. Thus, both extremes are ill suited for learner-centric teaching.

Within our ongoing research project, we are looking for a middle way solution. To be usable outside computer science, the system must not place high expectation of computing familiarity on users or authors. Finally, standard content as commonly found on Web pages should be embeddable, for example QuickTime or MPEG movies that illustrate special subtopics.

Our research is part of the WiBA-Net project funded by the German Ministry of Education and Research. The project shall provide a common platform for online teaching. Our current topic focus is on civil engineering. The finished system shall be embedded into the teaching at the various participating universities, to the benefit of both learners and educators.

In this paper, we present the chosen approach for supporting learner-centric online teaching. The paper is organized as follows. We first provide a short overview of related online teaching systems, focusing on their support for individual students. We then give a short overview of the L^3 system used for content modeling, followed by the technical implementation. Finally we summarize the paper and outline areas of future research.

Related Work

Although e-learning has become very popular lately, there is still no "ideal environment" which attracts masses of learners and fulfills all their needs. Many "traditional" educators are therefore skeptic about massive use of the Internet as a medium for learning processes. Virtual School or University is still more "vision" than reality. However, most universities are trying to implement an online form for at least some courses. At the moment probably the best individual access is given in WebCT (WebCT 2002), which allows the tutor to distribute the learning materials and assessments to each student separately – we could say "manual individualization of study". Element K KnowledgeHub™ (Element K 2002) also offers this feature. Macromedia Authorware 6.0 (Macromedia 2002) can be considered as the most flexible environment in which a high level of interactivity can be reached. For course and test building, it provides an iconographical language with decision step elements so the author can in fact "program" some individualization for the students. However, this is relatively difficult for authors without programming experience.

Teachers are of course aware that really effective learning requires more than the individualization in the above-mentioned meaning. It is only logical that we recently observe a boom of many different projects, mainly at universities, focused on building learning environments, which would provide epistemological pluralism and hence a better transfer to the learner. Following the learner way of thinking has been shown to increase the efficiency of education (training) and retention. In these environments intelligent tutoring and adaptability to learner needs are present at different levels and are also interpreted differently. A brief overview with a short characteristic of the most important projects follows.

TANGOW (Carro et al. 2001) (*T*ask-based *A*daptive Lear*n*er *G*uidance *o*n the *WWW*) lets students choose their learning strategy, for example placing theory before exercises. Suggestions for changing the current strategy can be made by the system if the student does not obtain good results with a given strategy.

ELM-ART II (ELM-Art 2002) is an intelligent interactive textbook for programming in LISP. Adaptability is implemented by selecting the next best step in the curriculum on demand. Links are annotated according to a traffic lights metaphor, indicating if a section is ready to be learned, ready but not recommended or not ready yet. The annotation is updated after a learning unit is finished, reviewing all prerequisite concepts to the current unit (Carro et al. 2001). *ELM-ART II* enables direct interactivity by providing live examples and intelligent diagnoses of problem solutions. All function call examples can be evaluated. When the learner clicks on a live example link, an evaluator window shows the evaluation of the function call. Users can type solutions to a programming problem into an editable window and then send them to the server (Weber et al. 2002).

SKILLS (Neumann et al. 2002) (scalable Internet-based teaching and learning system) organizes the course material according to its prerequisites. Adaptability is implemented by taking the student's previous knowledge of the subject into account (Carro et al. 2001). The teacher prepares a default configuration for every course. Concepts addressed by the system are marked in the user's profile. If the user is familiar with some concepts from external sources, control questions are given from the tutoring component. If these questions are answered, the known concepts are removed (hidden) from the course. If the student does not want to answer the control questions, the concepts to be removed are marked until the student solves the exercises at a later time (Neumann et al. 2002). Annotations, notes and additional files can be stored or published to other students.

WINDS (*W*eb-based *In*telligent *D*esign and Tutoring *S*ystem) (WINDS 2002) produces individualized courseware for the students according to their current state of knowledge, their preferences and learning styles. Each learning element has a didactical goal. Authors can create new content using a set of predefined paragraph templates. Examples paragraphs are *Cover Story, Simple Explanation* or *Picture Compare. Complex Paragraphs* combine several elements ("content blocks") with different pedagogical functions to fulfill a pedagogical goal, for example *introduction*, *definition* or *example*. Each such chunk of information has a predefined order, pedagogical role and other metadata. Based on the user model and the metadata, the system can adapt the content sequence according to the chosen learning strategy. For instance, a concrete example can precede or complement an abstract statement if needed. To prevent or at least reduce cognitive overload, the pedagogical roles of the learning elements as well as those of the content blocks can also be expressed graphically, for example by different background colors (Specht et al. 2001).

The L^3 Learning Environment

L^3 (Leidig 2001) ("*l*ife-*l*ong *l*earning") is a learning environment by SAP CEC at Karlsruhe, Germany. L^3 structures course materials into four different types of containers. *Learning networks* (LN) are the topmost element of the hierarchy and may contain a set of *LN, learning objects* (LO) *and instructional elements* (IE). The actual content is represented by *instructional elements* (IE), each covering roughly one page of paper. The different types of IE include example, action, introductions or resource links. Learning objects combine a set of IEs addressing a common topic. Additionally, the relation between given elements can have different types, specified by the classification of the edge connecting the elements, as shown in (Fig. 1).

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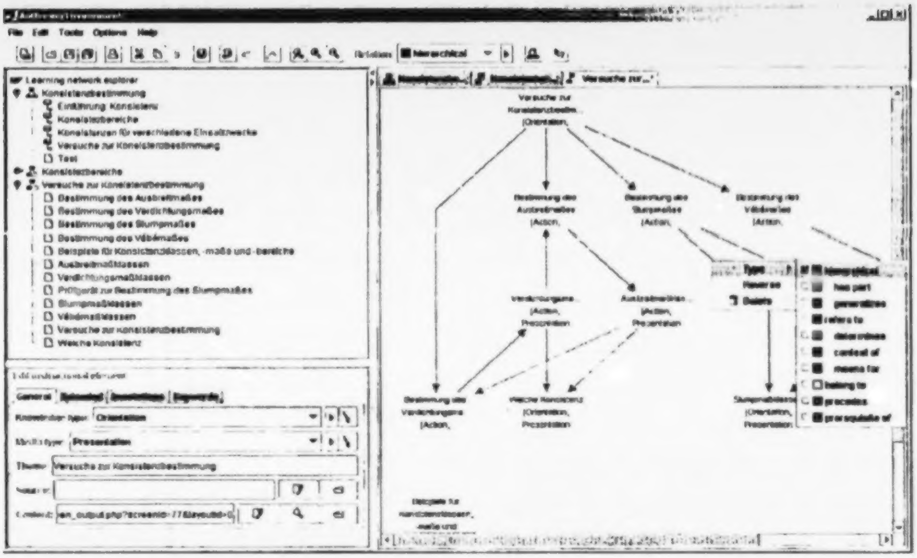
File Edit Tools Options Help
Hierarchical
Learning network explorer
Konsistenzbestimmung
Einführung Konsistenz
Konsistenzbereiche
Konsistenzen für verschiedene Einsatzzwecke
Versuche zur Konsistenzbestimmung
Test
Konsistenzbereiche
Versuche zur Konsistenzbestimmung
Bestimmung des Ausbreitmaßes
Bestimmung des Verdichtungsmaßes
Bestimmung des Slumpmaßes
Bestimmung des Vébémaßes
Beispiele für Konsistenzklassen, -maße und -bereiche
Ausbreitmaßklassen
Verdichtungsmaßklassen
Prüfgerät zur Bestimmung des Slumpmaßes
Slumpmaßklassen
Vébémaßklassen
Versuche zur Konsistenzbestimmung
Welche Konsistenz
General
Versuche zur...
Type
Reverse
Delete
has part
generalizes
refers to
determines
context of
means for
belong to
precedes
prerequisite of

Knowledge type: Orientation

Media type: Presentation

Theme: Versuche zur Konsistenzbestimmung

Content: en_output.php?screenid=77&layoutid=0

Figure 1: L^3 course editor, showing the course structure, metadata and connection types

Each element has a title, an author and a set of metadata. This metadata includes the knowledge and media type, approximate time required for finishing the unit, the types of competencies that can be achieved by working on the unit and a classification of the content according to an underlying taxonomy.

The learning path is generated based on the relations between the elements and the content type of IEs. The user can choose a learning strategy on two different levels. The *macro-strategy* covers the order of the higher-level elements such as LNs and LOs. The following macro-strategies are offered: table of contents, deductive and inductive, as well as one linear version each of these strategies. The ordering of the IEs within a given learning object is controlled by a *micro-strategy*. Currently available are orientation only, orientation first, explanation oriented, action oriented and example oriented microstrategies. The learning material can also encode temporal or causal dependencies between IEs as prerequisites, if they cannot be avoided.

The learner may submit offered tests at any time. Failed tests may influence the course process, for example by asking the learner to review parts of the course. Any SCORM-compatible test (SCORM 2002) can be used, for example generated using Authorware (Macromedia 2002). Additional techniques that may be integrated into page content are beyond the scope of this paper. Basically, all content types acceptable in HTML 4.0 can be integrated easily, for example Flash, MPEG, RealMedia or QuickTime media.

L^3 courses are executed on a standard Apache Web server with an Enhydra Application Server (Enhydra 2002). Enhydra performs the rendering of the L^3 content. The end-user requires only a current web browser. Additional plug-ins may be required for special embedded content, such as MPEG or QuickTime video material.

The WiBA-Net Approach

WiBA-Net is a course network that contains learning units for civil engineers and architects. The content is a central part of civil engineering studies. We have to address the following user groups, each with its own unique interest in the system:

- Undergraduate students use the network to prepare for the mandatory exam at the end of the course,
- Graduate students use WiBA-Net to access the basics of their study and additional courses,
- Professionals in related fields use the network for research and learning more about covered materials,
- High school students can experiment with WiBA-Net to gain or increase their interest in the topic area and possibly induce a desire for studying in this field.

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The target audience also contains the educators who can use the WiBA-Net for publishing content for lectures and sharing it with other educators. Currently, 31 educators have agreed on a content memorandum for WiBA-Net, coming from universities in Germany, Austria, Switzerland, Denmark and Hungary.

We have to consider not only different needs of user but also a different (moreover non-computer science) backgrounds of the authors. Therefore, our system has to respect the learner's individual needs and be easy to use. At the same time, it must also be comfortable for authors who want to share their materials and combine them in different way to course contents. We have decided to adopt L^3 as the tool for managing and displaying the content for WiBA-Net due to the features offered. Key aspects in the decision werethe following:

1. learner-centric approach - for example, the "orientation only" micro-strategy fits high school students,
2. a user-friendly interface which can be used intuitively,
3. metadata support should allow authors to provide essential information about materials for efficient sharing of resources, even among different universities,
4. online courses require high interactivity and lots of multimedia materials. Therefore, we need good support for tests and multimedia files.

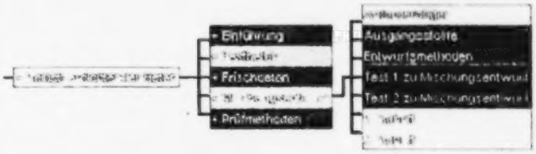

Figure 2: Example learning path in L^3

As shown in (Fig. 2), the course elements on the learning path are marked with different colors according to their degree of recommendation, including not recommended, recommended and visited elements, as well as the current element and test entities. The elements in the right row from top to bottom contain the current element, two recommended elements followed by two tests and two elements which are not yet recommended. The second element in the middle row is a finished learning object.

The educator specifying the course contents does not directly define the learning path. Rather, the path is assembled dynamically from the learner's chosen strategy. Thus, WiBA-Net offers a very good compromise between cognitive and constructive learning, both for educators and students. The learner can also pursue a different path than the offered learning path by clicking on the element in the navigation structure at any time.

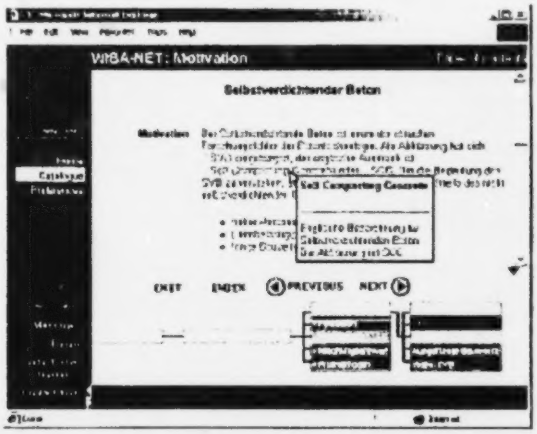

Figure 3: Example content as shown in WiBA-Net

An example content provided by WiBA-Net is shown in (Fig. 3). The left frame contains elements for customizing the environment, selecting a course, and entering communication via mail, forums or direct contact. The actual content of the page is shown in the center of the window. The standard navigation elements for

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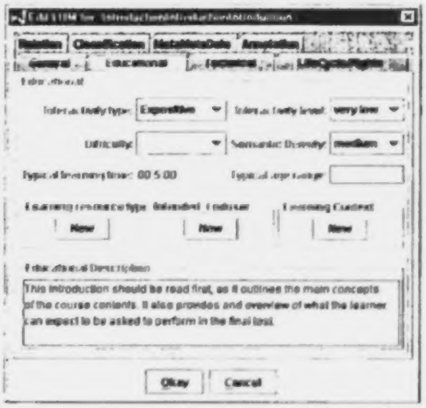
leaving the current course or accessing the index, as well as stepping forward and backwards, are placed below the content area. The bottom of the page shows the current leaning path.

Similar to the common navigational elements provided by L^3, the course contents are formatted using a common underlying style sheet, providing a corporate identity for the whole set of courses. By assuming the same underlying layout, we achieve a harmonization of both the content and the facilities, making the finished product "smoother" to both look at and use.

A key concern within the project is that learners shall not be restricted by the tight focus of the single course they currently are in. For this end, our project partners have coined the concept of *knowledge clusters*. A cluster contains a set of pages addressing a common topic in a well-structured manner. They can be referenced from any course as "related topics", offering a more in-depth treatment for the selected topic than would be possible within a given course. The page order of clusters may also adapt dynamically based on the strategies.

Since the project shall create a platform for online learning at the field of civil engineering for the whole German academic community, metadata are one of the key points. The metadata must provide sufficient reusability of the learning materials, as well as a basis for an effective searching function for the authors and for the students. L^3 itself supports the definition of various LOM-based metadata (LOM 2002), as illustrated in (Fig. 4). For the reasons mentioned above we have decided to adapt this model as follows:

- all the metadata are fully SCORM compatible (SCORM 2002),
- those optional data in SCORM model which are relevant to the project; most of them will actually be mandatory for the authors within the project.
- as much as possible is generated automatically by the system (e.g. metadata scheme, size of the file,...),
- many categories have already predefined content but authors are allowed to change it anytime (e.g. intended end user role, copyrights,...).



Educational

Interactivity type: Expositive

Interactivity level: very low

Difficulty:

Semantic Density: medium

Typical learning time: 00 5:00

Typical age range:

Learning resource type

Intended End user

Learning Context

Educational Description

This introduction should be read first, as it outlines the main concepts of the course contents. It also provides and overview of what the learner can expect to be asked to perform in the final test.

Figure 4: Example screen shot of the LOM-based Metadata editor

We are working on realizing automatic links to the appropriate knowledge clusters for the current content. This requires both a thorough classification of the content with metadata and a clever server component that can automatically deduce "related" entities. Additionally, a precise taxonomy is needed for building a meaningful set of terms for classifying the contents.

Conclusions and Further Research

Effective Web-based learning requires two key features: learner-centric design and a harmonization of both content and facilities. The former point mainly touches upon the degree of guidance given to learners for navigating the content.

The WiBA-Net project builds a prototypical system for learner-centric online teaching that incorporates the SCORM (SCORM 2002) standard. WiBA-Net has to address different target user groups and accommodate a

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large set of educators from different countries. The main focus of our prototype system thus lies in learner-centric navigation support and the harmonization of both content and facilities.

The content is presented within the L^3 environment. L^3 accepts standard HTML-conformant input for its components and thus supports many different input types. We employ a default style sheets that provides a common look and feel that is not restricted to a single course. The large amounts of participating parties that provide content necessitate such measures to keep the system's harmonious look.

The project presents several challenging aspects for all project partners, including different views of software solutions and slight but important differences in the usage of key terms. More seriously, some key definitions needed for the software solution are currently lacking. This is especially the case for the support of related elements to be linked to the currently displayed content, termed "knowledge clusters" within the project.

References

Carro, R.M, & Pulido, E., & Rodriguez, P. (2001). TANGOW: A Model for Internet-based Learning. *Continuing Engineering Education and Lifelong Learning, 2001*, Vol. 11, Nos. 1/2, 25-34.

Element K KnowledgeHub™. Online: http://www.elementk.com/elearning_solution/htm/managing.asp (seen April 22, 2002)

ELM-ART project. Online: http://www.psychologie.uni-trier.de:8000/projects/ELM/elmart.html (seen April 22, 2002)

Enhydra Application Server Home Page. Online: http://www.enhydra.org/ (seen April 22, 2002)

L^3. Online: http://www.l-3.de (seen April 22, 2002)

Learning Object Metadata (LOM) Online: http://ltsc.ieee.org/doc/wg12/LOM-WD3.htm (seen April 22, 2002)

Leidig, T. (2001). L^3 – Towards an Open Learning Environment. *Journal of Educational Resources in Computing (JERIC)*, 1 (1), Article No. 7.

Macromedia Authorware. Online: http://www.macromedia.com/software/authorware/ (seen April 22, 2002)

Neumann, G., & Zirvas, J. (1998). SKILLS - A Scalable Internet-Based Teaching and Learning System. *Proceedings of the World Conference on WWW, Internet and Intranet (WebNet '98), 1998*, Orlando, Florida, 688-693.

SCORM definition and resources. Online: http://www.adlnet.org/scorm/downloads.cfm (seen April 22, 2002)

Specht, M., & Kravcik, M., & Pesin, L., & Klemke, R. (2001). Integrated Authoring Environment for Web Based Courses in WINDS. *Proceedings of the Interactive Computer Aided Learning Workshop (ICL2001), 2001*, Villach, Austria.

WebCT. Online: http://www.webct.com (seen April 22, 2002)

Weber, G., & Specht, M. (1997). User Modeling and Adaptive Navigation Support in WWW-based Tutoring Systems. *Proceedings of the Sixth International Conference for User Modeling (UM-97), 1997*, Vienna, New York: Springer Wien New York, 289-300.

WINDS project. Online: http://www.winds-university.org/ (seen April 22, 2002)

Deploying an Infrastructure for Technologically Enhanced Learning

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Abstract: A number of university campuses have undertaken the development of *digital classrooms* that enable presentation of digital media and digital lecture recording. Deploying the infrastructure for a digital classroom is difficult at best even for a technically savvy person. As people from many disciplines become interested in building similar digital classroom spaces, there is a need to produce a useful set of design and implementation guidelines to reduce the project risk and steepness of the deployment curve. The goal of this paper is to report on the experiences we have had in deploying the UCSB digital classroom. The two main contributions of this paper are: (1) a *phased* deployment model; and (2) a discussion of how the proposed technology enables new educational models and techniques.

Introduction

Advances in technology coupled with increased familiarity with technical tools have paved the way for new paradigms in teaching and learning. Instructors are now using media such as PowerPoint slides and digital video in their lectures. Students can take digital notes on laptop computers or Personal Digital Assistants (PDAs). These types of technologies allow students and instructors to communicate digitally across time and space. However, while these tools are readily available, using them in a coherent manner is still a challenge. A number of university campuses have undertaken the goal of developing *digital classrooms* that enable presentation of information using cutting edge multimedia tools as well the capability to digitally record an account of the classroom activity. The account can be used in realtime to enable distance learning or realtime collaboration, or can be archived and reviewed at a later time.

A number of universities have deployed digital classrooms for both teaching and research on new learning methodologies and tools. One of the earliest experiments with this kind of technology was the AT&T Learning/Teaching Theater at the University of Maryland (Schneiderman et al. 95). More recent examples include 405 Soda at UC Berkeley (Wu, Swan, & Rowe 99) and Georgia Tech's eClass (Abowd 99). While the research that has come out of these projects has focused largely on user-level issues, the piece of the puzzle that has yet to be solved is the question of what functionality these classroom spaces should support, and more importantly, how that can be achieved. Without a useful model to draw from, there is an enormous learning curve involved in determining first, what functionality a classroom should support, and second, what technology exists to realize the design. A huge number of tradeoffs need to be considered. It is difficult at best for a technically savvy person to undertake the challenge of deploying a classroom. As people from across disciplines become interested in building similar digital classroom spaces, there is a need to produce a useful set of design and implementation guidelines for ease of deployment.

The goal of this paper is to report on the experiences we have had deploying a digital classroom. By drawing from our experiences, future classroom architects can reduce project risk as well as the steepness of the deployment curve. We identify four classroom functions, and suggest that a classroom should be deployed in four phases corresponding to those functions. In June of 2000 we took on the challenge of deploying a digital classroom at UC Santa Barbara. To date, we have spent approximately $70,000 on our classroom setup broken down as roughly $14,000 for phase 1, $42,000 for phase 2, and $12,000 for phase 3. To date, our phase 4 deployment has leveraged technology purchased in the prior phases. It is difficult if not impossible to deploy a fully functional digital classroom infrastructure before testing or using it. Therefore, it is imperative to support incremental development, deployment, use, evaluation, and modification.

Presentation Facilities

The first phase of classroom infrastructure deployment focuses on providing technology to allow an instructor to give a multimedia presentation in a digital classroom. It is impossible to develop an infrastructure that will accommodate every lecturer or class ever held in a digital classroom. Some professors will use PowerPoint slides while others prefer to use transparencies while still others stick to the standard chalkboard method. In addition, instructors using digital presentation media may require a variety of software. Managing a few pieces of software is tractable, however a system to manage lots of software is not. Fortunately, a large percentage of cases can be accommodated with a standard collection of hardware and software. Minimally, a classroom should include a data projector to show PowerPoint slides or other computer video in addition to providing an Internet connection for a presentation laptop or desktop machine.

Selecting a presentation computer and data projector for purchase requires some thought about the specific classroom and the complete functionality that will eventually be supported by the classroom. We identify three main concerns that need to be addressed when selecting equipment. The first is **compatibility**. A major concern is whether or not each piece of equipment will be compatible with the remaining infrastructure. For example, if the classroom will eventually have a room control system to control various components (e.g., power on/off, input device switching, etc), does the data projector support that type of control? An additional concern with data projectors is how to **install** our mount them. One option is to simply purchase a media cart where a projector can be stored. However, a media cart is not a scalable or permanent solution. The preferred solution is to mount the data projectors into the ceiling. This requires the purchase of a ceiling-mount kit for each projector. Additional concerns include providing a power source as well as ensuring that the ceiling is high enough to mount the projectors out of the way of sight for students and other equipment. Once a data projector and presentation computer have been selected, the next concern is **connecting** them together. The standard solution is to run a VGA cable from the computer to the projector. However, in a digital classroom the distance might be too great thus the quality of the video signal degrades. The solution is to purchase a signal interface -- a device to boost a computer video signal such that it can travel greater distances.

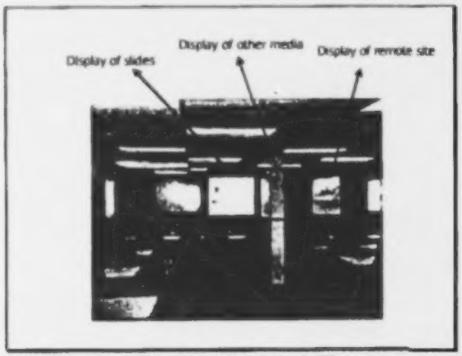

Figure 1: The UCSB Digital Classroom.

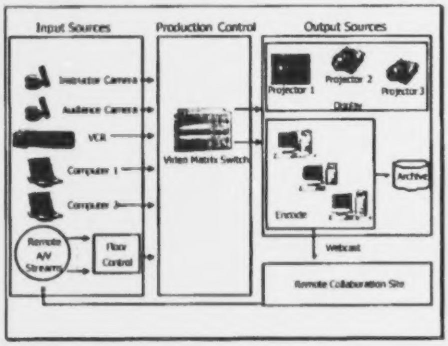

Figure 2: The UCSB digital classroom infrastructure.

The UCSB digital classroom shown in Figure 1 has three ceiling mounted data projectors that project on standard projection screens, two presentation laptop computers with signal interfaces at the front of the room, and one presentation desktop with signal interface at the back of the room. In addition, we provide a VCR for showing standard VHS videotapes. Each computer has a DVD player and an Internet connection and can be used for showing DVDs, presenting PowerPoint slides, and/or web browsing. In addition, speakers may bring their own laptop computers with specialized hardware and/or software and use the data projectors we provide. Finally, students may connect to the Internet using their own laptops or PDAs though a 10Mbps wireless network.

We are currently in the process of identifying other extensions to the infrastructure. Short-term extensions include integrating existing technology such as a document camera. Longer-term extensions include upgrading the display technology to be more sophisticated. Instead of three separate screens we could have a single wall-sized display (Fox et al. 00).

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A Webcasting Studio

Once the basic infrastructure is in place to support lectures in a classroom, the next step is expanding the infrastructure to include support for webcasting. A webcasting environment captures audio and video feeds generated in the classroom and sends them, potentially accompanied by other materials such as slides, over the Internet to a remote location. There are two pieces involved in making this happen. The first is to provide support for capturing video and audio of the presentation. The remote audience should be able to see and hear the instructor. Second, multimedia material (e.g., slides) presented to the local audience should also be presented to the remote audience.

The minimal requirements for a webcasting environment are one camera, a microphone for the instructor, and an encoding computer. However, producing a reasonable quality webcast requires a great deal more effort. First, a single camera can be limiting if you hope to capture all of the activity that occurs in a classroom. To capture all of the classroom activity including instructor and student movement, multiple cameras must be mounted in various locations in the room. In addition, capturing slides or a web page can be done simply by focusing a camera on the projection screen. However, capturing the computer video feed straight from the computer can produce a higher quality image. Determining which streams are encoded and webcast at any given time adds a non-trivial bit of complexity to the system. Generally, a *producer* must be available to manually select the stream for webcast. A producer is generally a student or staff member who produces the webcast by controlling the encoding tools and selecting the appropriate video and audio streams.

Managing multiple streams simultaneously introduces a host of complexities. First, devices such as cameras have an associated **control** interface and may be controlled (e.g., zoomed) from a remote control or computer interface. However, when numerous, heterogeneous devices are installed in a room, it becomes difficult to control all of the individual elements. Rather than having multiple interfaces such as computers and remote controls, it is desirable to support a single, integrated interface that supports control of many or all of the devices in the room (Yu et al. 01). Also, it is unlikely that any hardware configuration would support encoding of all possible streams simultaneously. The general protocol is to **select** a subset of all available streams for encoding. In order to accomplish this, the infrastructure must include a video matrix switch. A video matrix switch is a device that takes as input a set of video signals and allows routing of the video signals to one or more of the switch output channels. By routing all video through a video switch, the architecture becomes much more modular. Audio signal capture poses many of the same problems encountered by video stream capture. If an infrastructure supports only a single microphone used by the instructor, the signal can be directly connected to a sound card. However, this model begins to break down relatively quickly. Capturing other audio sources such as audience discussion or the audio track from a VHS video is imperative. The ultimate solution is to install a professional quality audio system that is capable of mixing audio signals from the instructor, microphones placed to capture ubiquitous audience discussion, audio streams from remote sites, and other sources such as video. Finally, video format **compatibility** is a concern. Video capture hardware generally expects a composite video signal. Therefore, the computer video signal sent from a presentation computer cannot be directly encoded as part of a video stream. The solution is to use a *scan converter* to convert the high-quality computer video signal to a composite video signal.

Developing an infrastructure to manage and select multiple media streams in various formats is extremely complex and requires much thought. However, once the architecture to capture a selected stream is in place, the next step is to determine how to encode the audio and video streams into a format that can be easily distributed and viewed by remote participants. There are two primary concerns that need to be addressed. The first is **expense**. Hardware-based encoding solutions provide efficient, high-quality encoding. However, while cheaper solutions are on the way (e.g., NCast - www.ncast.com and VBrick - www.vbrick.com), current solutions can be very expensive. Software-based encoding solutions can also be expensive, but a range of lower-cost solutions exist as well. While **encoding** formats such as MPEG-4 may seem to be the highest quality solution, the chosen encoding format should have a widely available, cross-platform decoder/viewer. Ideally, students would have the viewing tools already installed on their desktop thus avoiding having to download or purchase them. The most common tools currently on the market are RealPlayer and Windows Media Player both of which have freely available and easy-to-install viewers and encoders.

The UCSB digital classroom infrastructure supports webcast of a single video stream selected from a set cameras or other video input. In addition, we have implemented the audio setup suggested by the Access Grid specification (www.accessgrid.org) which includes a number of microphones to pick up ambient sound

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and a high quality sound mixer[1]. The heart of the UCSB classroom infrastructure is a 12 input, 8 output video matrix switch. The switch supports both composite and computer video. The first two switch inputs (see Figure 2) are the composite video signals generated from the classroom cameras mounted to capture both instructor and audience views. In addition, composite video from the VCR is also routed through the switch. All computer video sources from the presentation machines, as well as remote sources, are also inputs to the switch. However, in order to capture and encode any of these feeds, the feed must be routed through a scan converter and converted from computer video to composite video. The resulting stream is then fed back into the switch and may be selected for encoding. The streams selected for encoding are fed into a video capture card installed on a standard PC. In addition, the mixed audio stream is fed into the sound card of the PC. The audio and video streams are then encoded using either RealMedia format or Windows Media format and webcast to a remote audience.

Remote Collaboration

The one-way distance learning scenario supported by a webcasting studio does not capture the true learning experience. For distance learning to truly be effective, we have to enable remote students to ask questions, participate in discussion, and otherwise appear to be at the local site. This requires two pieces. First, the remote site must have facilities similar to that of the local site. Second, the technology to communicate in realtime between the two sites must be in place.

Ideally, a remote site would be an exact replica of the primary site. In reality though, the infrastructure of a remote site is generally a subset of the infrastructure deployed at a primary site. Minimally, a remote site must include a camera, a microphone, an encoding machine, and a decoding machine. This could take the form of a standard webcam and microphone connected to a student's home PC where the PC is both the encoding and decoding machine. However, if a remote site is designed to support multiple students (e.g., an extension campus) a more complex infrastructure is necessary. For example, displaying video of the instructor on a PC screen is probably not sufficient. In addition, the camera should be able to capture an audience larger than a single person. Fortunately, the problems encountered when developing the remote site infrastructure are the same problems encountered when deploying the primary classroom and thus we can apply the same solutions.

While deploying the remote site infrastructure itself is relatively straightforward and follows directly from the experiences we have already described, deploying a communication layer on top of the infrastructure is more difficult. There are two main topics to be addressed. The first is realtime encoding. Our first inclination was to use the same software encoding solutions for realtime communication that we used for one-way webcasting. However, off-the-shelf encoding software such as RealMedia and Windows Media introduce intolerable delays from 7 to 15 seconds one-way due to buffering requirements. As with many of the problems we have encountered, extremely expensive encoding solutions exist. But, deploying these solutions without knowing whether or not they are going to work is a risky venture. The alternate solution is to use encoding software designed for video conferencing such as *vic* or Microsoft NetMeeting. While off-the-shelf video conferencing software is generally easy to use, quality is sacrificed to meet realtime requirements. Also, in addition to watching video generated at a primary site, students at a remote should be able to ask questions (Malpani & Rowe 97) and access shared components such as whiteboards. Additionally, as the number of remote sites grows, it becomes necessary to manage the sites so that only one remote site is asking a question or sourcing video at a given time. Some of these problems may be solved with standard videoconferencing software. However, the requirements are different for any given infrastructure and differences require specialized solutions.

We have deployed a test remote site we call a *kiosk*. The kiosk has one camera, a single microphone (to be passed from participant to participant), a single encoding machine, and two decoding laptop computers connected to data projectors for display (see Figure 3). We use Microsoft NetMeeting to communicate between the sites. The primary classroom sends slides (using the NetMeeting screen sharing facility), a video feed of the speaker, and an audio stream from the speaker microphone to the kiosk. The kiosk sends a single video stream and a single audio stream back to the primary classroom where it is displayed on a side mounted projection screen. Figure 4 shows the flow of streams between sites. In building the kiosk, we have made a number of simplifying assumptions. First, to avoid the problems of floor control and remote stream selection, we assume that there are only two sites participating at any given time. Second, we assume that the only audio stream for either site is generated from the single microphone available at that site thus we do not have to mix the audio signal. Extensions to our infrastructure would include enabling multiple sites to participate at any given time.

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[1] The Access Grid is an initiative to enable research labs and universities to conduct large scale, distributed meetings over the Internet through an *always on* infrastructure.

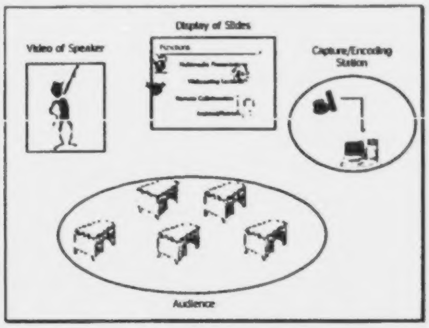

Figure 3: Remote site infrastructure.

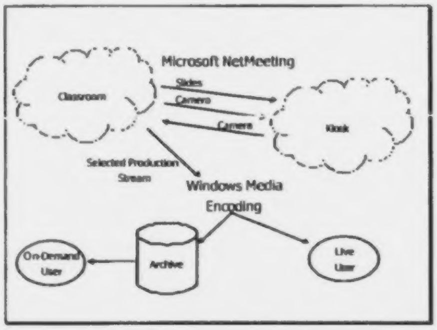

Figure 4: Classroom and remote site communication.

Lecture Replay

One of the primary advantages of recording a lecture or course is that it may be reviewed after the fact. Students may review material at the end of a course or before an examination. In addition, lectures given by guest speakers or experts in their field may be archived and watched by students for years to come (Tsichritzis 99). There are a number of issues involved with recording lectures for replay. However, most of the difficultly lies in providing more functionality over straightforward, sequential playback. The goal of the infrastructure is simply to provide a content base that may be accessed and used to research new methods of access. The challenge is to record and encode the content such that it may be accessed later in different ways using a variety of tools. Support of VCR-style interactivity as well as integration of multiple media types provides a more effective replay experience.

There are two main issues in the deployment of an infrastructure for lecture replay. The first is the deployment of a **mediaserver**. An hour of lecture can be 500Mbytes or more depending on the encoding scheme. Therefore, the first concern is to deploy a media server with enough disk space to hold the recorded lectures. The second issue is to determine which **encoding** standard to use. The simplest solution is to simultaneously save the stream already being encoded for webcast. However, it may be desirable to support postprocessing of the stream such as including synchronization between video and slides (Mukopadhyay 99).

The UCSB digital classroom primarily focuses on replay of the webcast stream. During webcast, the encoded Real or Windows Media stream is saved to a file and may be streamed from the server later. We are still in the early stages of generating a content base and thus have not yet deployed a server to support large amounts of data. We have also built a tool to support synchronization between notes written by participants and the video of the lecture.

Potential Impact on Education

Multimedia in the classroom presents a number of opportunities for students and educators alike. First, using technology, learning can become a more interactive process. Teachers can use a variety of media to teach students in new and different ways while students can use technology such as laptop computers or PDAs to share information and communicate with one another. Moreover, using webcasting and remote collaboration facilities, we can remove the physical barrier imposed by a classroom environment. Enrolled students can "web commute" rather than miss lectures, and students who may have otherwise been unable to take a class at all have more flexibility to choose to attend lecture from their home. Additionally, the number of people who can fit in a room or be physically present no longer limits audience size. For example, if an expert speaker visits a university, the number of people interested in attending her lecture may exceed the capacity of the largest

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lecture hall on campus. Finally, as webcasting enables a limitless number of people to watch a lecture given by an expert, lecture archival and replay can make the same lecture persistent. Students for years to come can watch and learn from experts in their field

Conclusion

Deploying the infrastructure for a digital classroom is a long and often tedious process. In theory, it involves technical staff, facilities staff, as well as researchers. In the past year, we have brought the UCSB digital classroom online to support the four functions defined by our model to varying degrees of completion. While the process has been slower than we originally anticipated, delays in deployment can be attributed to lack of staff as well as to factors such as back-ordered equipment and equipment incompatibility. However, we are pleased with the resulting infrastructure and its use so far.

To date, we have used the classroom for three different types of events: (1) we have hosted and recorded a standard graduate course; (2) we have conducted a graduate student seminar with participants distributed between the classroom and our remote kiosk; and (3) we webcasted a talk given by a Nobel laureate to an elementary school classroom located in a nearby town. The Nobel laureate's talk was also viewed from other locations in the US, as well as in the UK. Overall, our experiences have been successful. While we are working toward automating the process of set up and configuration as well as lecture production, our infrastructure supports nearly all of the intended functionality.

Throughout the process of designing and implementing our classroom model, we have identified a number of considerations that may not be immediately obvious to the designer or implementer. These considerations range from high-level decisions such as supported functionality to low level choices such as required equipment. We would like to acknowledge many helpful discussions with Larry Rowe and other classroom architects that have helped us to determine the common properties of most digital classrooms. We believe that most digital classroom implementations support similar functionality. Thus, it is unnecessary for each design team to start from ground zero. As campuses around the world begin to embrace technology in their curriculums, it is essential to be able to quickly and easily deploy technologically enhanced meeting spaces.

References

Shneiderman, B., Alavi, M., Norman, K., & Borkowski, E. (1995). Windows of Opportunity in the Electronic Classroom. *Communications of the ACM*, 38 (11), 19-24.

Wu, D., Swan, A., & Rowe, L. (1999) An Internet MBone Broadcast Management System. *Multimedia Computing and Networking*, 1999, San Jose, CA, USA.

Abowd, G. (1999). Classroom 2000: An Experiment with the Instrumentation of a Living Educational Environment. *IBM Systems Journal*, 38 (4), 508-530.

Fox, A., Johanson, B., Hanrahan, P., & Winograd, T. (2000). Integrating Information Appliances into an Interactive Workspace. *IEEE Computer Graphics and Applications*, 20 (3), 54-65.

Yu, T., Wu, D., Mayer-Patel, K., & Rowe, L. (2001). dc: A Live Webcast Control System. Multimedia Computing and Networking, 2001, San Jose, CA, USA.

Malpani, R., & Rowe, L. (1997). Floor Control for Large-Scale MBone Seminars. *ACM Multimedia*, 1997, Seattle, WA, USA.

Tsichritzis, D. (1999). Reengineering the University. *Communications of the ACM*, 42 (6), 93-100.

Mukopadhyay, S., & Smith, B. (1999). Passive Capture and Structuring of Lectures. *ACM Multimedia*, 1999, Orlando, FL, USA.

Information Technology Groupware: The Impact of Electronic Collaboration on Project Teams

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Abstract: Team collaboration is an important part of working in business today. We produced an experiment in which students were given the opportunity to use many different collaborative tools. We used a pre-test survey and post-test survey to evaluate the student's willingness to use collaborative tools. The paper describes the test, findings and ramifications.

Introduction:

Team collaboration is an important part of working in business today. Because teams are used often in business settings, universities require prospective business candidates to become exposed to collaboration through team projects. One type of collaboration that can be used in team settings is electronic. The purpose of this study is to show that electronic collaboration can impact students' frequency of technology usage as well as their acceptance to using collaborative technologies. Our first goal was to verify that students will use technology more often over time in project team settings after they have been exposed to both the technology and the actual team collaboration. Our second goal is to verify that students will find the technologies useful, thus increasing their acceptance of it, with certain features for group projects. Therefore, the student acceptance of using technology in team settings will increase as they become more acquainted with the tool and its features.

Several new tools have been designed to make teamwork and collaboration more efficient. These groupware programs can allow users to exchange files, draw collaborative sketches, and use auditory voicing along with providing many other features. These features are attractive to users who are highly involved in teams and collaboration. Furthermore, electronic collaboration is becoming more important in both academic and business settings. The benefits these technologies can offer to users will hopefully solve problems of distance, communication, sharing information, and costs.

This study in electronic collaboration usage and implications which extends what has already been done in groupware and group collaboration systems. Electronic collaboration holds promise for future studies in a variety of settings as technology continues to grow and becomes an even more integral part of culture throughout the world. The structure of this paper is presented in the following format: I. Introduction, II. Literature Review, III. Hypothesis Development, IV. Methodology, V. Data Analysis, VI. Research Results, and VII. Recommendations, and VIII. Further Studies.

Literature Review:

Information technology has had a revolutionary impact on society within the last several years. The recent growth of networks, cellular communications, and fiber optic cables have spawned the Internet boom and have provided opportunities for convergence with existing media such as television (Halal, 1992). This shows the trend of technology being converged into current social norms. Other examples include the Internet and teleconferencing as means to improving communication in office, school, and home settings (Halal, 1992). These instances further show the fact that technology is changing the way we live and work.

The result of these trends shows that technology is a catalyst for defining our social domain. Consequently, the term "virtual community" formed to reflect how our culture acts toward technology; a virtual community is one where the people are able to communicate and interact in an online environment (Halal, 1992). Because of the heavy reliance on technology in our global society, people have a strong need for communication. Collaboration is one aspect which technology can advance in order to bring citizens in virtual communities closer together.

Collaboration is a term for actively communicating with other people. The benefits of effective collaboration can be highly favorable in work, academic, and personal settings (Chandra, 1996). This current term for communicating with the aid of technology is called electronic collaboration. There is a tremendous synergy that exists in an effective e-collaboration environment. The benefits from these virtual teams can solve many problems such as distance and schedule conflicts.

With the enhancements of team communication in business and academic environments, electronic collaboration can revolutionize the way people exchange information. For example, many businesses have integrated collaborative designs and opted toward a paperless environment. In addition to e-collaboration being an advantage, there are several types of electronic tools that offer unique features.

Electronic collaboration tools, also known as groupware contains a certain outline of functionality, which includes messaging, scheduling, and audio communication. There are also special capabilities of e-mail, including beeper triggering, which can be useful to individuals who carry pagers. Another type of e-collaboration is instant messaging. Three popular services, which provide instant messaging, are Yahoo, AOL, and MSN (Agnew, 2000). Instant messaging is a forum for real-time communication that can include text chat and audio transmission over the Internet. This real-time synergy allows individuals to communicate instantaneously with other users, unlike e-mail, which stores a record. Furthermore, text chat simulates person-to-person chatting while e-mail represents letter writing.

Additionally, there are other groupware products on the market that incorporate several features into one package. Among these tools are Blackboard, Stuffincommon, Centranow, Webex, Placeware, Blink, Backflip, Groove, and Lotus Notes. These e-collaboration tools each have their own unique features. One feature is known as an electronic calendar (Agnew, 2000). This can allow one to schedule and plan activities online. Other important features of e-collaboration tools include notification of users online and file download capabilities. These abilities can let someone know when a team member is online. Furthermore, the ability to download and upload files is a tremendous advantage to exchanging information.

Several popular groupware packages, such as Groove, Lotus Notes, and E-Room, allow users to utilize one program for many features (Fontana, 2001). Some of these features include threaded discussion and file sharing across the Internet. Furthermore, bookmarks, post-it notes, and white boards also allow users to post and store information online. Bookmarks are useful for saving links to other websites while post-its can act as reminders for information. Also, whiteboards are a popular feature that allows users to interact real-time and draw (Fontana, 2001). Though e-collaboration features are very important for user-specific tasks, the benefits from those features are far more significant. Another important benefit is the improved flow of communication between users (McDougall, 2000). This peer-to-peer advantage can increase the effectiveness of online collaboration by minimizing interruptions and system lock-downs.

Flexibility, navigation, and control are very important when using software packages (Borck, 2000). These benefits allow the system to adapt to the user and promote usability. Other advantages of using groupware include convenience, accessibility and user-friendly interfaces. If a collaboration tool is fast, easy to use, easy to learn, and visually appealing, individuals will more likely be willing to use the program. Also, timing and costs are important considerations (Darrow, 1997). Collaboration tools that save users time, allow them to work over distant geographic boundaries, and save costs, can be tremendous benefits to users in work as well as academic settings for team projects.

Another important aspect of electronic collaboration is its usage by individuals in team settings. The term usage refers to the frequency of an e-collaboration tool or how often it was used. The frequency of use indicates the number of times a user employs or activates an electronic collaboration tool or one of its features. If a user increases his frequency of usage, he is more likely to become more dependent on the collaboration tool.

In addition to frequency, usage can also be referred to by effectiveness. For instance, if a user sees a purpose in using an e-collaboration tool, he is more likely to use it. This shows that the tool has been effective in providing a feature to the user for intended use. The variables that mainly affect this acceptance in use include level of experience using the product, level of tool exposure, and ease of use (Agarwal, 2000). If a user has had more experience using a product or has had a significant level of exposure to it, he may be more willing to use it, thus, increasing his acceptance of the product. Acceptance refers to the opposite of resistance, as it is used in an organizational or institutional setting (Ishii, 1999). For example, many users resist change from an old product to a new one. If a user sees a purpose for using an e-collaboration tool or feature, he may increase his level of usage.

Hypothesis Development:

Within this study, all subject matter is written in terms of class or group project teams. With this in mind, we will proceed to the hypothesis development. There are several variables in this study that require hypothesis testing in order to generate conclusions.

In this study, an analysis of the electronic collaboration affects on students in work teams and their implications was provided. The first objective was to measure how often students use a particular technology over **time** in the context of a team setting. The variables measured for this objective include the number of occurrences or times using a particular technology as well as the average time spent using a technology in one session. The arguments presented above form the following hypothesis:

H1: The frequency of technology usage by experienced students after two weeks using the tool in a team setting will increase

The second objective in this study was to measure student preferences on collaboration tool features as well as the benefits that can be derived from them. The variables measured for this objective include the level of importance of a particular technology feature as well as the level of usage while working on team projects over a two-week time frame. These arguments present the following hypothesis:

H2: The usefulness and acceptance of technologies by experienced students after two weeks using the tool in a team setting will increase

Methodology:

The methodology of this study is a progressive test experiment that compares sets of data over a period of time. The design of the experiment began with a pilot test consisting of a survey targeting college students. The pilot was given to approximately 10 candidates who were upper level information systems students.

The next step of the study was to survey a set of students. The set consisted of two classes; these were upper level and graduate students. Although there were 75 original subjects, only 38 subjects were usable. There were actually three separate surveys given to each student throughout the semester. The first survey obtained general background information on each subject and was given in the middle of the semester. The second and third surveys were given two weeks apart toward the end of the semester.

Throughout the experiment, the students were given the opportunity to use several e-collaboration tools including e-mail, instant messaging, and peer-to-peer tools including Blackboard and Groove; they were encouraged to use these tools for their team projects throughout the semester. The surveys were posted online through a university server. This allowed the users to complete the surveys at convenient times.

Data Analysis:

After the data was collected, we performed data analysis to determine if there was a statistical significance in the responses sent via electronic surveys.

For this survey there were several variables analyzed primarily to describe background data about the subjects. This included the variables gender, age, year in school, and location of address.

The first hypothesis to measure frequency of technology usage was tested using several variables for different collaboration types: email, instant messaging, Blackboard, and peer-to-peer groupware. These variables were compared from survey two to survey three after two weeks of student interaction in teams. For each of these five variables, the amount of times used in the past two weeks was also included.

Finally, the second hypothesis to measure the usefulness and increase in importance or acceptance for online collaboration was tested. Comparing survey two and survey three in terms of the features and benefits did this. There were a total of 11 feature variables and 14 benefit variables measured in this study.

Research Results:

After the data was analyzed, the results of the research project were reported in order to deduce outcomes and generate conclusions. In terms of experience in team environments, all users stated they had opportunities to work in those settings. The average amount of team projects students have had in the last year was between five and seven. Also, teams mostly met at the campus library on evenings in person. The majority of subjects claimed to exchange information online through email, as opposed to instant messaging and other more complex groupware packages. Instead of meeting online for team project collaboration, they normally shared information electronically.

H1: The frequency of technology usage by experienced students after two weeks using the tool in a team setting will increase

The usage of instant messaging slightly declined over two weeks. This could be a result of students meeting physically in their teams more often than electronically.

There is no significant difference in the amount of time spent per session using e-mail as opposed to instant messaging. Hypothesis 1 is not supported due to the decline in the means. The decline in email usage over the two-week period could be a result of team members exchanging more files in one setting. Also, only a few members of each team may have been responsible for updating the other members and sending files through email.

Third, results for the groupware, Blackboard, demonstrated a decline in frequency of usage. The means for this variable are distinct; Hypothesis 1 is not supported due to the decline in the means. This shows that there was actually a decrease in the frequency of technology usage for Blackboard. This decrease is mostly a result of a disruption in class meeting times from Thanksgiving break (see Further Study). Also, the number of class assignments requiring students to access Blackboard had decreased before the Thanksgiving break.

Finally, students were tested on their usage of their two most preferred groupware programs. However, the majority of students did not have a preference for using a groupware collaboration tool, nor did they spend time using them during their group activities. This was the case before the study as well as after the two-week test.

H2: The usefulness and acceptance of technologies by experienced students after two weeks using the tool in a team setting will increase

First, the variable for the collaboration feature real-time voice was tested. Initially, students believed that real-time voice was an average concern. It was rated 3 on a scale of 1 to 7, where 7 is the highest rating. However, after the experiment, preference for voice changed to a rating of two. This shows that students did not see much of a purpose for using real-time voice with in their teams. In addition to voice, real-time text messaging had also slightly decreased in level of importance. Initially, students rated real-time messaging as highly important at level six. However, after the study, students rated real-time text chat at level of 5.6. Although this change represents a slight decline for text chat, students generally use this feature and find it important. Students' initial perceptions of these features were slightly higher than their actual level of use during the two-week experiment. The drop in voice usage could have been a result of restrictions requiring students to keep a low voice volume when working in the computer labs.

The next set of features that represented a significant decline in preference, were file download capabilities and Internet file sharing. Initially, file download capabilities and file sharing were rated at 6.5 and 5.7 respectively. However, after two weeks, the two features were rated at 5 and 4.6 respectively. This shows that within the two-week experiment, most users did not use these capabilities as much as they initially did.

Another less commonly used feature was the online calendar. This variable was initially given a rating of 5.1 out of 7. However, after two weeks, users decreased their level of importance rating to 2.4. This shows that students did not have a need for collaboration tool calendars through out the span of their project.

Also, one last feature was the ability to notify others online. Before the experiment, students had a preference of 5.8 out of 7 for this feature. After the two-week time period, students rated online notification at the range of 5.5. This shows that there was no significant change in this variable. Therefore, online notification is still considered moderately important to students.

In addition to feature ratings, students were also tested on whether they saw a benefit from using electronic collaboration tools. Initially, students rated the importance of control, access, and convenience in the range of 6.4. After two weeks of working with collaboration tools, their preferences for these three benefits changed to a range of 6.2 out of 7. Though there was a slight drop in the means between the beginning and end of the experiment, the ratings were very high at both times, which supports Hypothesis 2. Because users rated these benefits above 6 both before and after the study, they believed the benefits were useful, thus increasing their acceptance of the tools.

The next set of benefits that had a slightly higher decline in preferences included flexibility, information flow, navigation, and security. Originally, students rated these benefits in the range of 6.2 out of 7. After two weeks, these students changed their preferences to approximately 5.8. Although there was a slight drop, users generally find these benefits important. However, they may not be as important as they were before the study.

The next two benefits with similar initial preferences were the speed and the user-friendly interface of the collaboration tool, which were initially rated at 6.3. After the short two-week time period ended, students rated these features at approximately 6.1. This shows that students still find system speed and ease of use to be very important despite the fact that preferences dropped slightly. The student rankings were above 6 on the 7-point scale both before and after the experiment. This supports Hypothesis 2, because students believed the benefits from fast and easy usage were useful, which increased their acceptance of the tools.

In terms of features available, users do not have much of a preference for the number of options that one groupware package can offer. This was shown by the decline in the means from 5.2 to 4.7 for the importance of feature quantity in e-collaboration tools.

One final set of benefits that users rated included the ability to save time, travel, and costs. Despite a slight decline, students believe that the benefit from time savings when using e-collaboration tools are very high, which supports Hypothesis 2; the benefit was found useful for students and has increased their awareness and acceptance of the technologies.

In summary, students generally rate certain features of collaboration tools more important then others. For example, real text messaging, online notification, and file download capabilities were the most used over the span of two weeks within their team projects. This shows that students see a purpose or importance to using electronic collaboration tools, such as e-mail and instant messaging, which contain these features. Users ranked the importance for convenience, easy access, control, user-friendly environment, speed, and time and distance-savings as the most important. Although the importance of these benefits has not significantly changed over the two-week time period, students have continued to rank their usefulness high. This supports Hypothesis 2, because receiving a benefit from technology is considered very important to students; therefore, their acceptance of the technologies has increased as a result of them using the tools to collaborate.

Recommendation:

After analyzing the results of this study, we have proposed a few recommendations. Hypothesis 1 was not supported; It is suggested that facilitators increase the level of e-tool exposure and requirements for their students in order for them to gain experience using a multitude of electronic collaboration features. By making it a requirement for students to study and learn the wide variety of collaboration features available, students would then be more educated and informed about using an e-collaboration tool.

In contrast to the first hypothesis, Hypothesis 2 was supported; students found several electronic collaboration features necessary for communicating in virtual environments. Thus, they saw a purpose for using e-collaboration tools and should be willing to use these tools for projects in the future. I suggest that students should have many teachers promote electronic collaboration environments for classroom use in order to positively reinforce the benefits from these tools.

Further Study:

In addition to this project, there are several possible extensions for consideration when doing further research. For example, time was a very important factor in the completion of this experiment. If more time can be allocated between survey instruments, then the accuracy of the comparisons would improve. Also, the time restriction in this study brought several constraints to the subjects of the experiment who actually used technology. In addition to timing, another consideration for further research was related to the actual subjects. For instance, in this study, many of the student subjects were majoring in academic curriculums that focused on technology, such as information systems. By expanding the subjects by area of expertise and experience, the external validity of this research could proxy for a wider distribution of student academic curriculums.

Literature References

Agarwal, Ritu and Elena Karrahanna. "Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage." MIS Quarterly. Dec. 2000. ABI Inform. Online. Internet Explorer. 10 October 2001.

Agnew, Marion. "Collaboration on the desktop." Informationweek. 10 Jul. 2000. ABI Inform. Online. Internet Explorer. 12 October 2001.

Borck, James R. "As e-collaboration tools mature, they can help you work out a competitive advantage." Infoworld. 27 Nov. 2000. ABI Inform. Online. Internet Explorer. 12 October 2001.

Chandra, Neal. "The new age of collaboration." Telecommunications. Jan. 1996. ABI Inform. Online. Internet Explorer. 7 April 2001.

Darrow, Barbara. "ERoom enables secure collaboration." Computer Reseller News. 11 Aug. 1997. ABI Inform. Online. Internet Explorer. 12 April 2001.

Ewart, Park J., James S. Ford, and Chin-Yuan Lin. Applied Managerial Statistics. New Jersey: Prentice-Hall, 1982.

Fontana, John. "Partners are key to groove's peer-to-peer effort." Network World. 30 Oct. 2000. ABI Inform. Online. Internet Explorer. 12 April 2001.

Halal, William E. "The Information Technology Revolution." Futurist. Jul/Aug. 1992. ABI Inform. Online Internet Explorer. 16 April 2001.

Ishii, Hiroshi and Minoru A. Kobayashi. "Iterative design of seamless collaboration media." Communication of the ACM. Aug. 1994. ABI Inform. Online. Internet Explorer. 12 April 2001.

McDougall, Paul. "Groove networks' software to aid in collaboration." Informationweek. 30 Oct. 2000. ABI Inform. Online. Internet Explorer. 4 April 2001.

Web-Notes: an tool for supporting contextual asynchronous discussion on an e-learning platform.

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Abstract

We present an HTTP-based discussion tool that allows in-context asynchronous interaction. Our prototypal system can be integrated in any HTTP-based e-learning platform. It allows to annotate web pages, and to share the notes with the teacher, with (a selected group) of other students, or to keep them as personal notes.

Introduction

E-learning platforms aim non only at providing content to the student: in order to be effective they must support the learning process. For this reason virtually every elearning suite provides at least some tool for asynchronous collaboration, like bulletin boards etc. Very often these tool offer a poor degree of integration with the content of the e-courses. In many cases discussion among the "actors" (students and teachers) is carried on a forum: the forum though is a different tool, so it is separated from the presentation material. While sometimes this is perfectly acceptable, in many cases it is rather inconvenient since the discussion happens out of context, and many external references are necessary, making the whole process rather cumbersome.

Our system allows to discuss in a context: the (e.g.) lecture content can be annotated by (e.g.) students for their exclusive use, or they can share the notes with their classmates or with the teacher. Readers can respond to the notes in place, for instance clarifying the original content of the page. The system allows to annotate web pages, since most platforms today use HTML as a *lingua franca* for content delivery.

WebNotes use

In order to use WebNotes, existing HTML pages need to be preprocessed to conform to the standard expected by it. An automatic tool allows to perform the preprocessing of the page. During the conversion process the granularity of the markable context that can be annotated is chosen: it can be each word, each phrase or each paragraph. The process is necessary in order to guarantee that the resulting pages are XHTML compliant, and that the contexts are suitably defined. The resulting page is still normal HTML, although it conforms the more restrictive rules that make it XML compliant.

The pages requested by the user are filtered through a servlet enabled Web server, that maintains a set of notes and their properties (like ownership, visibility etc). Notes are shown in the text as tiny icons embedded in the page. Public notes are visible to everybody. After the user identifies him/herself through a login process, s/he can see all notes allowed by her/his privileges.

The user can toggle between two modes: browsing and editing. While browsing, when s/he moves the mouse pointer over an icon that shows the presence of a note, the note pops up on place. When moving the mouse away the note disappears, unless it was stuck by the reader, in which case it disappears only when explicitly closed.

In order to edit the page (adding or modifying a note) the user enables editing mode and simply clicks on the location where s/he wants to add the note. A popup window appears, and the user can edit/modify the note. In the basic version the note contains only text, without any formatting. In an enhanced version of WebNotes, the window contains an applet that allows writing HTML in a simple "What-You-See-Is-What-You-Get" fashion. We kept the applet separated in order to minimize the requirements we make on the browser, and in order to avoid delays related to its downloading.

The system is currently in the final stages of development, and already underwent some extensive testing with different browsers.

Although WebNotes can be used in various contexts, it was explicitly designed for deployment in an e-learning environment. We envision its use for performing some of the discussions that presently happen on electronic forums. In particular, we target at those (many) cases where the emphasis is on clarifying a point in a lecture. For instance, we had many cases of students discussing programming

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code presented in an electronic lecture: in those circumstances, continuous references to "line X of code Y on page Z" make the writing and reading of the notes an exhausting task. Our system allows simplifying these discussions, and by diminishing the needed effort to start or join to a discussion thread it will increase the student participation rate. The increased interaction should give a better learning process that is the final goal of every e-learning environment.

At the moment of writing, we plan to use its preliminary version on the field in some e-courses at the University of Trento during the last bimester. By the time of the conference we expect to have gathered statistics on its use and feedback by the users.

WebNotes requirements

WebNotes is made by a series of Java Servlets, and can therefore be deployed on any Servlet-enhanced Web Server (nowadays virtually every serious Web Server can has a servlet-compliant engine). We do not assume any special requirement on the client side, the only request being the support of (the standard subset of) JavaScript (that is available on all recent browsers). We tested our annotated pages with all the major players (i.e. Opera, Mozilla, Netscape, Internet Explorer) on several platforms without encountering problems. The notes are simple text, so their writing and the editing is performed in a normal web page. Also the administration of the system (e.g. group creation and maintenance) occurs in a web page. An enriched version of our tool also includes a Java Applet that is a HTML composer: this allows formatting the notes in a reach way, using the full power of HTML. Since the Applet adds functionality but is not needed to make the system usable, WebNotes can be configured according to the preference of the deployer. Thanks to these choices WebNotes can be integrated in most e-learning platforms, enriching them with a new functionality.

Related Work

Although much emphasis has been given to the support of collaboration via web since the early WWW years [COL], a convincing technology has not yet emerged. Interesting approaches run from an almost uncontrolled interactive editing of web pages (wiki's [CUN]) to more controlled annotations. In particular, adding notes to a Web page is not a new idea *per se*. Tools comparable to what we present have been proposed in the past, but in most cases their architecture was dissimilar from the one we've chosen. The main architectural choices were either based on browser-specific tools, or on external mediator servers. A comparison of some available tools can be found in [GAR].

Brower specific tools (e.g. [COM]) require the use of a customized browser, which is certainly an inconvenient choice.

In the proxy-based approach, the annotation process is taken care of by an intermediate server, that collects the notes, gets the original page and present to the user a page decorated it with the annotations. This allows taking control of the annotation process, and in some cases is offered by commercial enterprises [ANN] [THI]. A non-commercial instance of this class of tools is CritLink [CRI].

Our tool is rather based on an automatic pre-processing of an HTML page to include the fields that (with the chosen granularity) define the markable locations, and rely then on a basic browser and on a rather standard web-server architecture to deliver the content. This promises to be a winning point, since it allows an easier integration with existing e-learning platforms.

Bibliography

[ANN] http://www.annotate.net/ Annotate

[COL] "Collaboration, Knowledge Representation and Automatability" http://www.w3.org/Collaboration/

[CUN] Cunnigham, W.: wiki (wiki wiki web) http://c2.com/cgi/wiki?WikiHistory

[CRI] CritLink http://crit.org/http://crit.org/index.html

[COM] CommMentor http://hci.stanford.edu/commentor/, by Martin Röscheisen, Christian Mogensen, and Terry Winograd at the Stanford Digital Library Project

[GAR] Garfunkel J., "Web Annotation Technologies", http://look.boston.ma.us/garf/webdev/annote/software.html

[THI] ThirdVoice http://www.thirdvoice.com/ Following the link, one discovers that: "As of April 2, 2001, we are no longer supporting the consumer version of the our search and annotation tools."

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The Good, The Bad, & The Ugly: lessons learned from electronic portfolio implementation

At the AACE Conferences during 2001, we were inspired by the work being done with electronic portfolios. Returning to campus, we knew that this was something we wanted to do. It fit so nicely with what we had heard about the new NCATE guidelines. So, during the past year, West Liberty State College, a small 4-year state institution in northern West Virginia, undertook the challenge to move to performance-based assessment and electronic portfolios within the Professional Education Department. As a result, over 900 of the institutions 2500 students are now creating electronic portfolios for student and program assessments.

This decision was not made quickly or lightly and reflects our commitment to remain aligned with the new NCATE guidelines and the NETStandards. Through the development and implementation of our plans, we learned many lessons that should be valuable to any other institution considering a similar program. Our faculty required education on portfolios and performance-based assessment before we could begin discussing portfolios, electronic portfolios, or artifacts and structures. This lead to an enlightenment that perhaps some very tried, if not true, teaching methods might need to change. We conducted workshops and in-services in addition to one-to-one mentoring sessions. In addition to motivation for the common good of our students, we are approaching an NCATE review next year.

Once a commitment to portfolios was formalized, albeit some reluctance, a committee was formed to make a proposal. The format was determined to be electronic with a meshing of our NCATE Conceptual Framework and the INTASC Standards. Students would be required to select two artifacts to support each standard and provide a written reflection offering (1) a description of the artifact, (2) a statement relating how the artifact demonstrates work related to that standard, and (3) a personal reflection of future growth goals in this area. Additionally, each portfolio would include a personal statement/resume, a philosophy of education, and any additional information the student wished to include. Finally, it was decided that the portfolio would be conceptually introduced in the first education course, *Introduction to Education* and the technological mechanics would be addressed in the first technology course.

The second hurdle was the decision of how to "use" the portfolios. The department agreed that this should be an assessment portfolio demonstrating breadth, depth, and growth on the part of student. A comprehensive rubric was developed and a decision made to assess the student reflections rather than the specific content of each artifact. As a result, we back peddled and decided that each and every EDUC, READ or SPED course would include multiple assignments that would be designated as "potential" portfolio items. Each assignment should be performance-based and assessed within the course where it was assigned. The instructor of each course would be required to assess the assignment and give a course grade. From this collection of "potential" portfolio assignments, the student then selected the items for reflection and inclusion within the portfolio. The initial evaluation of the portfolio would be at the time of formal application to the Education Program. This usually occurs after approximately 60 credit hours. A committee of two faculty members would review each portfolio in conjunction with other admittance criteria.

The second assessment would occur midway through the professional/student teaching semester. At this time, the portfolio would be assessed to determine how the student demonstrated mastery of each of the standards. Again, a rubric was developed to guide a committee of three faculty members. Scores for each standard were noted and used to determine weaknesses in our program and courses. Students received an unacceptable, developing, acceptable, or exemplary rating. Feedback from this assessment is used for program modifications and department decisions.

One of the most challenging decisions was to use an electronic format. Several faculty were not comfortable with this idea. Unfortunately, these people are not comfortable with much of the technology available today and reflect many of the skills still found in our local schools. For this purpose, it became necessary to select a platform that was advanced enough to provide a comprehensive picture of the candidate's knowledge, skill and attitude yet still be consistent with what might be useful for future purposes (i.e. interviewing). We chose to build web-based portfolios with electronic documents, scanned documents and images, digital photos, video clips, and audio clips. Students were encouraged to link PowerPoint presentations, Web Quests and other projects as artifacts.

We have worked on this for one year and now know what we did right and what we did wrong. Our first set of portfolios has helped us to see what we should have considered. The largest problems we are facing are reluctant students and overworked faculty members. The students don't see the value/need for these. They are very comfortable with the tried and true lecture to me and then give me two tests model. Many are kicking and screaming about a shift to performance-based assessment. Yes, it is more work for them; and for us, the faculty, too. The faculty found more work than expected in designing, developing and grading these portfolio assignments. Faculty had the additional burden of assessing the portfolios. Let's see… 90 student teachers with 3 evaluators each means 270 assessments divided among 12 faculty members who don't all do share. Sound familiar? This was the ugly part!

The actual portfolio results have been both good and bad. Some are disappointing. Others made it all worthwhile. The elementary students have more motivation but sometimes lacked the depth of reflection or technical skills. Some of the secondary students really showed their expertise and have portfolios on CDs that will certainly open many job doors. Some others, often by major, are less satisfactory. For us, we will continue and hope that we can grow from our lessons learned. Perhaps, our lessons learned will help you too.

Teacher roles in synchronous chat classes

Abstract

Synchronous classes are mushrooming in post-graduate education and new roles have been heralded as necessary for effective class instruction. This case study looks into transcripts of chat classes from Newport Asia Pacific University Master Program and analyses its discourse analysis to see how true is this assertion of paradigmatic role change. A coding scheme was developed for this purpose and data were then compared against the result of online interviews with tutors and students. Results point to caution in assigning dramatic changes in online instruction because of new technology.

This work will be a case study of online classes belonging to Newport Asia Pacific University and it will look specifically into roles played by tutors in the classrooms, whether they are radically different from face to face classrooms and what patterns of class organization may appear as distinctive.

Newport Asia Pacific University (NAPU) (www.napu.edu) is an Internet university dedicated to providing post graduate courses in TESOL (Teaching English to Speakers of Other Languages) through its Master of Science program. Students from around the world participate in real-time online classes with world renowned professors on a weekly basis. All subject content is provided via a Web site and all communication, including assignment submission, takes place via the Internet. Faculty and tutors are Dr. David Nunan, Dr. Rod Ellis and Dr. Ruth Wynryb. These professionals moderate classes and discussion lists and hold their classes through chat rooms in a synchronous mode.

in order to analyze these classes a coding scheme was developed for discourse analysis and qualitative interviews with both tutors and students of the courses delivered were implemented.

The criteria used to select sample lessons were:
a. classes with a beginning/ending difference with 2/3 students only.
b. classes with one student only.
c. classes with 4+ students
d. classes with same tutor, same content and number of students, from beginning stages of the program and in the last few months.

The coding scheme used

The Online Instruction/Moderator/Facilitator's roles have been categorized by Berge (1995) into the following four categories: pedagogical, social, managerial, and technical.

Following coding into Berge's four role categories, I developed a coding scheme to capture the essence of the instructor's actions within each category focusing on abstracting what the instructor actually *did* in each posting and categorizing these pedagogic acts. This coding scheme was drawn following Speech Act Theory which identifies both locutory (literal meaning of words) and illocutory (motivating intention of utterance) acts as "markers" encoded in the language of the postings. (Searle, 1976)

Berge's categories were further categorized as:

A. Pedagogical: Encompasses all attempts to reach a particular learning objective relevant to the course. Includes:

1. Feedback
2. Setting instructions
3. Giving information
4. Advice/suggestions/opinions
5. Framing questions
6. Summarizing comments
7. Referring to other sources

B. Social: Encompasses attempts to make students comfortable and/or promote feelings of participation.

1. Empathy
2. Personal communication
3. Meta-communication
4. Humour

C. Managerial: Encompasses attempts to coordinate course activities and maintain a sense of coherence and structure in the course. Instructor acts include:

1. Coordinating assignments
2. Coordinating Discussion
3. Coordinating course and program information

D. Technical: Includes assistance to students in mastering and troubleshooting course delivery software.

1. User
2. System issues
3. Problem not easily detected

Twenty-five classes by the three different tutors of the program were analyzed in all. The analysis of raw discourse used the participant-defined paragraph since it provided a practical answer to the need to get a code that reflected both the essence and context of tutor contributions to the online class.

Conclusion

What the data clearly show is that the majority of interventions have been the tutor's while students' interventions have been secondary. The tutor's most important role has been management of the online class while pedagogic roles ran second.

The analysis of these classes also point out to highly structured classes, where agendas are set out at start. In general no classes present evidence of cooperative work among students, reflection among students and group production, or class objectives suggested by student input or questions. Role shifting (the teacher-as-learner, the learner-as-teacher) did not show up in any of the samples. They typically show a teacher-centered classroom delivery where the "sage teacher as expert" role is predominant. On the contrary, the I-R-F (Initiation-Response-Feedback) scheme of discourse characteristic of teacher-led classrooms is recurrent in most classes. (Sinclair & Coulthard , 1975; Sinclair & Brazil, 1982)

Whatever the reason why chat lessons are so characterized, what they certainly point to is the need to provide a pedagogic scenario that can complement, supplement, and also offer the possibility to carry out all the cooperative work and social network necessary to make learning a wholesome experience. In the case of NAPU, this is already set up by an ongoing discussion list and a face-to-face residential. These two elements provide the rest of the architecture that supports the feeling of online presence acknowledged by all the actors.

Bibliography

Berge, Z.L. (1995). *Facilitating Computer Conferencing: Recommendations From the Field.* Educational Technology. 35(1) 22-30.
Lincoln, Y. S. and Guba, E. G. Naturalistic Inquiry. Newbury Park, CA: Sage (1985).
Searle, John Rogers. (1976) "*A Classification of illocutionary Acts.*" Language in Society 5 pp.1-23.
Sinclair J. & Coulthard R.M. (1975) *Towards an Analysis of Discourse: The English used by teachers and pupils*, Oxford: Oxford University Press
Sinclair, J. M., & Brazil, D. (1982). *Teacher talk*. Oxford: Oxford University Press.

Online Mastery
A Certification Curriculum for Faculty

ABSTRACT

Faculty certification increases the chances that online instruction in higher education will successfully meet the needs of students. This paper introduces a new approach to designing a program of faculty certification for online instruction. The paper also proposes that the national and state departments of education as well as accreditation institutions establish certification standards that reflect the quality of preparation defined in the proposed program of certification or a comparable program.

Introduction

Status of the Work: Beginning
Partners Involved: The Academy for Teaching Excellence, the School of Letters, Arts, and Sciences, and the Division of Information Technology at Metropolitan State College of Denver.
Major Goals: The project described in this paper/presentation has two goals. First, the system goal involves the introduction of a competency model of certified training of faculty that will demonstrate how faculty should be educated to develop and instruct online courses. Second, the outcomes goal involves training faculty for certification of quality online instruction.
Basic Approach: With the participation of the Director of the Academy for Teaching Excellence, the Director of Training for the Division of Information Technology, and key faculty and staff from the School of Letters, Arts, and Sciences, develop and validate a sequenced and articulate curriculum of mastery certification in online instruction.
The Educational Problem: What sort of faculty preparation does it take to equip an institution of higher education for success in online education? The authors believe that certification of faculty is essential yet very rare in the traditional colleges and universities. Few offer a sequenced, articulated program that leads to officially sanctioned certification for all faculty members who would teach online (POD Network, 2001). Barring such certification, online instruction may be devoid of any institutional standards of quality (Willis, 1994; Ridley & Husband, 1998; and Palloff & Pratt, 1999). The lack of standards rapidly translates into highly uneven quality as seen by students and hence into lost enrollment, particularly given the competition for student tuition dollars that now prevails in the domain of post-secondary online education (Berge, 1997 and Dominquez & Ridley, 1999). Therefore, for the sake of student learning and institutional success, the authors propose a new approach for preparing faculty for the online educational enterprise. Institutions should require certification of faculty for online educational instruction.
Background: The increase in online instruction in the past five years and its projected acceleration in the next twenty leave no doubt about the need for faculty professional development in online instruction both in terms of technology and pedagogical competencies (Ridley, 1996).
In the U.S. very few faculty development programs exist that train faculty in higher education to enhance their online instructional efforts (Schrum, 1995). Those that do

exist consist of fragmented workshop programs or one-shot conferences on technology (Williams & Peters, 1997).
Description: A specific concept of a mastery certification curriculum has been developed. This curriculum includes preparation in the core competencies as well as in enabling and sustaining competencies. See below for a full description of the concept.
Validation: Two actions will assist the researchers in validating the certification model for this faculty online development training prior to the date of the Ed-Media Conference. First, the researchers will validate the concept of faculty certification training for online instruction in a conference of peers entitled "Teaching Online in Higher Education Online Conference" on November 12, 2001 in which the model for faculty development training will be discussed and assessed by an online set of peer reviewers at the conference. Second, a survey of the top ten institutions with the largest enrollments where the majority of the program majors and minors are taught online will be instituted on current faculty development programs and the data reported in the presentation at the Ed-Media Conference. In addition to these two actions, a pilot test of the model will be initiated during the summer months at Metropolitan State College of Denver through a U.S. Department of Education, Title III, Activity Two grant, the funding of which the college received for the professional development of its faculty at the institution.
Future Work and Implications for Others: The paper/presentation proposes that national and state departments of education as well as accreditation institutions establish certification standards that reflect the quality of preparation defined in the proposed program of certification or a comparable program.

Core Competencies

A program of certification in online education operates on the basis of six functions that Duchastel (1997) describes as: l) specifying the goals to be pursued; 2) accepting diversity of outcomes; 3) requesting production of knowledge; 4) evaluating at the task level; 5) building learning teams; and 6) encouraging global communities. These functions influence the development of five core competencies learned by online instructors:

• Selecting:	Selecting materials, activities and courses that are suited for online delivery
• Preparing:	Preparing content for online delivery
• Delivering:	Delivering instruction online
• Managing:	Managing the online course
• Assessing:	Assessing student learning in the online environment, providing praise, encouragement, and corrective feedback as needed.

Enabling Competencies

Many faculty members who are excellent instructors and who wish to teach online do not have the computer skills that constitute the essential threshold to online education. For these educators, the certification curriculum should offer instruction in fundamental enabling competencies including:

- Selecting a computer system and or essential components
- Setting up a computer system and its components
- Creating a healthy workspace
- Acquiring ergonomically sound work habits
- Using input devices
- Using the operating system
- Mastering advanced features of the operating system
- Developing word processing and spread sheet competencies
- Using voice input
- Selecting and using ADA input and output options
- Operating the electronic communication system in the college/university

Sustaining Competencies

To ensure that a program of online education does not fall victim to the entropy of complacency, the certification curriculum must include instruction in the competencies that are essential for creating and perpetuating excellence. These include:

- Evaluating: Evaluating the effectiveness of the online course
- Revising: Altering the online course when and where appropriate

A Closer Examination of Core Competencies

The five core competencies constitute the heart of the curriculum because they are what faculty do:

- From a vast body of domain-specific knowledge, faculty *select* the concepts, information, and skills to include in their courses.
- They *prepare* this material for instruction.
- They *deliver* it in such a way that learners can make it their own.
- They *manage* the learning experience, taking into account the mix of personality and ability among their students as well as the technology and logistics of the instructional environment.
- Throughout the course, they *assess* the learning of their students, providing praise, encouragement, and corrective feedback as needed.

Competency in these five steps is essential for success in moving from purely on-site instruction to instruction that is either partially or totally online. The following sections expand on the concept of each core competency.

1. **Selecting What to Put Online**
Faculty will inventory the courses they teach and identify materials, activities and possibly entire courses that could work well online. This component of the curriculum will provide faculty with specific guidelines for accomplishing this inventory. Faculty will be encouraged to work closely with their department chairs for validation of their selection of materials for online delivery.

2. **Preparing the Learning Experience**
With specific instructional content in mind, faculty will explore the options for preparing instruction for online delivery. They will learn pedagogical principles and techniques for making the materials they put online more effective for their students. They will learn to make accurate estimates of how long it will take to implement their plans for preparing their materials for online delivery. They will learn how to use the tools of technology to actually prepare course materials for online delivery. They also will learn how to work with specialists in multimedia development to produce advanced media components or even entire online courses.

3. **Delivering the Learning Experience**
Studies of what makes for successful classroom teaching indicate that personal dynamism, energy, and the ability to make contact with learners are major components of success. Dynamism, energy, and ability to make contact are also major factors in the success of online delivery, but the effective application of these traits requires a set of very different skills compared to classroom instruction. Workshops in this section of the curriculum will present methods of online instruction and help faculty identify those methods that are most appropriate for their teaching style and various types of course content.

4. **Managing the Online Class**
One of the most frequent comments from faculty new to online teaching is that they find it extremely time consuming. Can one avoid being overwhelmed and still provide a quality learning experience for students? What about decorum in the online environment? How does the online teacher keep the tone of the entire experience on high plane? And what does one do if students start "flaming" one another or the instructor? This component of the curriculum will present methods of managing the online class and suggest techniques for success.

5. **Assessing Student Performance**
The online learning environment puts in question many of the standard practices of on-site assessment of student performance. What kinds of tests can one offer online? Is there any way to guard against cheating? Are proctored tests a good solution? Can one assess students in other ways than just testing? Can one require graded group activities in an online course? Classes in this section of the workshop curriculum will help answer these questions by presenting options for assessing student performance in online courses with an emphasis on alternatives to the proctored written exam.

A Closer Look at Enabling Competencies

For faculty members, equipping for the online endeavor means expanding their store of knowledge and skill to include use and ultimately mastery of the essential tools of technology. It means acquiring and installing the essential computer system components. It means learning how to use those components. Finally, it means creating an ergonomically appropriate workspace and adopting healthy computer work practices. All these factors become particularly important when the faculty member plans to handle online courses from home.

Most programs of faculty preparation overlook these foundational considerations. The negative results of such omission affect the full spectrum of faculty, from computer novices to long-time veterans of computing. Some novices drop out because they never grasp the basics essential for being at ease in using computers. Others survive but fossilize in inefficient uses of their computer systems. Finally, many expert users find themselves out of action or hindered in their work due to unhealthy computing practices or poor ergonomics.

A Closer Look at Sustaining Competencies

The two sustaining competencies--evaluate and revise--are essential to ensure that flaws and weaknesses are identified and eliminated as soon as possible. This is a particularly problematic area of endeavor. Some extensive online education enterprises that have been in operation for a number of years still have not determined how to realize peer evaluation of online instruction. As to student evaluation of online instruction, it may be simple to implement but quite difficult to validate. Students come to the online learning experience with widely varying expectations and levels of competency in the computer essentials. Under such conditions, students may be incapable of differentiating between peripheral frustrations and the quality of instruction as they evaluate a specific online course and instructor. Finally, where institutional evaluation exists, it may be purely summative and generalized, serving as a poor tool for identifying what specific changes should be made to improve instruction in specific course offerings. Thus, instruction in the sustaining competencies will provide instructors the tools for formative evaluation and revision of their own courses as they are teaching them.

Summary

This curriculum will offer learning experiences that lead to certification in each of the core, enabling, and sustaining competencies. These learning experiences may be of various sorts, e.g. peer tutoring/coaching, team teaching with certified faculty, computer or Web-based instruction, workshops, classes, and seminars. Faculty who accumulate certification or validation in all competencies will earn "Online Master" certification.

References

Berge, A. (1997, May-June). Characteristics of online teaching in post-secondary formal education. *Educational Technology Magazine*. 35-47.

Dominguez, P. & Ridley, D. (1999). Reassessing the assessment of distance education: A proposal for an alternative framework in higher education. *T.H.E. Journal*. 27(2), 70-76.

Duchastel, P. & Iricptte. S. (1996). On-line learning and teaching in an Information-Rich context. Proceedings of the Inet'96 International Conference, Montreal, Canada.

Professional Organizational Development Network,.(2001). Plenary Session, October 5, 2001, St. Louis, Missouri.

Ridley, D. & Sammour, H. (1996). Viable alternative means of instructional delivery: Online courses as an alternative teaching method. *College Student Journal*. 30(3), 337-339.

Ridley, D. & Husband, J. (1998). Online education: A study of academic rigor and integrity. *Journal of Instructional Psychology*. 25(3). 26-30.

Schrum, L. (1993). Tales from the trenches: Educators' perspective on technology implementation. *Journal of Teaching Educational Technology. 1, 409-421.*

Williams, V & Peters, K. (1997). Faculty incentives for the preparations of web- based instruction. In (B. Khan, Ed.) *Web-based Instruction*., Englewood Cliffs, N.J.: Educational Technology Publications.

Willis, B. (Ed.) (1994). *Distance Education: Strategies and Tools.* Englewood, Cliffs: Educational Technology.

Pedagogical Models in the Design and Assessment of Network-Based Education

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Abstract. This article presents the Helsinki-Lappi project (HelLa) co-run by two Finnish universities: the University of Helsinki, and the University of Lapland. The general aim of the project is to study, develop, and assess how different training programs relate to educational use of information and communication technologies (ICT). The project is expected to contribute substantively to the national Virtual University Project of the Faculties of Education (KasVi). The specific aims of the project are to analyze (i) how the pedagogical models of network-based education (NBE) can be seen in educational use of ICT programs; (ii) what kind of design, quality, and assessment principles can be elaborated in NBE (iii) how a didactic network environment and NBE support media skills and the development of the individual and the community; and (iv) how national training programs in media education and educational use of ICT can be streamlined and made accessible to the international audience. The outcomes of the project will be models and didactic principles, which can be used in design and assessing NBE.

Keywords: Network-based education (NBE); teachingstudying-learning (TSL) process; learning and studying environments; pedagogical models; designing and assessing principles; meaningful learning; information and communication technologies (ICT).

Introduction

The Finnish virtual university project (KasVi) aims at developing: 1) teacher education curricula in technological environments, 2) flexible training systems based on distance and flexi-mode teaching, 3) continuing teacher education, 4) qualitative ICT training programs, and 5) innovative pedagogy for NBE. The Universities of Helsinki and Lapland initiated the joint HelLa project in 2001 as part of the national KasVi project. The objective of the HelLa project is to study the following areas in 2001–2003: i) the pedagogical models of NBE in training programs of media education and educational use of ICT, ii) the further development of the principles and characteristics of designing and assessing NBE, iii) the support of NBE for the media skills of the individual and the community, and iv) the standardization and internationalization of national ICT training programs. This article examines the pedagogical models for NBE and the principles of design and assessment.

The Challenges of Assessment

Quality can be defined as a relation between the object and the aim of the study. The assessment of quality is always related to the situation; it is dependent on time, space and context. (Raivola 2000, 19-22.) In this article, the quality of NBE is primarily studied as the realization of the objectives of education. The quality of university

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[1] http://www.urova.fi/home/ktk/and http://www.urova.fi/home/mpk/
[2] http://www.edu.helsinki.fi/media

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education is always closely related to research. Research creates knowledge, and assessment, again, is deeply rooted in this knowledge obtained. Teaching based on research is seen as quality teaching. In this respect, quality is also understood as a corresponding principle. (Raivola 2000, 38–51.) In this study, quality is also defined as fundamental, goal-oriented, curriculum-oriented, meaningful, and profiting from the didactic principles of NBE.

When assessing NBE certain issues should be raised to fore: the operational context of NBE, communication and communalism, research into the role of the teachers and students, and modes of studying and teaching. (Ruokamo & Pohjolainen 1999; Tella et al. 2001.) According to Duffy and Jonassen (1992), learning and studying environments that have focused on users and their needs and a problem-oriented approach have been successful. (Vahtivuori 2001). It seems that NBE should be assessed at all levels; a study restricted to the surface level is insufficient. Thus, social perspectives, media culture, communication and mediation should be taken into account. (Tella et al. 2001.)

Pedagogical Models of Network-Based Education and Learning Theory

Based on pedagogical models of NBE and theoretical models of learning (e.g., Jonassen 1995; Ruokamo & Pohjolainen 1999; Tella et al. 2001), the HelLa project will study the didactic thinking involved in the teaching–studying–learning (TSL) process (Uljens 1997). We aim at presenting different pedagogical models that can be used to define the principles for designing and assessing NBE. Our study focuses especially on those pedagogical models that can be used to realize cooperative and communal modes of learning and studying. In this article, cooperative means that students work together and build their knowledge in cooperation with others, using their knowledge and skills beneficially (Jonassen 1995; Ruokamo & Pohjolainen 1998; 1999; 2000). Cooperative learning is based on the socio-constructivist perspective. By communal learning and studying, we refer to the philosophy of interaction and to the individual way of life. In communal studying, a common culture of activity and the process of work are strongly emphasized (Vygotsky 1934/1962; Panitz 1996; Tella 1998; Passi & Vahtivuori 1998; Hakkarainen et al. 1998).

Uljens (1997) emphasizes the teaching–studying–learning process (TSL) as central for didactics. According to him, both teaching and learning are important but equally important is studying. (Cf. Kansanen et al. 2000.) Uljens (1997) argues that teaching cannot directly influence learning; rather, *teaching [affects] learning indirectly through the individual's study activity* (Uljens 1997, 39). For this reason, we also need to examine teaching, studying, and learning as equally important components. (Kynäslahti 2000, 25; Tella et al. 2001.) We argue that these concepts are the most beneficial way to organize and assess NBE.

The multi-dimensional model of media education is a conceptual framework for NBE, in which designing and assessing NBE are handled in an integrative way. In the model, the concepts of media education and the didactic TSL process are incorporated to communication and mediation. This model attempts to avoid the problems contained within earlier analytical criteria and the simplification of the complex realities involved in NBE. (Tella & Mononen-Aaltonen 2000.) Another model used is that of different uses of ICT, partly based on Goldsworthy's (1999) lenses of learning. It deals with four categories that examine the relationships between studying and technology. The four categories of the model are pedagogic, instrumental, communal, and communicative use of ICT. NBE profits most from several or all four different ways of using ICT being linked to the same educational program or to a TSL situation. (Vahtivuori & Masalin 2000; Vahtivuori 2001)

Our study also focuses on the shared and divided expertise (Oatley 1990; Brown et al. 1993), which is based on research into the theory of learning, and the reciprocal teaching method (Palincsar & Brown 1984) in NBE (see also Hakkarainen et al. 2000). We have organized some experiments in this field in media education and NBE courses (Ruokamo & Syrjäkari 2001). In addition, we shall examine problem-based learning (Norman & Schmidt 1992) and meaningful learning (Ausubel 1968; Jonassen 1995). Experiences were promising for increasing quality of NBE. Research-focused teaching has also been used to study interaction and dialog in NBE. One of the key observations points to the significant role of the teacher in creating research-focused dialog. The meaning of social interaction in studying was also emphasized strongly alongside interaction which handled substance-specific issues. (Mononen-Aaltonen 1999; Lintula 1999). Observations of the NBE courses showed that groupwork software supports communal modes of learning and studying, different styles of studying and students' developing skills. (Cf. Sharan & Sharan 1992; Vahtivuori, Wager & Passi 1999.)

Some Principles for Designing and Assessing NBE

In the following, a few principles for designing and assessing NBE will be presented, based on the pedagogic models above. In terms of the TSL process, our key observation is that, as far as design and assessment go, the same kinds of principles and characteristics apply to all the three components of TSL. (Ruokamo & Pohjolainen 1999; Tella et al. 2001.) In designing learning and studying environments, NBE and educational use of ICT can be understood as broad trends in which different tools and environments are used in many ways to support the TSL process. Networks are not to be understood simply as tools; rather, they can also serve as intelligent partners and new contexts (Jonassen 1995; Tella 1998). The entire context of NBE should be examined. The materials, the users' activity and needs and general didactic planning are crucial for the design and assessment of NBE (see also Bonk & Reynolds 1997). NBE also calls for user-oriented applications and customized models at the local level. In designing network-based environments, attention should be paid to their functionality to enable multi-level teaching and guidance. For meaningful and purposive learning and studying, we need, for instance, a fully operational tutoring and mentoring system in addition to the activity of the teacher. We will now present eleven characteristics of meaningful learning and studying and describe the corresponding didactic and learning theoretical network-based environment together with the desired teacher orientation.

1. Constructive and Cumulative. Students build new knowledge upon the basis of their earlier knowledge (de Corte 1995; Jonassen 1995; Lehtinen 1997; Ruokamo & Pohjolainen 1999; Mannisenmäki 2000; Nevgi & Tirri 2001). Well-organized, complicated skills for constructing and justifying information structures are emphasized in a learning and studying environment (Sinko & Lehtinen 1998; Manninen et al. 2000). The students' earlier knowledge controls the acquisition and interpretation of information (Lehtinen 1997). The teacher should construct learning and studying situations and contexts (Tella et al. 2001) in such a way that a student can build on his or her prior knowledge. Initial mapping can clarify the students' preparedness to receive information and skills. The learning and studying environment can be adapted to suit students' activities best and to fulfil their needs through the support of the teacher, tutor, and the peer group. (Manninen et al. 1999.)

2. Active and Self-Directed. The roles of the students and other members of the learning community are active. The students commit themselves to objective-oriented (Uljens 1997) and sensible processing, for which they are responsible. (Jonassen 1995; de Corte 1995; Lehtinen 1997; Ruokamo & Pohjolainen 1999; Mannisenmäki 2000; Nevgi & Tirri 2001.) A learning and studying environment enables a new kind of teacher-student relationship, which emphasizes communalism and the personal expertise of the students. (Sinko & Lehtinen 1998; Manninen et al. 2000.) Students can ask practical, informative questions, acquire information, and critically evaluate that information. The teacher creates and maintains students' activities with challenging and interesting settings for tasks shared with the students themselves. Students are encouraged to express new ideas and models of thinking. This way the entire community can see and profit from the "media traces" born during the process of learning (Sharan & Sharan 1992; Vahtivuori, Wager & Passi 1999; Mannisenmäki 2000; Tella et al. 2001).

3. Cooperative and Communal. Students work together and build new knowledge in cooperation with one another while benefiting from the knowledge and skills of others (de Corte 1995; Jonassen 1995; Lehtinen 1997; Ruokamo & Pohjolainen 1999; Mannisenmäki 2000; Nevgi & Tirri 2001). Communalism is embedded in dialogic thought (cf. Vygotsky 1934/1962; Vahtivuori, Wager & Passi 1999; Tella et al. 2001). Based on the theory of shared expertise, social interaction and communal modes of learning and studying are emphasized. The teacher is expected to maintain dialog and contact with the students in NBE (Passi & Vahtivuori 1998; Sinko & Lehtinen 1998; Ruokamo & Pohjolainen 1999; Manninen et al. 1999; 2000.)

4. Conversational and Interactive. A central element of the TSL process on the net is dialog (Jonassen 1995; Tella & Mononen-Aaltonen 1998; Mannisenmäki 2000). Dialog and dialogic communication, i.e., comprehensive understanding of and respect for one another as well as interaction and interactivity are at the core of NBE (Tella & Mononen-Aaltonen 1998). The quality of interaction has to be considered when an environment for NBE is being designed and assessed. Many different channels of communication should be used in learning and studying environments (Lintula 1999). The well-designed environment includes, among other things, common and shared conversation and working spaces in which documents can be worked on together.

5. Contextual and Situational. There are some problematic issues related to the physical environment the situation as well as to time and place. On a network, the place and the situation gain new forms. When teaching and studying on a net, it is necessary to consider the changes in these phenomena and how they affect designing and assessing NBE. (Vahtivuori 2001.) According to the features of meaningful learning and studying, learning tasks support meaningful solutions to the problems of the real world, or are simulated through certain case-specific or problem-based examples of the real world (Sharan & Sharan 1992; de Corte 1995; Jonassen 1995; Lehtinen 1997; Ruokamo & Pohjolainen 1998; Mannisenmäki 2000). Gaining experiences in NBE is at least as important as in the face-to-face TSL process (Ackermann 1994; Boud & Feletti 1999; Vahtivuori 2001). The links with school are essential in the professional practices of working life and the rest of society (Sinko & Lehtinen 1998; Manninen et al. 2000). Among other things, simulations, videos, Internet links, implementations in the microworlds and applied problem-based situations are used in the learning and studying environment (Mannisenmäki 2000). Especially promising are on-line strategic and role games that include the principles and criteria linked to the community and experience (Vahtivuori 2001). In teaching we should find examples and connections to the real world and to the personal world of the students through questions touching on their interests. Through joint discussions, the teacher can perceive the external world and widen his or her own perspective substantively. (Sharan & Sharan 1992; Manninen et al. 1999.)

6. Transferable. Students know how to use their knowledge and skills in other situations and how to learn, adopt and benefit from them when learning new topics (Ruokamo & Pohjolainen 1999; Mannisenmäki 2000; Nevgi & Tirri 2001). A learning and studying environment supports emerging learning skills, problem solving skills and the skills of self-directed learning. (Sinko & Lehtinen 1998; Manninen et al. 2000.) A learning and studying environment includes cognitive tools, hypertext, professional systems, and databanks that underpin meaningful learning (Mannisenmäki 2000). The deep-going discussions between the teacher or the tutor and the different groups of students are fruitfully conducive to enabling the transfer of learnt knowledge to future situations and contexts (Manninen et al. 1999).

7. Goal-Oriented and Purposive. Students achieve a cognitive goal proactively. They can define and set objectives of their own (de Corte 1995; Jonassen 1995; Lehtinen 1997; Ruokamo & Pohjolainen 1999; Mannisenmäki 2000). The guidance and support given by the teacher are related to goal-oriented and purposive studying (Uljens 1997; Mononen-Aaltonen 1999). Self-guidance and a genuine attempt to learn also contribute to creating a learning and studying environment (Sinko & Lehtinen 1998; Manninen et al. 2000). A learning environment includes various tools for planning and monitoring one's learning process. Here, a teacher helps to support the materialization of his or her own curriculum (Manninen et al. 1999; Mannisenmäki 2000).

8. Guided. Learning itself as well as the learner's assessment of his or her own skill are promoted by the teacher and by the feedback and support from other students and actors (cf. Vygotsky 1934/1962; Nevgi & Tirri 2001). The need for guidance increases rather than decreases in NBE. On the other hand, the roles of the teacher and the student gain new dimensions and emphases in that in NBE they alternate and, at the same time, they enrich the TSL process. Students and teachers take turns in acting as guides and experts. (Tella et al. 2001.) The learning and studying environment has such tools for cooperation and discussion that enable feedback and support for both the individual and the studying community. The most important characteristics of the learning and studying environment are functional interaction, the opportunity to communicate informally, and to get immediate (synchronous) and delayed (asynchronous) feedback.

9. Individual. Humans have individual learning styles and strategies. Learning and studying are always influenced by the students' prior knowledge, concepts of learning, foci of interest and motivation (de Corte 1995; Lehtinen 1997). A learning and studying environment is basically individual (Nevgi & Tirri 2001), that is, it is never the same to all students. Learners can construct their own individualized interpretation of the challenges and opportunities posed by the environment. Each learner constructs his or her own learning and studying environment, where the immediate feedback given by the teacher supports the learner's individual process of handling and coping with information. (Lehtinen 1997, 20.) Here, the individualized guidance given by a teacher is of primary importance.

10. Reflective. Learners express what they have learnt and they examine the thinking processes and decisions required by the learning process (Jonassen 1995; Ruokamo & Pohjolainen 1999, Mannisenmäki 2000; Nevgi & Tirri 2001). Information retrieval and processing as well as the skills of critical assessment are emphasized in the modern learning environment (Sinko & Lehtinen 1998; Manninen et al. 2000). A learning environment includes the tools, such as diaries and the tools for a portfolio, necessary to support the assessment of one's learning and active output (Mannisenmäki 2000). The environment should also include the tools that the teacher can use when guiding students to assess their own studying process.

11. Abstract. Learning can be defined as the construction of new ideas at an abstract level; the development of theoretical ideas reaches from practical experience to the deeper level (Lehtinen 1997). The learning and studying environment enables students to review the socio-constructive process of abstract scientific theories and ideals (Lehtinen 1997). Here, the support given by the teacher is the more important the younger the students are.

Conclusions

The above-mentioned characteristics of NBE should be seen as flexible in their nature. Through them, it is possible to examine how different pedagogical models realize the principles of design and assessment and how pedagogical models can be further developed. New learning environments apparently demand new cultural skills and media skills that call for further practice. Teacher educators have the key position to develop the media skills of future teachers in educational use of ICT and in designing goal-oriented and purposive NBE. The design and assessment of NBE presuppose that the teacher and all users have sufficient media skills and an ability to use their skills for the benefit of the community and themselves. (Tella et al. 2001.)

This article has examined the objectives and pedagogical models of the HelLa project, the principles of didactics and the teaching–studying–learning process as applied to NBE, and, most importantly, the development of the characteristics of meaningful learning and studying as principles of designing and assessing learning environments. The aim has been to analyze certain didactic and learning-theoretical issues in order to develop NBE and educational use of ICT in the context of network environments.

To sum it up, the principles arising from the didactic models of NBE are in harmony with the principles emerging from the learning-theoretical models, e.g., the model of meaningful learning. In particular, both approaches underline the significance of contextuality, the importance of guidance, working together, dialog and social interaction. The training programs in educational use of ICT being implemented in Finland provide a versatile opportunity to experiment with different concretizations of NBE that can be tested against the principles of design and assessment. In the HelLa project, the aim is to summarize and further develop pedagogical models, on the one hand, and the principles of design and assessment, on the other.

References

Ackermann, E. (1994). Direct and Mediated Experience: Their Role in Learning. In Lewis, R. & Mendelssohn, P. (eds.) *Lessons from Learning.* Amsterdam: North Holland.

Ausubel, D. (1968). *Educational Psychology: A Cognitive View* New York: Holt, Pinehart & W inston.

Bonk, J. & Reynolds, T. (1997). Learner-Centered Web Instruction for Higher-Order Thinking, Teamwork, and Apprenticeship. In Khan, B. (ed.) *Web-Based Instruction.* New Jersey: Englewood Cliffs, 167–177.

Boud, D. & Feletti, G. (eds.) (1999). *Ongelmalähtöinen oppiminen.* (Problem-Based Learning.) Helsinki: Hakapaino.

Brown, A. L., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A. & Campione, J. (1993). Distributed Expertise in the Classroom. In Salomon, G. (ed.), *Distributed Cognitions: Psychological and educational considerations.* Cambridge University Press, 188–228.

de Corte, E. (1995). Fostering Cognitive Growth: A Perspective from Research on Mathematics Learning and Instruction. *Educational Psychologist* 30 (1), 37–46.

Duffy, T. & Jonassen, D. (1992). *Constructivism and theTechnology of Instruction: A Conversation.* Hillsdale, NJ: Lawrence Erlbaum.

Goldsworthy, R. (1999). Lenses on Learning and Technology: Roles and Opportunities for Design and Development. *Educational Technology,* July–August, 59-62.

Hakkarainen, K., Ilomäki, L., Lipponen, L. & Lehtinen, E. (1998). *Pedagoginen ajattelu ja tietotekninen osaaminen.* (Pedagogical thinking and computer skills.) Helsingin kaupungin opetusviraston julkaisusarja A7:1998.

Hakkarainen, K., Lonka, K. & Lipponen, L. (2000). *Tutkiva oppiminen. Älykkään toiminnan rajat ja niiden ylittäminen.* (Exploratory Learning. The Limits of Intelligent Activity and Crossing those Limits.) Helsinki: WSOY.

Jonassen, D. H. (1995). Supporting Communities of Learners with Technology: A Vision for Integrating Technology with Learning in Schools. *Educational Technology,* July–August, 60-63.

Kansanen, P., Tirri, K., Meri, M. Krokfors, L., Husu, J. & Jyrhämä, R. (2000). *Teachers' Pedagogical Thinking. Theoretical Landscapes, Practical Chalenges.* American University Studies Series XIV Education, Vol. 47. New York: Peter Lang.

Kynäslahti, H. (2000). *Näkökulmia opetusteknologian käytön leviämiseen Helsingin yliopistossa.* (Perspectives on the Spread of the Educational Use of ICT at the University of Helsinki.) Helsingin yliopisto. Opetusteknologiakeskus.

Lehtinen, E. (ed.) (1997). *Verkkopedagogiikka.* (Net Pedagogy). Helsinki: Edita.

Lintula, A. 1999. Vuorovaikutusta verkkoympäristössä. (Interaction in a Network Environment.) *Kasvatus 30* (3), 240–253.

Manninen, J., Nevgi, A., Matikainen, J., Luukannel, S. & Porevuo, M. (2000). *Osaajien koulutus 2000-luvulla – Leonardo da Vinci -ohjelman tuottamat pedagogiset ja teknologiset innovaatiot ammatillisessa koulutuksessa.* (Training Experts in the 2000s – the Pedagogical and Technological Innovations Produced by the Leonardo da Vinci Programme for Vocational Training.) Valorisaatioprojektin loppuraportti. Opetushallitus. Helsinki: Hakapaino.

Manninen, T., Brax, S., Hein, I., Kairamo, A-K., Salkunen, K., Rintamäki, T., Larjomaa, I. (1999). Arviointirunko oppimisympäristöjen organisoinnin ja teknisen toiminnallistamisen arviointiin in Ruokamo, H. & Pohjolainen, S. (eds.) *Etäopetus multimediaverkoissa - Kansallisen multimediaohjelman ETÄKAMU-hanke. Digitaalisen median raportti 1/1999.* (Core Checklist for Evaluating the Organization and Technical Implementation of Learning

Environments) Teknologian kehittämiskeskus TEKES, Helsinki, 43–47. [http://matwww.ee.tut.fi/kamu/loppuraportti]

Mannisenmäki, E. (2000). Oppija verkossa – yksin ja yhdessä. In Matikainen, J. & Manninen, J. (eds.) *Aikuiskoulutus verkossa. Verkkopohjaisten oppimisympäristöjen teoriaa ja käytäntöä.* (The Learner on the Network – Alone and Together.) Helsingin yliopiston Lahden tutkimus- ja koulutuskeskus. Tampere: Tammerpaino, 109–120.

Mononen-Aaltonen, M. (1999). *Verkkopohjainen opiskeluympäristö ja dialogin tukema tutkimusopetus.* (Network-Based Learning Environments and Dialog-Supported Research-Focused Teaching.) Kasvatus 30 (3), 223–239.

Nevgi, A. & Tirri, K. (2001). Oppimista estävät ja edistävät tekijät verkko-opiskelussa. Aikuisen oppiminen verkossa. In P. Sallila, P. & Kalli, P. (eds.)*Verkot ja teknologia aikuisopiskelun tukena*. (Factors Promoting and Inhibiting Learning in Network-Based Study. Adults Learning on a Network.) Aikuiskasvatuksen 42. vuosikirja. Jyväskylä: Gummerus Kirjapaino Oy, 117–151.

Norman, G.R. & Schmidt, H.G. (1992). The Psychological Basis of Problem-Based Learning: a Review of the Evidence. *Academic Medicine*, 67, 557–565.

Oatley, K. (1990). Distributed cognition. In: H. Eysenck, A. Ellis, E. Hunt & P. Johnson-Laird (eds.) *The Blackwell dictionary of cognitive psychology*, Oxford: Blackwell, 102-107.

Palincsar, A.S. & Brown, A.L. (1984). Reciprocal Teaching of Comprehension-Fostering and Comprehension-Monitoring Activities. *Cognition and Instruction* 1, 117–175.

Panitz, T. (1996). CO versus CL. A definition. Electronic Notification in *Learning Styles Theory and Research List* in 1/10/1996 [tpanitz@mecn.mass.edu].

Passi, A. & Vahtivuori, S. (1998). From Cooperative Learning Towards Communalism. In Tella, S. (ed.) *Aspects of Media Education: Strategic Imperatives in the Information Age*. University of Helsinki. Department of Teacher Education. Media Education Centre. Media Education Publications 8, 259–273.

Raivola, R. (2000). *Tehoa vai laatua koulutukseen?* (Efficiency or Quality in Education?) Helsinki: WSOY.

Ruokamo, H. & Pohjolainen, S. (1998). Pedagogical Principles for Evaluation of Hypermedia-Based Learning Environments in Mathematics. In JUCS – Journal of Universal Computer Science, 4 (3), 292-307. [http://www.iicm.edu/jucs_4_3/]

Ruokamo, H. & Pohjolainen, S. (eds.) (1999). Etäopetus multimediaverkoissa – *Kansallisen multimediaohjelman ETÄKAMU-hanke, Digitaalisen median raportti 1/1999.* (Distance Learning in Multimedia Networks.) Teknologian kehittämiskeskus TEKES, Helsinki. [http://matwww.ee.tut.fi/kamu/loppuraportti]

Ruokamo, H. & Pohjolainen, S. (2000). Distance Learning in Multimedia Networks project: Main Results. *British Journal of Educational Technology*, guest editors: Nichol, J. & Baggott, L. 31, (2), 117–125.

Ruokamo, H. & Syrjäkari, M. (2001). Mediapedagogiikkaa Lapin yliopistossa. (Media pedagogy at the University of Lapland.) ITK'01, eOppia ikä kaikki. *Interaktiivinen tekniikka koulutuksessa*, Aulanko, Hameenlinna, 19–21.4.2001, Hämeen kesäyliopisto, 16.

Sharan, S. & Sharan, Y. (1992). *Expanding Co-operative Learning through Group Investigation*. New York: Teachers College Press.

Sinko, M. & Lehtinen, E. (eds.) (1998). *Bitit ja pedagogiikka. Tieto- ja viestintätekniikka opetuksessa ja oppimisessa.* (Bytes and Pedagogy. Information and Communication Technology in Teaching and Learning.) Jyväskylä: Atena kustannus.

Tella, S. (1998). The Concept of Media Education Revisited: From a Classificatory Analysis to a Rhizomatic Overview. In Tella, S. (ed.) *Aspects of Media Education: Strategic Imperatives in the Information Age*. Media Education Centre. Department of Teacher Education. University of Helsinki. Media Education Publications 8, 85–150. [http://www.helsinki.fi/~tella/mep8tella.html]

Tella, S. & Mononen-Aaltonen, M. (2000). Towards Network-Based Education: A Multidimensional Model for Principles of Planning and Evaluation. In Tella, S. (ed.) *Media, Mediation, Time and Communication: Emphases in Network-Based Media Education*. Media Education Centre. Department of Teacher Education. University of Helsinki. Media Education Publications 9, 1–58.

Tella, S., Nurminen, O., Oksanen, U. & Vahtivuori, S. (eds.) (2001). *Verkko-opetuksen teoriaa ja käytäntöä.* (Practice and Theory of Net-Based Education) Helsingin yliopiston opettajankoulutuslaitos ja Vantaan täydennyskoulutuskeskus. Studia Paedagogica 25.

Uljens, M. (1997). *School didactics and learning*. Hove, East Sussex: Psychology Press.

Vahtivuori, S. (2001). *Kohti kokemuksellisen ja yhteisöllisen verkko-opetuksen suunnittelua*. (Towards the Experiential and Collaborative Designing of Network-Based Education.) In Tella, S., Nurminen, O., Oksanen, U. & Vahtivuori, S. (eds.) Verkko-opetuksen teoriaa ja käytäntöä. Studia Paedagogica 25, 79–113.

Vahtivuori, S. & Masalin, T. (2000). Designing Communal Web-Based Learning Environments: Case GLOBE Project. In Tella, S. (ed.) *Media, Mediation, Time and Communication: Emphases in Network-Based Media Education*. University of Helsinki. Department of Teacher Education. Media Education Centre. Media Education Publications 9, 59–82.

Vahtivuori, S., Wager, P. & Passi, A. (1999). *"Opettaja, opettaja teletiimi 'Tellus' kutsuu..." Kohti yhteisöllistä opiskelua virtuaalikoulussa*. (Teacher, Teacher, Teleteam Tellus Calling..." Towards Communal Studying in a Virtual School) Kasvatus 30 (3), 265–278.

Vygotsky, L. S. (1934/1962). *Thought and Language*. Cambridge, MIT Press.

The University of Lapland Faces the Challenges of the Virtual University

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Abstract. This article presents the solution developed at the University of Lapland for organizing local activities to support the Finnish Virtual University. The Centre for Media Pedagogy (CMP) was established in February 2001 and its fields of operation include research, support services, and training. The focus of research is based on network-based learning environments. Support is provided to meet the needs of pedagogy, technology, and content production. The objective of the support service is to help university personnel and students to face the challenges of the educational use of information and communications technology (ICT). The objective of training is to support and produce the preparedness for those things the teaching staff need in educational use ICT. The University of Lapland is participating and coordinating several Virtual University network and internal projects. The CMP has also other national and international cooperative projects with businesses and other universities.

Background

The establishment of the Virtual University was taken as an objective in the Information Strategy for Training and Research for the years 2000–2004 by the Ministry of Education (Ministry of Education 1999). The Finnish Virtual University was established in February 2001, when the representatives of all universities signed an agreement. The Virtual University is not a new or independent university; rather, it is a new means for the universities to act as a network. [http://www.virtuaaliyliopisto.fi]

An objective of the Virtual University is to provide students the opportunities for flexible and open study, where information and communications technology is utilized in teaching. The Centre for Media Pedagogy (CMP) project started in the University of Lapland at the beginning of 2001. The research and product development, support services of the Virtual University and training are centred in the Centre for Media Pedagogy [http://www.urova.fi/home/mpk] as a synergistic entirety. The objective of the CMP is to support and coordinate the development and use of new teaching methods and the activities of the Virtual University in the University of Lapland. (Ruokamo & Syrjäkari 2001a.) The organization and fields of operation for the CMP are presented in Figure 1.

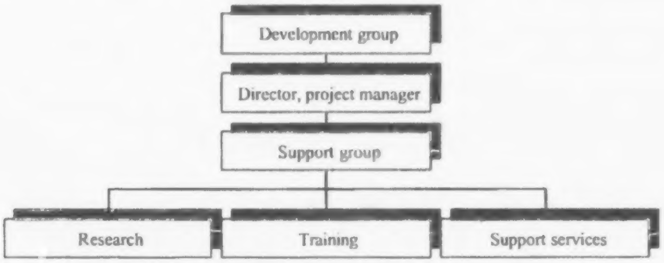

Figure 1. The organization and fields of operation for the CMP

The development group of CMP consists of representatives from different faculties and departments and its support group was formed of the representatives of the projects by the Virtual University working in cooperation with a team consisting of researchers and staff from the CMP. The team, with its pedagogical and technical expertise, is responsible for the operation and realization of support services and realizes the training provided to university personnel and students in cooperation with professionals from the faculties. The responsibility for directing research rests with the faculties.

Research and Cooperative Projects

The activities of the CMP include research (e.g. Ruokamo 2001a, b, c) and product development, which in turn support the activities of the Virtual University and the design, realization, and assessment of network-based education (see Ruokamo et. al.). The Faculty of Education is responsible for directing research. It initiated a seminar on *network-based learning environments* in the autumn 2000, the realization of which utilized the *BSCW* group work program. The research topics relate to, among other things, online interactive curriculum representation (see Lehtonen), interaction in cognitive science network studies (see Johansson & Ruokamo) and the effectiveness of training.

The CMP has underway and in progress some national and international cooperative projects with universities and the business world. The Centre for Media Pedagogy has operated as a cooperative actor with the Spanish University of Catalonia in the Scottish *University of Highlands and Islands (UHI)* project. The aim of the UHI project was to create a decentralized university that is based on cooperation between local institutions of education. The UHI is part of the EU-funded ADAPT-LINC project that was realized from April 2000 to June 2001. (Ruokamo & Syrjäkari 2001b.) In 2002, the CMP initiated the IMPEL FIN_2002 project. The objective of the project is to design, realize, and pilot a web-based period of study as part of the subject sphere of the Ministry of the Environment, in which students will be from several European countries.

Support Services – Support for Personnel and Students in Multiform Education

An objective of the Virtual University is to provide university students with opportunities for open and flexible studies. For example, through flexibility and openness, the barriers to study will be removed, in that university students can participate in the education provided by another university without the need to travel to another locality. The opportunities for flexible and open study require education to be multiform, which often means that teaching utilizes video-conferencing and web-based learning environments. In some cases, an entire course will be fully realized by studying on the net. The development of education to become multiform sets new challenges in front of teachers: it is necessary to know how to utilize information and communications technology in an appropriate pedagogical manner. Even today, the development and realization of network-based education are the activities of a small group of pioneers, and neither has it yet become established as normal practice. A network-based learning environment is a student-centred mode of action that requires the development of a new form of study skills and self-direction (Syrjäkari & Abrahamsson 2000). For this work of development, teachers need various forms of preparedness (technical, pedagogical, and content production) as well as a ring of support around them. Besides support activities, the follow-up and continuing education of teaching staff is one of the most central means to meet these challenges. (Ruokamo & Pohjolainen 2000.)

The CMP organizes developmental projects for university personnel for the pedagogical, technical, content production, and material support of teaching utilizing information and communications technology. The support team provides advice, guidance, and training. The support is provided either personally or as guidance for a small group of university personnel, and it is also provided to students. With respect network-based learning environments, teachers are offered either the *WebCT* [http://www.webct.com/], or the *Discendum Optima* [http://www.discendum.com/] platforms. Experience is also being gained with other platforms, such as *Humap* [http://www.humap.com/humap/default.htm] and *Future Learning Environment* [http://fle3.uiah.fi/].

The CMP organizes an extensive range of support in the educational use of information and communications technology, which corresponds to the needs of the representatives of Virtual University projects and other personnel. The training needs, that relate to net pedagogy and the multiform nature of education as well as to the content production of network-based education, of university teachers and the teaching support staff were surveyed in the spring 2001. Thirty-five people responded to the questionnaire. Figure 2 below shows the earlier experience of teachers in multiform education.

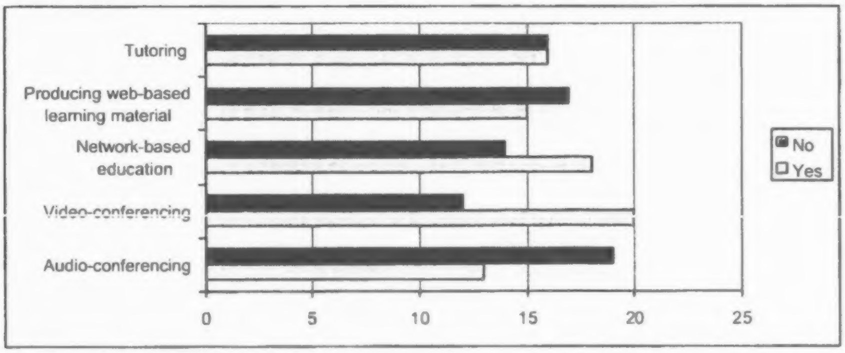

Figure 2. The earlier experience of teachers in multiform education

As can be seen in the diagram, over half the respondents were unfamiliar with the production of web-based learning materials and almost half stated that they had no personal experience of web-based education. The utilization of video-conferencing in teaching was familiar for many either in the practice of a meeting or in the role of a student during a video lecture. Based on the survey of training needs, the training of personnel was planned for the 2001–2002 semester and it began in the autumn 2001. Its contents include the development of a web-based course as a process, net pedagogy, the *WebCT, Sonera eXperience Training*, *Sonera eXperience Learning* and *Discendum Optima* platforms, the ABC of video-conferencing, the production of web-based learning materials, and the strategic preparation for the educational use of information and communications technology. In addition, the training is organized through linking sound, picture, and video to web-based learning material.

At the beginning of 2002, the support training was redesigned. The objective is to support the diversification of staff teaching projects even more effectively. The provision of training was planned to originate from the idea of the project and supports the teacher through to its realization. Teachers have the opportunity to participate in content courses so that they can if wished also complete media education studies as credits. In addition, teachers can select courses in skills according to their own needs, which include handling sound, picture, and video and attaching them to the web-based learning materials. In addition to these, teachers can participate in courses on using different media such as the use of video-conferencing in teaching.

In allocating support for 2001–2002, the projects aimed at what the Virtual University has to offer are in a very special position. The University of Lapland is participating in the following 8 network projects by the Finnish Virtual University. *SOSNET* is a national university network for social work coordinated by the University of Lapland [http://www.urova.fi/home/mpk/Sosnet.htm]. *KasVi* – The Virtual University of Educational Sciences is a joint project by the Finnish Faculties of Education [http://www.urova.fi/home/mpk/Kasvin%kuvaus.htm] and its sub-project *HelLa* is a research project for the design and assessment of pedagogical models in network-based education [http://www.urova.fi/home/mpk/HelLa.htm] (see Ruokamo et. al.). *CONNET* – Cognitive Science and Cognitive Engineering National Education Programme is realized through the cooperation of eight universities and the objective is to train multi-disciplinary professionals to meet the needs of the information society [http://www.urova.fi/home/mpk/Connet.htm] (see Johansson & Ruokamo). Network projects include also Postgraduate Studies of Law, Finland Futures Academy (*TVA*), a network-based teaching project for the acquisition of scientific knowledge (*TieDot*) and the Virtual University of Women's Studies (*Naisverkko*).

The University of Lapland is also participating in 2 national projects by the Virtual University; *IT-Peda* is a network for enhancing knowledge on online teaching and learning in Finnish universities and *TieVie* is a national teacher-training programme for the use of information and communications technology in higher education. The University of Lapland has its own Virtual University projects in content production including a course on the community, art and the environment, subject studies in quantitative research, a Swedish, English, and German language module for students of economics, the use of mobile services in teaching, and developing constitutional rights.

The activity of the Virtual University realizes the existing information administration strategy for the years 1998–2001 and especially its focus of development *"New Learning Environments – the Diversification of Teaching"*. In cooperation with the Faculty of Education, the Centre for Media Pedagogy participates in the information strategy process initiated at the university, especially in preparing the strategy for the educational use of information and communications technology.

Training

The CMP arranges and acquires funding in order to organize long-term training. An example of such is the 15 credit study program *New Learning Environments in the Work of the Teacher* (NET), which is directed by the CMP [http://www.urova.fi/home/mpk/Koulutus.htm]. NET, which is financed and realized with funding from the European Union's European Social Fund (ESF), is a development project of university-level teaching methods that promotes the development of employment by supporting employability, entrepreneurship, adaptability, and equality as well as by investing in human resources. It has been aimed at the university teachers and teaching support staff in the University of Lapland, in the Rovaniemi Polytechnic and in the Kemi-Tornio Polytechnic. The study program is realized 2 times in 2000–2001. At the beginning of 2000 there were initially 74 participants and 72 participants in the autumn 2001. As of the autumn 2001, the studies are in accordance with the requirements set by the Faculty of Education at the University of Lapland. Research into effectiveness will be performed in relation to the NET studies.

The CMP functions as the local actor responsible for supporting the *TieVie* training project initiated by the Virtual University. The objective of the TieVie training is to familiarize participants with information and communications technology from the perspective of pedagogic, technological, and organizational change as well as to research the challenges and problems of networked education. Representatives of the personnel at all Finnish universities are participating in the training. The CMP is responsible locally for providing information, support services, and mentoring.

In the University of Lapland, the CMP coordinates the Virtual University's CONNET – Cognitive Science and Cognitive Engineering National Education Programme. This project was coordinated by the University of Helsinki in 2001 and will be coordinated by the University of Jyväskylä in 2002–2003. The curriculum, the purpose of which is to train multi-disciplinary professionals to meet the needs of the information society, consists of eight different subjects. Each of the eight universities coordinates the practical organization of the information, registration, and teaching at its own university. Basic studies in cognitive science began in the autumn semester 2001 and research related to the interaction for their realization is underway. (See Johansson & Ruokamo.) Subject studies in cognitive science will begin in the autumn semester 2002.

The University of Lapland has responsibility for a course on *Organisations and Modern Communication*, which is held in cooperation with the University of Helsinki. The course was realized for the first time in the spring 2002 and the Faculty of Education at the University of Lapland was responsible for the professionalism of its content. Students from six different universities participated in the section of the course prepared by the University of Lapland. They were divided into small groups both according to university and between universities. The course consisted of an introductory lecture realized through video-conferencing and two separate parts: a web-based reading group and study tasks. In the web-based reading group, each student wrote an introduction based on course literature and these were discussed in small groups utilizing WebCT. In the study tasks, the student groups wrote cooperatively an essay based on course literature, which they also presented through video-conferencing with other universities. The small groups also commented on each other's presentations in video-conferences. Overall, 59 % of the students that had registered for sections of the course completed it. The experiences of the first realization of the course were encouraging and motivated the continuing development of the course. The learning tasks for the next realization of the course in the autumn 2002 will be developed to become problem based and the guidance for students will be further increased.

Conclusions

The operations of the CMP are in their initial phases and the modes and means of action are still being created. The objective in the future is to firmly establish its activities and the status of the unit. Information and communications technology is developing quickly and it enables new forms of realization for the development of teaching and study. Finland, and especially Lapland, is a sparsely populated region with long distances between places, so flexible opportunities for study are necessary in order to expand the possibilities for participation in training. The preparedness of teaching staff for the educational use of information and communications technology is growing and the attitudes that accompany it are becoming more positive. The increase in research knowledge for the educational use of information and communications technology supports the development of teaching more than ever before to correspond to the needs of the student.

References

Johansson, T. & Ruokamo, H. (to appear) The Realization of Interaction in Cognitive Science Network Studies. Paper to be presented and published in ED-MEDIA2002 Conference, June 24–29, 2002 Denver, Colorado USA.

Lehtonen, M. (to appear) Online Interactive Curriculum Representation as One Key to well Structured Students Learning Activity. Paper to be presented and published in ED-MEDIA2002 Conference, June 24–29, 2002 Denver, Colorado USA.

Ministry of Education 1999. Information Strategy for Education and Research 2000–2004. Implementation Plan. < URL: http://www.minedu.fi/minedu/education/inform_strategy_implementation_plan.pdf > (accessed 15.4.2002).

Ruokamo, H. 2001a. The Solver Learning Environment for Solving Mathematical Word Problems – How to Support Reflectivity? In Ruokamo et al. (eds.) Proceedings of PEG 2001 Conference, Intelligent Computer and Communications Technology – Learning in On-line Communities, June 23-26 2001, Tampere, Finland, 192–199.

Ruokamo, H. 2001b. The Solver Learning Environment and Anchored Instruction on Mathematical Word Problem-Solving. In C. Montgomerie & J. Viteli (eds.) Proceedings of ED-MEDIA 2001 Conference, June 25-30, Tampere, Finland, 1595–1600.

Ruokamo, H. 2001c. Mathematical Word Problem-Solving in the Solver Learning Environment. Abstracts of Invited Lectures and Short Communications Delivered at the Tenth International Colloquium on Numerical Analysis and Computer Science with Applications, August 12–17, 2001, Plovdiv, Bulgaria, 137.

Ruokamo, H. & Pohjalainen, S. 2000. Distance learning in a multimedia networks project: main results. BJET – British Journal of Educational Technology 31 (2) 2000, 117–125.

Ruokamo, H. & Syrjäkari, M. 2001a. Mediapedagogiikkaa Lapin yliopistossa. ITK'01, eOppia ikä kaikki. Interaktiivinen tekniikka koulutuksessa, Aulanko, Hameenlinna, 19–21.4.2001, Hämeen kesäyliopisto, 16.

Ruokamo, H. & Syrjäkari, M. 2001b. Centre for Media Pedagogy at the University of Lapland – Meeting the Challenges of the Virtual University. UHI Millennium Institute, ADAPT LINC Project. Presentation held at the Dissemination Event, 15 June 2001, Inverness, Scotland.

Syrjäkari, M. & Abrahamsson, M. 2000. Academic Learning Skills can be developed on the Net! Proceedings of the EADTU Millennium Conference: Wiring the Ivory Tower. Linking Universities across Europe, Paris, France, 28–30.9.2000, 105–108.

Ruokamo, H., Tella, S., Vahtivuori, S., Tuovinen, H., & Tissari, V. (to appear) Pedagogical Models in the Design and Assessment of Network-Based Education. Paper to be presented and published in ED-MEDIA2002 Conference, June 24–29, 2002 Denver, Colorado USA.

A Case Study on the Use of Video Teleconferencing to Study Geography at the United States Air Force Academy: Lessons Learned

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Introduction

As some instructors have discovered, guest speakers can greatly enhance courses (Davis, 1993). Guest speakers can provide expertise and special skills that courses' instructors may lack. However, it is not always feasible to get a guest speaker to the classroom, given geographical separation, travel expenses, time constraints, and conflicting schedules. Video teleconferencing (VTC) helps bring speakers to classes as moneysaving and timesaving alternatives.

VTCs link geographically separated groups with two-way audio and visual displays, providing synchronous connectivity. With synchronous connectivity, both ends of the connection have television monitors with speakers, enabling them to see and hear each other nearly simultaneously. This connectivity enables interactivity and provides both ends with immediate response and feedback.

My interest in VTCs began when I developed a new course at the United States Air Force Academy (USAFA) on the geography of the British Isles. Believing it was important for cadets to experience the cultures and other geographical aspects of the region, I decided a VTC would be an interesting, educational learning experience.

I felt a VTC would be a valuable supplement for a cultural geography lesson because cadets could interact with people from the distant culture. Davis (1993) recommends enhancing courses by augmenting them with speakers from diverse ethnic communities. My intention was for the cadets to observe the linguistic, ethnic, and sociological differences during the interaction. Conducting a VTC was more cost effective than sponsoring a guest speaker to fly over from the British Isles. The results of the VTC were promising and cadet interest was high. This paper focuses on the lessons learned from the use of this technology in the course and provides some suggested guidelines for its effective use.

Conducting the VTC

The VTC was performed with Dr. Gerald Mills at University College of Dublin (UCD). The focus of the session was on Irish culture and politics. We devised a lesson that would give cadets an opportunity to talk with and ask questions of himself, a geography instructor, and two undergraduate students in their final year at UCD. The objectives of the lesson were for the cadets to understand the cultural differences between them and the Irish subjects, know the current events that shape the lives of the Irish, and understand the role that politics has in Irish culture. Cadets were tasked to read *The Irish Times* prior to the VTC to get a flavor of Irish culture through the current events and local interest articles, editorials, and advertisements. In addition, the cadets were instructed to prepare questions based on both the readings and their intellectual curiosity. Dr. Mills prepared a 10-minute presentation to begin the session, which centered on his view of the readings in the newspaper. The remainder of the session was an open question and answer session, with both cadets and UCD students asking questions of each side.

USAFA is fortunate to have a high-tech VTC lab with an excellent staff to maintain and operate it. We held the session in the lab, connecting our students with the Irish panel. Each side of the connection had two monitors—one with a view of themselves and the other with a view of the other end of the connection. Microphones were on desks, making audio communication simple and clear. As this session was the first VTC for all involved, I asked a colleague experienced with VTCs to begin the session by providing a four-minute PowerPoint lesson on VTC protocol (communication techniques). My colleague discussed time delays, background noise, speech delivery, and visual limitations. Participants on both sides then introduced themselves and the session proceeded as planned.

Lessons Learned

I went into the session blind, having neither previously conducted a VTC nor studied the background on procedures and techniques. I thought it important, however, to evaluate this attempt with the VTC process and prepared a questionnaire based upon one created and used by Heckman, Whitford, & Lawyer (2000). The cadets each completed a questionnaire anonymously. In the future, I will administer the questionnaire to all participants, not solely students, to capture all perspectives. The cadet comments revealed that some aspects of the session went well, while others areas needed improvement. Following is a synopsis of the results of the questionnaire in which a score of "1" is "strongly disagree/no value" and a score of "5" is "strongly agree/great value." The data is limited, as there were only six cadets in the class. However, there was consensus among most of the cadets, as many provided similar answers to questions.

One of the major benefits of using the VTC as a learning tool is the visual picture that helps create a human connection. Extolling the virtues of the use of video in geography classes, Gold (as cited in Gold et al., 1991) states that "sight is of prime importance in human sensory perception" (p. 15). VTCs especially aid those who are both aural and visual learners, as long as effective visual aids or gestures are used. For example, talking heads do not enhance the visual portion of the session.

When asked if they thought the session was valuable in gaining insight into the geography of the region, the cadets gave an 86.67 percent approval rating (4.33 mean score). One cadet commented that linking to the panel at UCD was "better than just reading a book". I could not have provided the same learning experience for the cadets had I been the sole instructor of the lesson because I have never lived in Ireland and could not share the same thoughts and feelings as did the Irish subjects. I could have accomplished the objectives through means other than a VTC—assigned readings, in-class discussions, presentations, or group activities, for example. However, the real-time audio and visual exchange provided more insight and left us with a more lasting impression of Irish culture. Online chats, email exchanges, and telephone conferences can be useful in exchanging information, but they lack the ability of the VTC to present a nearly face-to-face lesson and provide the two-way visual interface. The VTC provides the nuances (language and mannerisms) that are particularly important in the realm of cultural geography.

There are some limitations in conducting VTCs. There are constraints on days and times you can connect. With the popularity of VTCs, instructors are increasingly using the facilities. There are also limitations to the times that the lab is open and support staff are available. Due to the time difference between USAFA and UCD, we were unable to conduct the VTC during our class time and had to deconflict student schedules to find a good time.

Thanks to my colleague's guidance and the assistance of the lab manager, there were no glitches in the session. Once the connection was made with UCD, we found the VTC to be very user-friendly and maintenance-free. Cadets commented that the session "seemed quite natural," "ran smoothly," and was "relaxed and flowing." Cadets gave the format a 73.33 percent approval rating (3.67 mean score).

All of the cadets noted that the key factors in making a VTC successful are the preparedness of the students and the quality of the speaker(s). For example, those who had studied the material and prepared possible questions before class enjoyed the session much more than those who had not. The two who had not prepared questions commented that they wished they had. They also claimed that an instructor who is uninteresting in one delivery format will most likely be just as uninteresting in another setting.

One of the most significant ideas that I developed as a result of our VTC was that a VTC can only be as effective as the instructor or facilitator can make it. Many of the same methods that are used effectively in a VTC (e.g., active or problem-based learning) should be similarly effective in face-to-face classes. Mishra (1999) states that "most learning theories suggest[s] that for learning to be effective, it should be active" (p. 243). Conversely, many of the same methods that are not as effective in a VTC (e.g., traditional lecture) should be less effective in face-to-face classes. If the VTC had consisted solely of a lecture by Dr. Mills, the cadets would not have appreciated or learned as much from the session. The same can be said of a face-to-face class. Therefore, the major benefit of a VTC versus a face-to-face class, in this scenario, is the ability to reach out to a native and an expert. The cadets would have experienced nearly the same learning experience if the panel had appeared in person in our class, however, that luxury wasn't financially or logistically possible. In this case, the VTC was the technology that allowed us to connect and create a positive learning experience.

Although cadets emphasized the benefits of seeing visual images of the other participants, visual aids could have been used to make the session even more valuable. The visual aspect of VTCs is one of the key areas that should be exploited. Photos of Ireland would have further enriched our discussion of culture through examples of the architecture, landscape, and human subjects from the area.

For a course focusing on a region so geographically separated, the VTC was particularly effective in that it allowed cadets to ask questions of and exchange information with students of their own age and to observe a few of their cultural traits first-hand. In that 50-minute session, the cadets observed the Irish subjects' language, dialect, appearance, dress, and mannerisms, which are all aspects of cultural geography. The Irish subjects also shared some of their thoughts and feelings on subjects ranging from college life to terrorism, which helped paint a picture of Irish culture. When questioned about the value of interacting with the Irish panel, there was a 98.33 percent approval rating (4.83 mean score). Five of the cadets wrote comments similar to one, who wrote that it was "great to get a current perspective from native Irish students" on current events affecting Irish culture. The sixth cadet wrote that the interaction with the instructor was good, but that "the students seemed indifferent and unprepared". A better approach may have been to pass along prepared questions to the Dubliners prior to the session to better prepare them. Cadets also noted that listening to the panel was "much more interesting than [listening to] speculation of non-natives". Most cadets were well prepared and asked questions that could be best answered by the panel. For example, one cadet asked the Irish students how the conflict in Northern Ireland impacted their daily lives and if the conflict was a daily topic discussed in coffeehouses or pubs. Their USAFA instructors could not have adequately answered this question.

Cadets agreed we should pursue using VTC technology in this and other courses at USAFA, with a 96.67 percent approval rating. This information was forwarded to USAFA's instructor education office to possibly encourage other faculty members to use the technology in the future.

One cadet went so far as to suggest a specific course, comparative politics, which could benefit from the technology. Another cadet suggested that we use VTC sessions to interview subject area experts in performing research for papers and presentations. Given the expenditure of resources (time, personnel, and money) to conduct a VTC, it might be difficult to justify using the technology for such a limited audience and objective. Another cadet suggested that VTCs are more effective with small class sizes.

During his discussion of VTC protocol, my colleague informed us that one limitation of our connection would be that UCD had a slower baud (transmission) rate. Because of the slower rate, there would be a slight delay in transmission. He instructed us to begin a response to the other side by predicting and interrupting at the end of their question or statement. I found this to be as awkward as it sounds, although the briefing helped me mentally prepare for the limitation. There were pregnant pauses and interruptions on both sides. The situation improved, however, as the session progressed and both sides became better accustomed to the procedures. Although the delay was a bit awkward, the students thought the VTC provided them a valuable, interactive learning experience.

Many cadets did not find the introductory protocol briefing as useful as did I. They gave the briefing a 66.67 percent approval rating (3.33 mean score). Most commented that the briefing was useful, but based on common sense. They followed the guidelines fairly well throughout the session, providing comments such as "it ran smoothly, relaxed, and free flowing". One cadet commented that the briefing started the session out with a formal atmosphere and suggested instructors discuss the guidelines on their respective sides prior to the session. Given the lack of enthusiasm over the briefing, the suggestion is a good one, especially since it adds more time for achievement of objectives.

Suggested Guidelines

Although VTC technology has been used extensively for quite some time, it is not necessarily being used appropriately. Yes, quality equipment is an important component of VTC sessions, but "any successful program must focus on the instructional needs of the parties, rather than on the technology itself" (Muller, 2000, p. 225). Following are a few aspects of both technology and instructional methodology to consider when preparing for a VTC.

Instructors should become familiar with equipment operation. "Learners get more from the courses when the instructor seems comfortable with the technology" (Willis, 2001, Guide #1, ¶ 6). Communication checks should be performed prior to the day of the session and just prior to the session. Once participants are in place, microphone and camera placement should be checked, ensuring all participants are close enough to a microphone and camera angles are such that they center on the group. Some cameras can zoom and pan the room during the session (Video Development Institute (ViDi), 2000, Guide #2, ¶ 3).

Heckman et al. (2000) suggest that time and experience are necessary for instructors to become comfortable with this technology. They note that VTCs require more preparation time than face-to-face classes and that instructors must be more vigilant in monitoring the various aspects (equipment, students, and activities at each end of the connection) of the session. Hearnshaw's (2000) VTC discourse content analysis shows a marked increase in student interaction and, thus, comfort with the technology as a course progresses.

Visual aids are important materials to incorporate into VTCs, although they are not as easy to use as they are in face-to-face classrooms. Images are sometimes obscured or blemished through transmission. VTC equipment is available that allows users to incorporate high quality visual aids into sessions. The New England Medical Center has a camera that allows them to view x-rays in real time. Using this type of equipment can greatly increase the overall quality of the session, as it can provide clear, professional images. Demonstrations, experiments, and videos can help enhance the VTC as well. Regardless of the tools and methods used, they should be tested in the lab prior to the session to ensure connectivity and quality. As with face-to-face classes, images and other products should be accurate and large enough for participants on both sides to see clearly.

At the beginning of the session, all parties should be given a short briefing on VTC protocol, unless they have all participated in and are familiar with this type of session. ViDi (2000) highlights several protocol items to help ensure a smooth-flowing session. Unnecessary movement should be avoided, as it can adversely affect (break up) both audio and video, particularly on lower quality systems. Proper etiquette used in face-to-face classes, such as maintaining eye contact with the speaker and avoiding personal conversations, is even more important in VTCs. "Side conversations at remote sites seem to spring up more readily that they would if everyone were in the same actual room" (ViDi, 2000, Etiquette section, ¶ 5). These side conversations are disrespectful in any setting. In a VTC, however, these distractions add unnecessary noise to the session, causing disruption and moments where sometimes no one can hear the conversation at hand. To compound the problem, open microphones placed around the room allow these conversations to be readily picked up by the other side. Instructors must constantly monitor the session and discretely put a stop to all personal conversations.

Cultural differences are of particular concern in VTCs connecting people from different countries. Cultural sensitivities should be discussed and stressed prior to the session to avoid offensive comments or gestures. Willis (2001) states "that students may have different language skills, and that humor is culturally specific and won't be perceived the same way by all" (¶ 5). We experienced this in our VTC, as a couple of the jokes that the cadets made were not understood by the Irish panel. Although there was no offense by either side, the jokes created uncomfortable pauses while the panel attempted, unsuccessfully, to comprehend the jokes.

Finally, participants should be briefed on the limitations of the equipment, such as transmission delays. This can help reduce awkward silences. It is no easy task, however, and does take practice. In our VTC, participants began to better anticipate the other side and silent periods were reduced toward the end of the session.

Our geography class consisted of only six cadets. VTC sessions should limit class size in accordance with seating and equipment limitations. If we had more than 14, there would have been difficulty getting all cadets within an effective range of the speakers and camera. As with face-to-face classes, successful discussions are much easier to conduct in relatively small groups of approximately six to twelve each. Bates (1995) claims that "the opportunity for any individual to participate in questioning or discussion decreases in proportion to the number of students viewing a live interactive programme" (p. 101). Small class numbers are essential when conducting interactive VTC sessions. The classes should not be too small, however (much less than six), or the opportunity to share multiple perspectives is reduced.

Instructor presence during VTC sessions is necessary. VTCs are not television programs or films for students to sit and watch inactively. Without guidance from the instructor, students can stray off of the topic and are more easily refined in their participation. Students are more compelled to participate under the watchful eye of their instructor. In addition, an observant instructor can analyze participants' non-verbal cues and refocus or redirect the session. Because of transmission delays and varied levels of participant comfort in conducting VTCs, instructors should plan to cover fewer objectives in a VTC than in a face-to-face class. (Willis, 2001).

Many VTC guidelines stress an avoidance of pure lecture. Mishra (1999) concludes, "teleconference is a medium of sharing rather than lecturing" (p. 247). A sharing environment is one that promotes interaction between all participants rather than unidirectional instruction. Willis (2001) suggests an instructional design for VTC lessons to stimulate student learning through diversity of activities. McKeachie (1994) recommends that students prepare critical questions when a guest speaker is featured. Questions help encourage human interaction and help students with the relevance of covered topics.

Evaluations should be administered immediately following any VTC session. There is not much literature on VTC evaluations. However, Hearnshaw (2000) suggests an objective method for evaluating the learning processes of VTCs. In his evaluation, he assigns codes to types of questions and comments made by students. These codes are based on the depth of discourse and the learning types (cognitive vs. affective) involved. The results are then used to determine the progress of student learning throughout a series of VTCs. The difficulty in applying his approach is that it was designed for a distance education course using desktop videoconferencing where all participants (students and instructors) are geographically separated. Applying the approach to two-way VTCs that take place in classroom settings must be evaluated. The contrast between the desktop and classroom settings could produce dissimilar results, as students in desktop videoconferencing may perform and react differently than they would in classroom VTCs. The perception of anonymity may enhance their readiness to participate more freely and critically in the desktop setting.

Finally, instructors should have all participants, not solely students, complete a questionnaire. The lessons learned can be extremely beneficial for future VTC attempts, as I discovered in our session.

Conclusion

In courses such as geography, where the experts (native, empirical sources) are at such a great distance, it is not often possible to physically connect students with guest speakers. The current global crisis surrounding the threat of terrorism may even reduce the opportunities to physically connect, as people fear public transportation. The VTC is a fitting alternative in such cases. Instructors need to provide clear, structured guidance to both students and speakers prior to the session and should follow the aforementioned guidelines. In order to promote the effective use of this technology, institutions must support faculty by providing training and development programs and quality services. VTC sessions are not the answer to every situation and cannot replace the use of in-person instruction, but they are wonderful alternatives when needed and used appropriately.

References

Bates, A. W. (1995). *Technology: Open learning and distance education*. London: Routledge.

Davis, B. G. (1993). *Tools for teaching*. San Francisco, CA: Jossey-Bass.

Gold, J. R., Jenkins, A., Lee, R., Monk, J., Riley, J., Shepherd, I., et al. (1991). *Teaching geography in higher education: A manual of good practice*. Oxford: Blackwell.

Hearnshaw, D. (2000). Towards an objective approach to the evaluation of videoconferencing. *Innovations in Education and Training International*. 37(3), 210-217.

Heckman, B. E., Whitford, D. J., Lawyer, D. T. (2001, January). *Teaching geoscience courses collaboratively using compressed videoconferencing technology: an experiment conducted between the United States Air Force Academy and the United States Naval Academy*. Paper presented at the annual meeting of the American Meteorological Association, Albuquerque, NM.

McKeachie, W. J. (1994). *Teaching tips: Strategies, research, and theory for college and university teachers* (9th ed.). Lexington, MA: D. C. Heath and Company.

Mishra, S. (1999). An Empirical Analysis of Interactivity in Teleconference. *Indian Journal of Open Learning*, 8(3), 243-253.

Muller, N. J. (2000). *Desktop encyclopedia of telecommunications* (2nd ed.). New York: McGraw-Hill.

Video Development Institute (2000, June). *Video conferencing cookbook: Getting started with video clients*. Retrieved October 15, 2001, from http://www.vide.gatech.edu/cookbook2.0

Willis, B. (2001, February). *Distance Education at a glance: Interactive videoconferencing in distance education*. Retrieved October 4, 2001, from the University of Idaho College of Engineering, Engineering Outreach site: http://www.uidaho.edu/evo/distglan.html

Bringing Reality Back to Online Education

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Higher education, including teacher preparation programs, is rapidly becoming technology-based. Educational Technology (ET) is expanding opportunities for effective learning, penetrating into both campus-based and web-based curricula. ET offers the means to improve the quality of teaching and enhance learning. However, along with the numerous potential benefits, it brings new problems and complications. One of the counter effects of increasing technology dependence is a growing distance divide, both physical and social, between students and instructors in today's education that is grounded in the paradox of contemporary social life and technology.

A similar picture can be seen in strictly pedagogical terms. Nowadays education is (or at least, should be) unequivocally learner-centered. Learning, we believe, in order to be efficient, needs to provide the learner with a multiplicity of options of customized reality-based curricula. Nevertheless, due to some social and technological factors, among them the rapidly spreading use of information technology (electronic media in general and online education in particular), learners are becoming increasingly distanced from their schools and instructors. Reality-based experiences seem to disappear from the instructional process as the learner becomes more and more divorced from hands-on practices. This leads not only to the growing divide between the key participants in the educational interaction but to the disappearance of the teacher as a role model from the student's perspective as well. Moreover, it is not only the teacher's personality that may well become obsolete in online education (as classes are taught mostly by merely sharing text files), but also life and professional experiences that the teacher brings to class may become lost through text dominated technology. It becomes vital to preserve "human dimension" in a technology-based learning environment (Serdyukov 1999). In our research we address important pedagogical issues attempting to bridge the physical and social distance emerging in online education by capturing and bringing reality-based experiences straight to the student's computer.

In various methodology classes comprising, together with foundational courses, undergraduate as well as postgraduate preparation teacher preparation, e.g. "Methodology for Second Language Instruction", there is an inherent need for reality-based visual approaches to classroom practices. It is only through visual representation of reality-based situations that a student can attain a truly comprehensive teaching model as a premise to develop their own instructional techniques. In terms of online classes which purport to teach a methodological approach we posit this solution set: visual presentation of the instructional content through Streaming Video (SV). The rationale is straightforward. You cannot fairly ask a student to efficiently demonstrate an approach without the antecedent of a competent presentation. In other words, for methodology classes visual expert presentation precedes actual student demonstration. The pedagogic focus of online teacher preparation is, after all, on how to adapt and transform traditional teaching practices and the content of courses to include students for whom the traditional onsite practices and interactions are

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restricted due to the nature of their distance learning. In teacher preparation it is imperative to find ways and means to compensate for the lack of real-life instructional situations.

The infusion of SV in online education is based on the situated learning model (Lave and Wenger 1991). It is not so much that learners acquire structures or models to understand the world, but they participate in frameworks that that have structure. Learning involves participation in a community of practice. (Cit. from Smith 2001) In other words, the complexity of the online course should not be on the screen but in the interaction between a student and the instructor (Ryan 2002).

To create authentic experiential and reflective environments for learning, we can use a number of professionally made video materials, including special instructional videos, documentaries and even feature films. "Best practices" videos are one of the best resources for teacher preparation programs. However, often we cannot find the video that suits our topic or objectives. Then we can create one within our means, e.g. record our own video introduction to the course, videotape the lecture we are going to teach, or present a tape with a demonstration of some situation we want to use in classroom activities.

The advent of professor's video presentations leads us to a student-produced demonstration of a given methodological approach. The value of having the student send a video demonstration (now via mailed VHS, soon via video streaming) with age appropriate learners (after viewing a professor's chosen video presentation) of a discreet methodological approach cannot be underestimated. This kind of student produced video assignment is one that can almost never be replicated in the traditional higher education classroom where age appropriate students (5 to 17 years old) are simply not available. Thus, in a very special way, this highly documented approach takes us one step further in reality-based education. Clearly, online education, especially in a methodology class, engages the human element via video, which enhances the student's range of social and pedagogic skills.

There are several goals in using video. They are as follows:

- To deliver the course content (videotaped lectures and instructional video)
- To illustrate some points of the lecture presented orally or in a text format (video clips)
- To use videotaped materials for analysis and discussion ("Best practices" documentary and demonstrations video, students' videos)
- To offer visual reality-based models for a comprehensive view of practices which work best in today's classroom.
- To use videotaped material as an instrument for self-evaluation or assessment (students' self-video)
- To incorporate a more holistic (i.e. intellectual, social, emotional) dimension to classroom learning, spurring both cognitive and affective growth (feature film, videotaped demonstrations).
- To humanize the online class by presenting both the instructor and students in video format.

The advantages of a SV-based approach are not exclusive to online instruction. In fact, any traditional onsite class may avail itself of the SV reality-based benefits (e.g. working with age appropriate learners). This is to say that SV is as a hybrid tool which can be used in literally any instructional format. It is so because it adds a reality-based human dimension to learning. Students are best prepared for teaching when instruction brings the real world into the classroom.

SV is opening new opportunities for online education. It brings the human dimension back into students' learning - in a specific, technology-mediated format: students can now see their instructor on the screen, watch real-life situations like teaching practices that are used to prepare them for their own teaching. It enhances new content acquisition by combining the multiple modalities, text and image. It creates the platform for situated learning based on observing reality-based classroom situations. Finally, it permits students to perform actual demonstrations in real classroom with live students, allowing professorial feedback on a "hands-on" approach.

References

Lave, J. and Wenger, E. (1991) *Situated Learning. Legitimate peripheral participation*, Cambridge: University of Cambridge Press.

Ryan, M. (2002) *Ask the Teacher*: A Practitioner's Guide to Teaching and Learning in the Diverse Classroom. Boston: McGraw Hill Companies, Inc.

Serdiukov, P. (2000) The Human Dimension In a Technology-Based Educational Environment. *IFIP TC3 WG3.2/WG3.6 International Working Conference on Building University Electronic Educational Environments*. Irvine, CA, 1999. Boston: Kluver Academic Publishers.

Smith, M. (2001) The social/situational orientation to learning (http://www.infed.org/biblio/learning-social.htm)

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How Does Learner Transform Knowledge Through Hypermedia Authoring: A Case Study

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Abstract: This case study was to explore how a learner transforms knowledge structure in hypermedia authoring. As a data collection method, think-aloud protocol, stimulated recall interview, and open-ended interview were used to examine the transformation process. The study revealed that the participant mainly used two distinctive cognitive processes to transform his knowledge: 1) top-down approach and 2) chunking strategy. Regarding top-down approach, the participant searched his knowledge structure to identify highest knowledge component; then it was followed from the highest knowledge component to organize it into hypermedia. Also, he used a chunking strategy in considering whether or not each piece of knowledge is appropriate for the chunk. Additionally the participant's thinking flow might be constrained with the authoring tools' function.

Knowledge Transformation in Hypermedia Authoring

Hypermedia Authoring

There have been some studies to explore the benefits of implementing hypermedia authoring, also referred to as students-as-multimedia-author, with two main premises. First, it is assumed that authoring hypermedia can provide learners high authenticity of a given task. Beichner (1994) insisted that learners regarded the work they were doing had importance outside of the classroom. Furthermore, learners showed that they were highly involved in the given tasks. High degree of learner engagement was found throughout the project (Lehrer, 1993; Lehrer, Erickson, & Connell, 1994).

Second, hypermedia authoring is assumed that it provides more opportunities of having learners develop sophisticated knowledge structure because they have to use multiple and linked mental representation to author hypermedia as a final product. Learners working with authoring environments outperformed than control group in terms of articulating and defending essay topics (Spoehr, 1993). Learners' knowledge structures became more sophisticated, their design skills emulated a cognitive framework and a problem solving process. As a result, their problem-solving skills increased and became more complex (Oughton & Reed, 1998). Similar result was reported that students in hypermedia authoring showed the increased cognitive process such as finding, interpreting, and articulating information and knowledge (Lehrer et al., 1994). These cognitive processes seem a promising advantage of hypermedia authoring.

In an effort to design an instructional material, a learner also has to reflect on his/her own knowledge in terms of transformation of an author's knowledge into a hypermedia product. In other words, learners need to refer to their structural knowledge in order to produce the given task. Along with this process, the learners in hypermedia authoring demonstrated high creative thinking (Liu, 1998). Additionally nonlinear structure of hypermedia enabled learners to be more reflective (Koehler & Lehrer, 1998; Lehrer, 1993).

Cogniti ve Process in Hypermedia Authoring

There are various frameworks representing author's cognitive process during hypermedia authoring. For instance, it consists of collecting, organizing, and displaying information in a multimedia format (Nicaise & Crane, 1999). However they did not provide in-depth descriptions about what cognitive process should be implemented in each phase. Moreover, there was no phase for revising or assessing the author's knowledge structure.

Unlike Nicaise and Crane's cognitive framework, Lehrer (1991, 1993) and Lehrer, Erickson, and Connell (1994) modeled a cognitive framework including evaluation and revision as (a) planning, (b) transforming, (c) evaluating, and (d) revision. Brief description was listed in the below.

- Planning the design of a hypermedia document involves deciding upon the nature of the problem and developing ideas about the overall structure of the document.
- Transforming is to modify information into knowledge. Knowledge is distinguished from information by its systematicity – a network of relationships that sustain one or more themes.
- Evaluation relies on designers' abilities to solicit feedback, which in turn relies upon their skills in articulating their goals and intentions to others.
- Revision requires multiple cycles of drafting and revision in order to make a successful product.

Moreover Oughton and Reed (1998) suggested a cognitive framework very similar to Lehrer's though they proposed 3 stages as 1) planning, 2) transforming, and 3) evaluation and revising.

Summary of Hypermedia Authoring

Planning plays a role as an initial step to locate required information; however, the identified information can be discarded depending on the author's decision when he/she transform and/or revise a hypermedia. Among planning, transformation, and revision, transformation and revision are more critical to produce an artifact as a final product in hypermedia authoring process. In this sense, transformation and revision will be a main activity, which learners involve in authoring hypermedia.

Therefore, main benefits of implementing hypermedia authoring may come from transformation and revision. By performing transformation and revision, learners modify and adopt their knowledge structure as an artifact, hypermedia. However, little is known about specifically focusing on cognitive strategies of transformation and revision.

Indeed the previous studies have loosely authenticated how learners use the authoring tool for their project. For instance what functions would be effective on learners' authoring is not identified. More specifically this question is to identify key components of developing ideal authoring tools. It is assumed that if there are distinctive learning process or pattern they can be applied for developing an authoring tool.

Research Questions

This study was focusing on examining how the learner transforms own knowledge into hypermedia authoring. The purpose of this research was to identify cognitive strategies with hypermedia authoring and to explain how he/she transforms knowledge to develop hypermedia. In particular this study will examine 3 questions; 1) How did the participant plan for the authoring tool, 2) What features of the authoring tool did the participant use, and 3) How did the participant use the authoring tool.

Method

Selection of Study Participant

In order to select an appropriate participant of this study the following criteria were used: a participant of this study should have (a) a familiarity with a given subject matter and (b) knowledge of instructional designing or experience of developing instructional materials. The first requirement is strictly related to the purpose of this study. It was to explore knowledge transformation process in hypermedia authoring process rather than knowledge acquisition. Knowledge transformation process is a manipulation of already acquired knowledge. In order to meet this purpose, it was necessary that a participant was knowledgeable to a given content. Second, knowledge of instructional designing or experience of developing instructional materials was also required for a study participant because hypermedia authoring requires designing skills of developing instructional material.

The Participant

One participant was selected with fulfillment of tow criteria described above. The participant, Chris (a pseudonym), is a first year doctoral student who has enrolled in a doctoral program of instructional design at a southeast public university. Chris took two courses related to instructional design theories. He was regarded as an intermediate instructional designer with satisfying the second criteria of selecting a participant of the study. Regarding the first criteria of selecting a participant, one of the classes, which Chris was taking, was selected as a subject matter. The selected class was about theoretical studies of learning and cognition for graduate students.

Materials and Tasks

The selected material is about Ausubel's meaningful reception learning (Driscoll, 1999). Thirty concepts were selected, and they were developed in a printout material as well as a digitalized format as a package. Each concept was called as a slide, and one slide contained only one concept. All slides were text-based format without any graphics or charts. The slides were sorted in an alphabetical order. The following 6 sequential tasks were assigned to Chris.

(1) Rating Slides with 5 Points Likert Scale: It was given to verify whether Chris was familiar with the given material. 5 points Likert scale was used from 1 point with very-well-unfamiliar to 5 point with very-well-familiar.

(2) Practice of the Authoring Tool: After rating the given package, Chris was asked to practice using the authoring tool. He was able to use the authoring tool without any problems in a given two trial

(3) Practice of Think-Aloud Protocol: It was the first time of performing think-aloud protocol for Chris; hence, practice of performing think-aloud protocol was needed. This task was conducted during the second trial of practicing the authoring tool. The researcher asked what he was thinking to prompt his think-aloud. During this practice, the following sample questions were used. Why are you selecting the slide? Are you looking at that slide? What are you thinking the relationship between the slides? What does the line mean?

(4) Authoring Hypermedia: Prior to authoring hypermedia, planning session was given as proposed in the previous studies. In order to visualize Chris' planning process, a blank paper proved to draw a planning map of how each slide will be connected and what would be master or non-master slides. It was also asked to draw links. After completing the planning session, Chris rearranged and linked the given set of slides by using the authoring tool.

(5) Evaluating and Revising the Developed Hypermedia: The final product was created; then, Chris was told to evaluate and revise the developed hypermedia. He looked through all master slides and linked slides to revise whether there are non-logical sequences. This phase was given to Chris to verify his initial plan for authoring. Then he revised the first planning map and re-authored the authoring tool.

(6) Concept Mapping: At the end of all tasks, Chris also was asked to make his concept map about the content without consideration of implementing the content to the authoring tool.

Authoring Tool

An authoring tool was developed for this study by using Toolbook version 5.0. The authoring tool had a function of rearranging the given materials. Composing, editing, and managing multimedia objects were not implemented to this authoring tool. The authoring tool contained slides, and each slide contained one concept of the subject matter. The user was able to rearrange the order of slides by selecting slides.

Data Collection

This study employed three ways of collecting data; an observation with think-aloud, stimulated recall interview, and open-ended interviews. These methods were to gain unbiased observation, to increase credence in the interpretation, and to demonstrate commonality of an assertion for data source triangulation (Stake, 1995). For the observation the researcher videotaped each reviser's utterances, and interrupted as little as possible, except to answer direct questions from the participant, to offer expressions of support, and to give Chris prompts to keep continuing thinking aloud. With videotaping, the researcher took notes for stimulated recall interview, which was conducted at the end of all assigned tasks. The stimulated recall interview was to investigate particular utterance or behavior observed in his authoring process during think-aloud protocol. The notes were used to stimulate Chris ' recall. Finally all examines were ended with the open-ended interview.

Findings

The participant's rating of the given slides with 5 points Likert scale showed that 17 (57%) slides were rated as very familiar, 12 (40%) were familiar, and 1 (3%) was just familiar. It indicated that Chris was so familiar with all given thirty slides.

How did the participant plan for the authoring tool?

Observation with think-aloud protocol and stimulated recall interview showed that Chris was trying to follow his knowledge structural of the given content in order to establish main structure. In this process he mainly used two strategies: 1) top-down approach and 2) chunking strategy.

Regarding top-down approach, he tried to identify which slide could be the highest concept. After setting several highest concepts, Chris narrowed down from them. During identifying the highest concepts, he compared slides in terms of hierarchical structure. The following excerpts represent protocols from think-aloud and stimulated recall interview.

> Let's see this slide is conceptually higher than number 5 (each slide had its unique identification number)...Oh! It is right. That slide (number 5) is definitely lower than this slide. Then which one can be equivalent with this slide? (Chris is shufflingslides to find another one.) I got it (picking up another slide). I need to make sure if these two slides are equally highest one.

Top-down approach is a conceptually driven processing guided by information already stored in memory. This process screens structural knowledge from higher level to generate expectations and hypotheses relating to the interpretation and evaluation (Eysenck, 1990). It supports that Chris was already familiar with the contents; hence, he did not need to figure out the concepts. Rather, as an author, he tried to establish key structure that can be easily conveyed to target audiences. To accomplish the cognitive task, he compared the given slides with considering how the slides were related to each other. In other words what he was seeking were procedural knowledge in terms of reflecting on each slide's relation. It can be supported from the result of Nicaise and Crane (1999) showing that all students reported having learned procedural skills.

Another strategy mostly used in planning stage was chunking strategy. Chris spent more time to determine whether which slide could be chunked in a particular highest concept. More cognitive efforts were made to chunk with the same conceptual structure. As a result, he created four key chunks, and each key chunk consisted of from 4 to 9 slides, and it was well-structured one. Regarding the total number of slides of the given package, each chunk contained from 13% to 30% of the total slides. The percentages of each chunk were relatively high in terms of total numbers of slide. This feature is consistent with the study supporting that hypermedia authoring increased number links within the same concept (Reed & Rosenbluth, 1995). During using chunking strategy, Chris applied two criteria: 1) degree of contiguity and 2) sequence within the same chunk. The following from think-aloud and stimulated recall interview proves what criteria he used.

> I think that number 10 (slide's number) is closer to that slide rather than this one. Is it correct? (Picking up another slide). This one should belong to that category and it won't be a problem. Still this slide is unclear. Um... Although this slide has different title (for that reason he is confused), I bet it is closer to this category. [From think-aloud protocol]

> Actually I got confused because that slide could belong to another category. However, I thought that I should decide one category. Sometimes deciding only category was not easy decision, but it was very important. If I made a wrong category (chunk), my students might have misunderstandings. Just I wanted to prevent that kind of situation. [From stimulated recall interview]

> Um… Which one should be a first one? This one or that slide? Let's see… This should be place in advance, then that slide should be second one (Two slides were already categorized into the same chunk). [From think-aloud protocol]

What features did the participant use the authoring tool?

Regarding the difficulties of using the authoring, there was no problem and any confusion for Chris to rearrange and link the given slides. He could finish authoring itself very quickly. In fact, using the authoring tool would be easier to use than the other authoring tools due to the restricted function of the authoring tool of this study.

Although the authoring tool was so easy to sue, the think-aloud protocol and open-ended interview disclosed potential problems. Chris was in troubles of presenting some slides that did not have a hierarchical structure. This problem might come from the navigation methods of the authoring tool based on linear ways of rearranging the given slides.

> It may not be a right way of putting this slide. However, this authoring tool just has linear-way of presenting information. How can I compromise this problem? [From think-aloud protocol]

> Sometimes it was hard to prioritize slides when they do not have concrete hierarchy. In addition, the authoring tool was based on linear navigation though it had a function to link related information to any master slide. I think that if you add some function of showing non-linear relationship between more than two slides it would be much better way to convey my concept mapping on the hypermedia product. [From open-ended interview]

The discrepancy between the picture of planning step and concept mapping supported that the observation and suggestions from think-aloud protocol and open-ended interview. In the planning step he draw a very linear fashioned picture in both of initial and revised plan. However, his concept mapping showed non-linear directions and dynamic relationships between any single concepts. It may come from difficulty of making appropriate technique representing learners' knowledge structure. Although representing learners' knowledge structure is very important, finding the technique is very challenging (Jonassen, Beissner, & Yacci, 1993).

It may reflect that functions of authoring tool can be a constraint of organizing knowledge. In this study, as mentioned early, the authoring tool was designed to produce linear based hypermedia by rearranging the given slides. For this reason Chris needed to fit the authoring environment. It suggests that various ways to represent different characteristics of knowledge should be considered in designing authoring tools.

How did the participant use the authoring tool?

Revision process was pretty simple because of the simplicity of the given authoring tool. Chris still employed the same criteria (degree of contiguity and sequence) used in the planning step. Most processes he performed were very similar to those of planning step. However, it may not reflect cognitive process associated with actual revision because this study did not provide any feedback to Chris. In other words, his revision was based on self-evaluation. In general revision requires interactions with audiences in authoring hypermedia method with specific feedback.

Implications

There are two implications from this study. Firstly, Chris evaluated the information in terms of hierarchical order. It reflects if an authoring tool has a function to evaluate value of information the user can easily organize information into knowledge structure. In addition, this function will be helpful to chunk the information in terms of the degree of importance within the same chunk.

Secondly, this study suggests that an authoring tool should indicate multiple relationships between information. Due to the linearity of the authoring tool, Chris was not able to connect certain information with another chunk if the knowledge did not belong to the chunk. It was a hard decision for Chris to make a decision to link information with a single indicator. For instance, some information may be connected into another information in multiple ways such as prior, currently related, or advance knowledge. These multiple layers of indicators showing types of knowledge can be represented with different colors within an authoring tool.

Reference

Beichner, R. J. (1994). Multimedia editing to promote science learning. *Journal of Educational Multimedia and Hypermedia, 3*(1), 55-70.

Driscoll, M. P. (1999). *Psychology of learning for instruction* (2nd ed.). Needham Height, Massachusetts: Allyn & Bacon.

Eysenck, M. W. (1990). *The blackwell dictionary of cognitive psychology*. Cowley Road: Oxford: Basil Blackwell.

Jonassen, D. H., Beissner, K., & Yacci, M. (1993). *Structural knowledge*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Koehler, M. J., & Lehrer, R. (1998). Designing a hypermedia tool for learning about children's mathematical cognition. *Journal of Educational Computing Research, 18*(2), 123-145.

Lehrer, R. (1993). Authors of knowledge: patterns of hypermedia design. In S. Lajoie & S. Derry (Eds.), *Computers as cognitive tools* (pp. 197-227). Hillsdale, NJ: Lawrence Erlbaum Associates.

Lehrer, R., Erickson, J., & Connell, T. (1994). Learning by designing hypermedia documents. *Computers in the Schools, 10*(1/2), 227-254.

Liu, M. (1998). The effect of hypermedia authoring on elementary school students' creative thinking. *Journal of Educational Computing Research, 19*(1), 27-51.

Nicaise, M., & Crane, M. (1999). Knowledge constructing through hyperMedia authoring. *Educational Technology Research & Development, 47*(1), 29-50.

Oughton, J. M., & Reed, M. (1998). The effect of hypermedia development on high school students' knowledge acquisition, general problem-solving skills, and general design skills. *Journal of Educational Multimedia and Hypermedia, 7*(4), 333-363.

Reed, W. M., & Rosenbluth, G. S. (1995). The effects of hypercard authoring on knowledge acquisition and assimilation. *Computers in Human Behavior, 11*(3-4), 605-618.

Spoehr, K. T. (1993). *Profiles of hypermedia authors: how students learn by doing*. Paper presented at the American Educational Research Association, Atlanta, GA.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks: CA: Sage.

Children's Participation
in the Design of an Interactive Encyclopedia:
An Exploration of Cooperative Inquiry

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Abstract. Today's children are discerning consumers of learning media in an interactive world. They explore computer programs and on-line environments at home and at school for different purposes, use many different learning strategies and develop perceptions about the usefulness of various types of interactive media. In this study, we consulted with five children in Grade 5 to explore their experiences learning with interactive reference media, and to document their participation in the development of a rapid prototype for an interactive encyclopedia. We explored qualitative methods synthesized from the disciplines of educational psychology and information design to study how and what we can learn from children's educational experiences with interactive media.

Introduction

Children are active learners who interact with teachers, fellow learners and educational media, to actively construct their knowledge of the world. Their opinions, insights and interpretations of their experiences are invaluable to the development of effective learning tools.

Approaches to studying children's learning with interactive media and their participation in the design of interactive media bridge disciplines, encompassing ideas, theories and practices embraced by constructivism, constructionism, user-centred design, participatory design, cooperative design, design-centred learning, collaborative learning and cooperative inquiry. In bridging the disciplines of educational psychology and information design, we may coordinate, synthesize and strengthen our approaches to the design of effective educational media. Educational psychology brings knowledge of how children learn and how to apply this knowledge effectively in learning situations. Phenomenology offers a relevant, practical approach to explore the experiences of learners with interactive media. Data analysis consists of deriving general or universal meanings from individual descriptions, to gain the essence of the experience. Researchers must bracket their own biases (Creswell, 1998). Information design stresses a socially responsible, user-centred focus to the design of educational technology and media. In the emerging culture of participatory design, the user becomes a proactive participant in the design process (Sanders, 1999).

In this study, we explored appropriate methods to study children's participation in the design of interactive educational media and how can these experiences inform the design of interactive learning media. Cooperative inquiry (Druin, 1999) is a design approach to creating new technologies for children, with children, and involves discussion and hands-on working groups in the rapid iterative creation of prototypes. This approach has been adapted from the methodologies of cooperative design, participatory design and contextual inquiry. Participatory design processes have generally involved adults, but cooperative inquiry employs intergenerational teams. We consulted only with children as learners, users, experts, researchers and designers to find out what kind of interactive encyclopedias would be useful and usable for them. We focused on the *process* of the cooperative inquiry, rather than the *outcome* (a prototype of an interactive encyclopedia).

Method and Results

Five Grade 5 children, aged about 10 or 11 years, were chosen at random by their teacher, and participated in three sessions for a total of two hours over three days. During the first, 30-minute individual session, participants searched for lemmings and ptarmigans, using a think-aloud protocol, and responded to structured interview questions about the design and use of interactive encyclopedias. During the second, 30-minute group session, five participants responded to semi-structured interview questions about their experiences in the first session. They were also asked to comment on how CD-ROM encyclopedias should be designed to help the user find information. Finally, during a 60-minute session, the five participants worked collaboratively to design a rapid paper prototype of what they considered to be an effective CD-ROM encyclopedia in the form of sample 'pages'. Comments were noted, and the working process was documented with sketches and photography.

What are appropriate methods to study children's participation in the design of interactive educational media? Any methods that can directly and actively involve children as consultants are valuable. These methods may need to be adapted from bridging disciplines, and to determine their usefulness. *How can these experiences inform the design of interactive learning media?* These experiences can be analysed to find common themes that would support the development of guidelines for design. For example, participants were quite aware of how information can be presented effectively, and wanted to see all images next to related text. They were able to judge features that provide easy navigation to get at desired information. The students were quite concerned with appropriateness of features and their functions ("no weirdo stuff," must be "easy to understand if you don't speak English," must have "access for all ages" and we should "add voice button, in case people can't read"). They felt that the search function should be easier to use, and they surprised to note that they had trouble using the help function. The children found it "frustrating to work this quickly" during the design activity, and wanted to continue the task to use authoring tools to design an improved interactive encyclopedia. They incorporated into the design of the prototype what they considered to be essential functions: search function, back button, bookmark and a place to store notes and documents. This group was highly effective at working together to organize their materials and process in a short time period. They demonstrated flexibility and innovation in thought and action, possibly learned from experience in problem-solving and group work.

Conclusion

Children's insights regarding the effectiveness of such media, and their participation in its design, are essential to developing learning materials that are best suited to their needs and interests. Synthesizing research methods promises to be beneficial in designing studies that involve children in cooperative inquiry, as consultants, researchers and designers in developing interactive learning tools. Being involved in this type of research-based, design-centred learning was enjoyable and beneficial for the participants. We would like to continue to study the design process with children, and would like to move to the next step of authoring technology so the participants can see some of their ideas in action. Further research could involve the development and evaluation of an interactive encyclopedia incorporating the guidelines outlined by the child designers, in comparison to a commercial product.

References

Creswell, J.W. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Newbury Park: Sage Publications.

Druin, A. (1999). *Cooperative inquiry: Developing new technologies for children with children.* Retrieved February 9, 2001 from <ftp://ftp.cs.umd.edu/pub/hcil/Reports-Abstracts-Bibliography/99-14html/99->

Sanders, E.B.-N. (1999). From user-centred to participatory design approaches. In *Design and the Social Sciences: Making Connections* [Conference proceedings on disk.]. University of Alberta.

Children's Visual Representation of Information Presented in Print and CD-ROM Encyclopedias: Implications for Research-based Design

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Abstract. In many jurisdictions, the use of computer-based learning tools is endorsed at a curricular level. Looking at how children search, select, organise and visually represent information can challenge our assumptions about learning and technology, to guide the design of effective learning tools. We report on the preliminary findings from a study involving 43 Grade 5 students designed to explore the effect of information presentation in print and CD-ROM encyclopedias on children's retrieval of information and design of research posters. We outline the effects of prior media experience, topic knowledge and attitude towards using interactive reference media to do research. Children may come to a research task with flexible strategies and mental models. Ease, convenience and speediness of use, and the availability and relevance of different types of information appear to be at least as important as the presentation of information.

Introduction

In our visually-oriented world, children learn with computer technology and interactive media, encountering different types of information presentation and using different strategies to respond to research tasks. Just providing children with technology does not necessarily increase learning. Well-designed, user-centred interfaces facilitate children's information-seeking (Zammit, 2000; Bilal, 2000). The presentation of information may influence children's use of these learning tools. Even the way a computer program is constructed influences the search strategies chosen by the user (Zammit, 2000). Due to "shortcomings in design and research the potential of hypertext/hypermedia for enhancing learning may have been underestimated" (Tergan, 1997, p. 209). Crook suggested that studies that evaluate academic performance may fail to investigate how media is used for research, synthesis and investigation. In our learner-centred study, we integrated methods in developmental science, instructional technology and information design to study how information presentation in print and CD-ROM encyclopedias affects children's retrieval and visual representation of information.

Study Method and Results

Forty-three Grade 5 children, aged about 10 or 11 years, participated in this study using the Junior print version of the *Canadian Encyclopedia*, and a Macintosh PowerBook laptop computer displaying the starting interface for Student CD-ROM version. In individual sessions of 30 minutes, using a think-aloud protocol, randomly-assigned participants searched for information about lemmings and ptarmigans using both encyclopedias, and sketched a small poster to show the life cycle of each animal. Participants then responded to semi-structured questions about their experience using encyclopedias, topic knowledge and attitudes towards searching for and presenting information.

Results and Discussion

All participants reported some prior experience with encyclopedias (print, 88%; CD-ROM, 77%; on-line, 21% and with the Internet (95%). Over half (56%) of the participants preferred the CD-ROM version (print, 28%; no preference, 16%). The print encyclopedia was "more hands-on" and "gives more information." The CD-ROM version was "easier to read" and "easier to find [the topic]" since "you can type in what you want and it takes you there with no page-flipping."

On average, participants spent almost twice the amount of time to search the CD-ROM encyclopedia (7.0 min) as the print version (3.3 min). Some participants suggested that the CD-ROM encyclopedia was not well designed, as it wasn't clear where to type in a search term. Even children with previous media experience were temporarily confused. Difficulty with navigation, increased options or motivation to explore may explain the difference in time.

On average, participants spent about the same amount of time to create posters after the print version (9.1 min) as after the CD-ROM (8.7 min). This may support children's having prior mental models of how to present information in research reports. Comparing features found in posters and in encyclopedias yielded only two features of significance: the use of comfortable margins and the inclusion of paragraphs or paragraph-like chunks of textual information. Comfortable margins are found only in the print encyclopedia, and paragraphs were found in both encyclopedias, so it difficult to find a direct effect of information presentation. Throughout the study, participants focused on the need to have easily accessed, relevant, readable information, with images close to related text.

Almost half (42%) of the participants included "life cycle" through a variety of layouts using diagrams or words in their at least one of their posters, although there were no life-cycle diagrams or textual descriptions for either topic in either encyclopedia. This suggests that they may have had a prior mental model about how life cycles could be visually represented. Indeed, students commented that they had learned about animal life cycles in science classes in earlier grades.

Conclusion

Children may have flexible learning strategies and may fit new information to pre-existing mental models. Ease, convenience and speediness of use, and the availability and relevance of different types of information appear to be at least as important as the specific arrangement of the information. These findings have implications for research-based design. We must challenge some of our assumptions about the design of learning tools. Studying the learner provides a powerful opportunity to focus not only on information presentation and other aspects of design, but on learners' motivations, preferences and learning strategies, which are critical factors affecting the optimal design and use of learning tools.

References

Bilal, D. (2000). Children's use of the Yahooligans! Web search engine: I. Cognitive, physical, and affective behaviors on fact-based search tasks. *Journal of the American Society for Information Science, 51,* 646-665.

Crook, C. K. (1999). The uses and significance of electronic media during development. In D. Messer and S. Millar, (Eds.), *Exploring developmental psychology: From infancy to adolescence.* London: Arnold.

Tergan, S.O. (1997). Conceptual and methodological shortcomings in hypertext/hypermedia design and research. *Journal of Educational Computing Research, 16,* 209-235.

Zammit, K. (2000). Looking, looking, looking: Students' search strategies using an encyclopedia CD-ROM program. In *ED-MEDIA 2000: World Conference on Education Multimedia, Hypermedia and Telecommunications Proceedings.* [CD-ROM]. Association of the Advancement of Computers in Education.

Pilot Study: Student Expectations of a Web-Based Collaborative Learning Environment

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Abstract Learners taking an online course often develop implicit expectations as to what they can expect from traditional classrooms. The purpose of this study was to determine student expectations of an online collaborative learning environment, as well as to examine how students adjust their expectations when the course ends. The results from an online survey indicated that student expectations before taking the course and after the course are different. Overall, the students raised their expectations at the end of the course, except for their expectations of the instructor and the level of effort and convenience. In addition, students significantly gained more understanding of an online learning environment after the course was completed.

Introduction

Learners construct their own meaning based on the beliefs, understanding, prior knowledge, and cultural practices they bring to class (Bransford, Brown, & Cocking, 2000). With prior knowledge formulated in traditional classroom settings, learners taking an online course often develop implicit expectations and faulty expectations as to what they can expect based on their prior experience in traditional face-to-face classroom instruction (Bigelow, 1999). It is believed that a deeper understanding of students initial expectations of online learning may be helpful in addressing the erroneous expectations leading to a higher success rate with novice online learners. As a result, the goals of this study are to determine student expectations of an online collaborative learning environment, as well as to examine how students adjust their expectations based on a one-semester experience.

The Study

The participants of this study consisted of seven voluntary graduate students, six females and one male, enrolled in a graduate Web-based course on Computer Supported Collaborative Learning (CSCL2001). The CSCL course was offered to both on-campus students and the University of Texas System TeleCampus students. The course was previously offered in a face-to-face format for four years. The course emphasized collaborative learning with students working together in virtual learning teams in completing learning tasks and projects. After the course had been completed, the online survey was administered. The Student Expectations Questionnaire consists of 45 questions. Of the 45 questions, 43 used a Likert-type response scale (strongly disagree to strongly agree). The other two questions also have five options. The questionnaire contains two response columns: Initial Expectations and Present Expectations. Each column provides the same five- point Likert scale (strongly agree to strongly disagree). The data was processed using the SPSS. To obtain an insight of student expectations, the entries from students' introduction and reflections posted on Teachnet, a primary communication tool based on FirstClass Groupware used in this course, were also exa mined.

The Findings

According to students' entries posted on Teachnet, students came to the course with an expectation that the course would provide them with in-depth knowledge of the course subject matter (CSCL) with hands on experience in the online learning environment. At the end of the course, several students showed their satisfaction with the course organization. In their final reflection papers, most students expressed their feelings and positive impressions towards working collaboratively with their online team members. This could imply that their expectations from the course activities/ course content, course design, and the online community had been met, or have even been exceeded. Besides reflecting on their expectations and perceptions toward the course and the online community, some students indicated the need for immediate feedback, especially when they had problems with a task.

The results revealed that students' initial expectations and their expectations when the course finished were different. At the end of the course student expectations were higher in most aspects, except for their expectations of the instructor and the level of effort and convenience. The three expectation aspects that significantly increased at the end of the course were expectations of the online community, learning outcomes, and understanding. In contrast, students lowered their expectations for the instructor at the end of the course. It is possible that, before taking the course, some students might never have had experience with Web-based collaborative learning. Thus, they came to class with high expectations based on prior knowledge from traditional classrooms and expected that the instructor would be continuously available and give them immediate feedback all the time. In fact, the communication patterns in this course had been shifted from vertical to horizontal communication. That is, students are supposed to communicate with and learn from other team members as well as the instructor, rather than focusing only on the instructor. In other words, the instructor takes a supportive but less directive role (Wegner et al., 1999). As a result, online students might feel a sense of increased distance on the part of the instructor.

Conclusions

The findings of this study reflect the views of one group of students taking a one semester Web-based course. Based on the very limited sample, it is not possible to generalize the results of the study to the broad array of online courses. However, the survey results and the entries from student reflections posted on the course bulletin board system do give some insights into what expectations students brought to the online course, emphasizing collaborative learning, and the differences between the expectations of students before and after the course. The results suggest that, the students had higher expectations about online learning when the course was completed. With experience in online learning, students also gained a greater understanding of the online collaborative learning environment.

References

Bigelow, J. D. (1999). *Quality Assurance for Online Courses.* Available:http://mg.boisestate.edu/jbigelow/jbigelow/qaonline.htm[2001, September].

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How People Learn: Brain, Mind, Experience, and School*. Washington, D.C.: National Academy Press.

Wegner, S. B., Holloway, K. C., & Garton, E. M. (1999). *The Effects of Internet-Based Instruction on Student Learning*. Available: http://www.aln.org/alnweb/journal/Vol3_issue2/Wegner.htm [2001, April].

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Exploring the strengths and limitations of learning styles towards the design of an adaptive web-based instructional system

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Abstract: This presentation reports on our current and on-going R&D efforts towards the design and development of an instructional system that supports individual learning preferences through an adaptive web-based learning environment. The aim of the system is to facilitate individualized instruction by providing both content-level as well as link-level adaptations through the exploitation of the user's particular learning style. In order to accomplish this, different learning style models are explored and compared. These learning style models have been formulated and used in classifying students according to their preferences. The implementation of the adaptive instructional system is based on the use of learning object technology on the one hand and an inference engine (JESS) on the other. The former provides the framework for the structuring of the domain model while the latter renders the rules upon which the adaptation is defined.

Introduction

In the present study we seek and analyze state of the art learning prescriptions for designing an adaptive web-based environment, which is a) pedagogically sound through the exploitation of the student's particular learning style and b) economically feasible based on emerging technologies and notions of the semantic web.

Research has shown that learning is more likely to occur if instruction is matched to the student's learning style. Examining the instructional system in this perspective, the notion of adaptiveness presupposes that the system will be able to initially determine and subsequently accommodate the specific learning characteristics of each learner.
The keywords here are "determination" and "accommodation".

- Which are the elements that define these learning styles and how can they be determined? Researchers have proposed different approaches without, however, having provided statistically significant evidence to date as to how effective these models are.
- How should the word "accommodation" be defined? Do students learn better when instruction is adapted to their learning style preferences or can and should they, at certain times, be trained to adopt a particular learning style? Do learning styles remain stable over time or are they dynamic? Are there particular learning style dimensions that remain stable and others that are modified over time? Which are these and how should the system deal with them?

This study reviews and compares prevalent learning style models. These models have been taken into consideration in designing the system prototype of the web-based instructional system.

Thus, this paper discusses our efforts towards the design and development of an adaptive instructional system that supports individual learning preferences through a web-based learning environment. The primary characteristics of the system are the following:

1. It adapts instruction to user learning needs according the particular learning style.
2. It provides adaptation of instruction both in terms of the content presented (content-level adaptation) as well as in terms of the navigation of the instructional material (link-level adaptation).
3. The key architectural components of the system are its domain model, its learner model and its inference engine.
4. These components are implemented through the use of learning object technology and JESS rules.

The role of learning styles

Learners are characterized by different learning styles. Learning styles are distinctive strengths and preferences for dealing with intellectual tasks in a specific way. This means that learners receive and process information in different ways, preferentially focus on different types of information, tend to operate on perceived information in different ways, and achieve understanding at different rates (Pask, 1988; Schmeck, 1988). In fact, according to the particular learning style mode, some learners may prefer to think about the nature of a task and determine a detailed plan before moving on to a specific course of action, while others may prefer to act on the first idea they have and see where it leads them. Some students prefer focusing on data, facts, and algorithms, while others rely more on theories and mathematical models. Some perceive information more effectively when it is in visual form (pictures, diagrams, graphs, demonstrations), while others respond better to verbal information (sounds and spoken words or formulas).

Educational researchers have been concerned with the implications of learning styles for instruction for many decades (Tobias, 1990; Kolb, 1984; Bruner, 1966; Gagné, 1967). Research to date has been attempting to identify robust relationships between learning styles and instructional methods (Tobias, 1990; Yin, 2001; Frick, 1990). The lack of statistically significant evidence to support the robustness of these relationships may mean that traditional learning style models need to be revised and modified taking into consideration new learning approaches and theories. Once this is achieved, learning style models could be used to provide a framework for designing learning environments (whether this means designing a course curriculum, creating class activities or assessment methods, writing a textbook, developing instructional software, or designing more adaptive instructional systems) that will be compatible with particular learning preferences, strengths, weaknesses, and behaviors of students.

Learning style models

Different learning style models have been formulated and have been used in classifying students according to their preferences and in helping educators to provide students with instruction that addresses their learning styles. The authors have been exploring the strengths and limitations of these models in order to exploit those particular learning style dimensions that would be more effective in serving as the basis of the user model module for an adaptive instructional system.

One of the first learning style models proposed during the early 1960s by **Jerome Kagan** was based on the dimension of reflectivity/impulsivity. Kagan suggested that some students seem to be characteristically reflective while others are characteristically impulsive. Reflective students prefer to collect and analyze information before acting whereas impulsive students prefer to act briskly.

Herbert Witkin proposed the dimension of field-dependence/independence for classifying students, referring to the extent to which an individual's perception and thinking about a specific piece of information is influenced by the surrounding context. Field-dependent students prefer to work within existing structure whereas field-independent students prefer their own structure and they are more capable of isolating target information, despite the fact that it is embedded within a larger and more complex context. The importance of this difference in approach becomes clear when the student is dealing with ill-structured tasks. Field-independent students usually perform better in these situations because of their willingness to create a more meaningful structure.

According to another such model, formulated by **Robert Sternberg** (2000), there are five dimensions (functions, forms, levels, scope, and leaning) which compose the learning style of each learner. There are legislative, executive, and judicial functions; monarchic, hierarchic, oligarchic, and anarchic forms; global and local levels; internal and external scopes and liberal and conservative leanings. Most people have a preference for one style within each dimension. For example, legislative style learners prefer to create and plan, executive style learners like to follow explicit rules, while judicial style learners are keen on evaluating and judging.

A learning style model that has been widely used is **Kolb's learning style model** (1984). Kolb proposes the classification of students in terms of how they choose to take in information (in which case they may prefer either: a) concrete experience or b) abstract conceptualization) and in terms of how they prefer to internalize that information (in which case they may have a preference for: a) active experimentation or b) reflective observation). This establishes four types of learners. Type A learners are concrete and reflective and respond well to explanations of how course material relates to their experience, their interests, and their future careers. To be effective with Type A students, the instructor or the instructional system should function as a motivator. Type B learners are abstract and reflective. These learners respond well to information presented in a logical, organized fashion and benefit if they have time for reflection. To be effective with this group of learners the instructor or instructional system should take on the role of an expert. Type C learners who are abstract and active, like to be given opportunities to work actively on well-defined tasks and to learn by trial-and-error in an environment that allows safety in failing. To be effective, the instructor or instructional system needs to function as a coach, providing guided practice and feedback. Finally, type D learners are concrete, active learners and like applying course material in new situations to solve real problems. To be effective, these students need to be given opportunities to find things out for themselves, maximizing their time and freedom for exploration.

The **Myers-Briggs model** (Lawrence, 1994; McCaulley, 1990) based on psychologist Carl Jung's theory of psychological types classifies students according to their preferences into: a) extraverts (who try things out while focussing on the outer world of people) or introverts (who think things through while focussing on the inner world of ideas); b) sensors (who are practical, detail-oriented, and focus on facts and procedures) or intuitors (who are imaginative, concept-oriented, and focus on meanings and possibilities); c) thinkers (who are skeptical, tending to make decisions based on logic and rules) or feelers (who are appreciative, tending to make decisions based on personal and humanistic considerations); d) judgers (who set and follow agendas and seek closure even with incomplete data) or perceivers (who adapt to changing circumstances and resist closure to obtain more data). The Myers-Briggs type preferences can be combined to form 16 different learning style types. For example, one student may be an EITJ (extravert, intuitor, thinker, judger) and another may be an ISFP (introvert, sensor, feeler, perceiver).

Another learning style model, accredited to Felder and Silverman (1988), the **Felder-Silverman learning style model** classifies students according to the following dimensions: a) the type of information that the student preferentially perceives: *sensory*---sights, sounds, physical sensations, concrete, facts and procedures or *intuitive*--- memories, ideas, insights, conceptual, theories and meanings; b) the modality through which the sensory information is most effectively perceived: *visual*---pictures, diagrams, graphs, demonstrations, or *verbal*---sounds, written and spoken explanations and formulas; c) the type of information organization that the student is most comfortable with: *inductive*---presentations that go from the specific to the general, facts and observations are given, underlying principles are inferred, or *deductive*---presentations that proceed from the general to the specific, principles are given, consequences and applications are deduced; d) the way in which the student prefers to process information: *actively*--- by trying things out, by becoming engaged in physical activity or discussion, or *reflectively*--- by thinking things through, by working alone; e) the type of progress toward understanding that the student is more capable of achieving: *sequentially*--- linear, orderly, by learning in small incremental steps or *globally*--- in large leaps, holistically. The dichotomous learning style dimensions of this model (sensing/intuitive, visual/verbal, inductive/deductive, active/reflective, and sequential/global) should not be considered as either/or categories but should be regarded as continua. A student's preference on a given scale (e.g. for visual or verbal presentation) may be strong, moderate, or almost nonexistent, may vary over time, and may change from one subject or learning environment to another.

The **Herrmann Brain Dominance model** (1990) classifies students in terms of their relative preferences for thinking in four different modes based on the task-specialized functioning of the physical brain. The four modes or quadrants in this classification scheme are: a) Quadrant A (left brain, cerebral): logical, analytical, quantitative, factual, critical; b) Quadrant B (left brain, limbic): sequential, organized, planned, detailed, structured; c) Quadrant C: (right brain, limbic): emotional, interpersonal, sensory, kinesthetic, symbolic; d) Quadrant D (right brain, cerebral): visual, holistic, innovative. The needs of students with strong preferences for C and D quadrant thinking are often not met by traditional forms of classroom instruction or by instructional systems that are not oriented toward taking these particular preferences into account.

Discussion

The above learning style instruments use lists of verbal statements or different visual forms prepared for people to choose or rank. Our initial research questions related to the determination and accommodation of the learner's specific style coincides with some of the issues raised by Sewall (1986). Sewall compared several of the above popular instruments and found that their scores have limited validity, are difficult to interpret, and that their reliability estimates are unstable. He also raised many questions such as the issue of whether learning styles are constantly modified by the educational environment and social context or are too dynamic to be measured on a predetermined and predictable scale, the issue of whether it is possible for learners to be trained to adopt a particular learning style, and the issue of whether a significant change in life situations result in changes in learning styles.

Researchers dealing with learning styles will need to explore these issues in order to assert that these learning models are effective tools and not merely artificial instruments, in which case other tools that will be able to appropriately survey the dynamic nature of learning styles will have to be proposed. Yin (2001), suggests that these predefined assessment tools require people to fit in the limited and selective choices with "I think this is who I am" or "I think this is what I will do or how I will react," which may not predict how one actually reacts to, or interacts with, a problem in a specific learning situation. He proposes that we observe and faithfully record the event changes of a learner-demonstrated process over time.

Learning Style Model	**Dimensions**	**Number of L.S**
Jerome Kagan	Process_info (reflectivity, impulsivity)	2
Herbert Witkin	Field (dependence, independence)	2
Robert Sternberg	Functions (legislative, executive, judicial), Forms (monarchic, hierarchic, oligarchic, anarchic), Levels (global, local), Scope (internal, external), Leaning (liberal, conservative)	96
Kolb's	Input_info (concrete experience, abstract conceptualization), Internalize_info (active experimentation, reflective observation)	4
Myers-Briggs	Dimension1 (extraverts, introverts), Dimension2 (sensors, intuitors), Dimension3 (thinkers, feelers), Dimension4 (judgers, perceivers)	16
Felder-Silverman	Perceive_Info (sensory, intuitive) Modality (visual, verbal) Organize_Info (inductive, deductive) Process_Info (actively, reflectively) Understand_Info (sequentially, globally)	32
Herrmann	Brain_mode (QuadrantA, QuadrantB, QuadrantC, QuadrantD)	4

Table 1: Learning Style Models and Dimensions

Learning Orientations

We would consider the previous discussion on learning styles incomplete without touching upon the idea of learning orientations, a different classification scheme for students introduced by **Margaret Martinez** (2001). Without disregarding the importance of learning styles, Martinez considers them to be of secondary importance since they focus only on cognitive factors of learning (i.e. on how learners receive, process, build and store knowledge) and overlook emotions and intentions as being equally important factors in the learning process. For Martinez the basis for providing individualized instruction lies in what she states as "a whole-person understanding about key psychological sources that influence how individuals want and intend to learn online."

The primary difference between learning styles and learning orientations is that whereas learning styles recognize the dominant power of cognitive factors (and degrade other factors to a secondary or no role), learning orientations recognize the dominant influence of emotions and intentions. As Martinez states, this perspective reflects recent neurological research that provides evidence for the dominant influence of the brain's emotional center on learning and memory (Ledoux, 1996).

According to the Learning Orientations model, learners can be classified into four types:

Type A: Transforming learners, who are generally highly motivated, passionate, and highly committed learners. These learners respond better to discovery-oriented, ensequenced, and mentoring environments. Type B: Performing Learners, who are generally self-motivated in learning situations (task-oriented, project-oriented, hands-on applications) that interest them. These learners respond well in task- or project-oriented, competitive, and interactive (hands-on) environments. Type C: Conforming

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Learners, who are generally more compliant and will passively accept knowledge, store it, and reproduce it to conform, complete routine or assigned tasks (if they can), and please others. They need scaffolded, structured solutions, guiding direction, simple problems, linear sequencing, and explicit feedback. Type D: Resistant Learners, who lack a fundamental belief that academic learning and achievement can help them achieve personal goals or initiate positive change.

Prototype and implementation issues

The above analysis has been used as the basis for designing the adaptive elements of the system functioning within a Semantic Web environment. The Semantic Web is an ideal environment for personalized learning especially when combined with the use of learning objects. Learning objects were used for the design of the present adaptive web-based instructional system.

A learning object is defined as an entity that can be used, reused, or referred to as a learning resource by a computer-based environment. Learning objects (LTSC, 2000a) are considered to be the predominant choice in terms of the pedagogical design, implementation and distribution of educational content due to their ability to provide reusability, productivity, adaptivity, and scalability.

The personalization of the system takes many forms as it adapts content, tasks, feedback, or navigation to match individual progress and performance. For example, two individuals using the same course simultaneously may see two completely different sets of learning objects. The greatest benefit of learning personalization is the ability of the system to make complex instruction easier by presenting only suitable information that a particular learner wants or needs according to specific preferences expressed by the learning style.

The adaptive instructional system consists of the following modules:

(a) The knowledge of the system is stored in a database (DB) and is:
  (a1) Knowledge regarding the learner. This knowledge comprises the *user model* and includes knowledge corresponding to the learner's knowledge level as well as knowledge related to the characteristics of the learner's learning style.
  (a2) Knowledge related to the domain that the learner is learning about (i.e. the *domain model*).

(b) The *monitoring* and *evaluation* modules. During the course of a lesson the monitoring and evaluation modules examine the learner responses and behavior and renew the DB data (user model) in terms of the learner knowledge level and learning style. It then gives the output variables "learning style" and "knowledge level" to the *lesson creation module*.

(c) The *instructional strategies module*. This contains a set of rules corresponding to the instructional method that will be applied. The rules have been derived from the fields of didactics and cognitive psychology.

(d) The *lesson creation module*. This module receives the input variables "learning style" and "knowledge level", and composes the lesson that will be presented to the student by selecting the appropriate educational content from the DB and a suitable strategy from the *instructional strategies module*. The *lesson creation module* determines the form and arranges the sequencing of the educational content.

The intelligence of the instructional system is derived from its capability to:

(a) Diagnose the knowledge level and learning style of the student, based on the data in the user model and according to the learner's responses and

(b) Adapt the lesson appropriately to the student's needs by drawing suitable educational content from the domain model, by using the proper instructional strategy, and by determining the form and sequencing of the educational content.

The underlying technology is based mainly on freely available software components: an Apache webserver, an Access (Microsoft Corp.) database management system, an Apache Java Servlet engine (Tomcat version 3.2.1) and the Jess scripting environment, which is a rule engine written entirely in Sun's Java language.

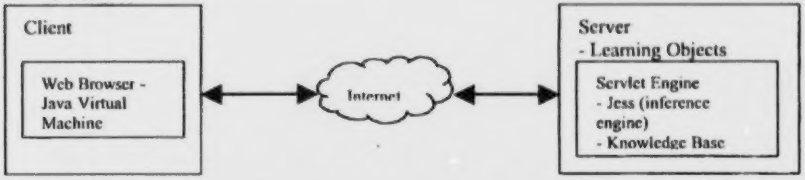

Figure 1: The modules of the system and the way they communicate

Future research

Our priorities for future studies are to attempt to reconsider and redefine the concept of learning styles. In order to extend the presently implemented system, which is based on existing theories and models, we should consider future research (both on a theoretical as well as an experimental level) regarding:

1. The suitability of the questionnaires corresponding to the determination of the learning styles. Are these questionnaires appropriate and to what degree can they be interpreted reliably by the system?
2. The particular implementation of the system (currently based on the use of servlets) and extending the way that it presently allows for the progress of the students to be recorded correctly. How could the recording of these events lead to the definition of learning styles?
3. The stability of learning styles over time. What is the stability of each learning style dimension over time?
4. The issue of adapting the educational environment according to the learning style of the student. Is this always necessary or would it be beneficial if, at certain times, the system trained the learner to adopt a different learning style imposed by the nature of the educational content or the particular learning goals? How would it be possible to achieve this?

Obviously, many research studies to date have attempted to deal with issues related to learning styles. However, on the one hand these studies have not yielded statistically significant results and on the other the web has emerged as a new environment with unique characteristics, which need to be explored, since it is expected to play a particularly important role in education.

References

Bruner, J.S. (1966). *Toward a theory of instruction.* Cambridge, MA: Harvard University Press.

Cronbach, L.J., & R.E., Snow (1977). *Aptitudes and instructional methods: A handbood for research on interaction.* New York: Levington Publishers/John Wiley.

Felder, R.M. (1993). "Reaching the Second Tier: Learning and Teaching Styles in College Science Education," *J. Coll. Sci. Teaching, 23*(5), 286—290.

Felder, R.M. and L.K., Silverman (1988). "Learning Styles and Teaching Styles in Engineering Education." *Engr. Education, 78* (7), 674-681.

Frick, T.W. (1990)."Artificial tutoring systems: What computers can and can't know", *Journal of Educational Computing Research, 27(1),* 180-204.

Gagné, R.M. (1967). *Learning and individual differences.* Columbus, OH: Charles E. Merrill Books.

Herrmann, N. (1990). *The Creative Brain.* Lake Lure, NC, Brain Books.

Kagan, D.M. (1996). "Developmental studies of reflection and analysis". Cambridge, MA: Harvard University Press.

Kolb, D.A. (1984). *Experiential Learning: Experience as the Source of Learning and Development.* Englewood Cliffs, NJ, Prentice-Hal.,

Lawrence, G. (1994). *People Types and Tiger Stripes*, 3rd Edition. Gainesville, FL, Center for Applications of Psychological Type.

Ledoux, J. (1996). "Emotional brain: The mysterious inderpinning of emotional life." New York, Simon & Schester,

Martinez, M. (2001) Building interactive Web learning environments to match and support individual learning differences. *Journal of Interactive Learning Research, 11(2).*

McCaulley, M.H. (1990). "The MBTI and Individual Pathways in Engineering Design." *Engr. Education, 80,* 537-542.

Pask, G. (1988). "Learning Strategies, Teaching Strategies, and Conceptual or Learning Style." In Schmeck, R., E., *Learning Styles,* Plenum Press, New York, Ch. 4.

Schmeck, R, Ed. (1988). *Learning Strategies and Learning Styles.* Plenum Press, New York.

Sewall, T.J. (1986). *The measurement of learning style: A critique of four assessment tools.* Evaluative/Feasibility Report, University of Wisconsin, Green Bay, Assessment Center.

Sternberg, R.J. (2000). "Allowing for thinking styles." In J. Snowman & Biehler, R. *Psychology Applied to Teaching,* Houghton Mifflin, Ch. 4.

Tobias, S. (1990). *They're not Dumb, They're Different: Stalking the Second Tier.* Research Corporation, Tucson.

Witkin, H.A., Moore, C.A., Goodenough, D. R. & P. W., Cox, "Field-dependent and field-independent cognitive styles and their educational implications". *Review of Educational Research, 47(1), 1-64*

Yin, L.R. (2001)."Dynamic Learning Patterns: Temporal Characteristics Demonstrated by the Learner", *Journal of Educational Multimedia and Hypermedia, 10(3),* 273-284.

Utilizing SMARTBoards to Enhance Technology Integration in University Classrooms

Abstract

This paper presents the preliminary results of a university-wide effort to enhance technology integration in the classroom. The College of Education at Idaho State University has received a grant to disseminate SMARTBoards, computers and projectors to all seven colleges within the university, to train faculty in the use of the equipment, to provide support and ideas for implementing the new technology, and to collect information on faculty and student attitudes towards, and use of, the technology. It is projected that the use of a non-threatening but extremely flexible digital technology, like the SMARTBoard, will encourage faculty to develop their own original digital classroom materials, to incorporate computer technology on a regular basis, and to encourage pedagogical changes in higher education classrooms.

Introduction

The College of Education, Idaho State University, received a State Board of Education Technology Incentive Grant to place SMARTBoards in classrooms in each of the seven colleges. The purpose of the project is to facilitate the integration of technology into higher education curricula, to enhance faculty productivity, to amplify the rate and quality of student learning, and to increase classroom access to educational programs. With a user-friendly delivery medium such as the SMARTBoard, it is hoped that university faculty will become more motivated to create their own applications, including web courses, original digital graphics and movies, electronic presentations and CD-ROMs. The project was begun in the fall of 2001 and, although not yet complete, has garnered preliminary indications of faculty skills and predisposition toward computer technology.

The SMARTBoard is an interactive surface, which acts as both a large computer touch screen and whiteboard. When the computer desktop is projected onto the SMARTBoard, the Board itself becomes the desktop and the user is able to open programs, type, select, and move objects by touching the board. The project is based on the premise that interactive digital boards are a convenient and comfortable way to reach instructors who may have resisted integrating technology in the past. Since the SMARTBoard requires minimal training and appears non-threatening, it is not as intimidating as other forms of technology. It is one of the few innovations that do not place a barrier of equipment between the instructor and the student. The Smart Board enhances the instructor's role in the classroom.

Bates (2000) argued that since faculty is critical to the instructional praxis of the university, any change in the core activity of teaching has to have faculty approval in order to succeed. Therefore, the integration of technology in the university classroom cannot be imposed on faculty if it is to succeed. However, adapting computer technology into the classroom may suggest a reversal of teacher-centered instruction, and this change process is critical to the successful adoption of technology by faculty. Bates identified several factors, which inhibited faculty's adoption of computer technology in the classroom, including anger, resistance, grieving for the old, cautious adoption, total disbelief, and fear. Dusick (1998) also identified factors that influence faculty members' decision not to use computers for teaching, including environmental factors outside the faculty's control and anxiety. Other environmental factors encourage the use of technology for teaching: a supportive administration, availability of the requisite hardware and software, a supportive technical staff, and positive personal and social elements. Both Dusick and Bates argue that training in technology integration is one way to overcome faculty fear.

This project sought to address some of these factors in order to facilitate faculty technology integration. SMARTBoards were chosen in order to introduce faculty to technology that was not only user friendly, but which also lends itself well to most classroom uses without drastically altering the instructor's role. Faculty training on the SMARTBoard was carried out in a non-threatening way and with plenty of opportunities for practical hands-on experiences. The training sought to convince faculty that using the SMARTBoard could enhance both teaching and student learning. The principle investigators argued that, if faculty members believed that computer technologies did indeed make a difference to classroom teaching, then they were more likely to integrate them on a more permanent basis (Woodrow 1991). If, on the other hand, faculty saw technology in teaching as a fad, they were more likely to adopt it just to conform and not take it seriously.

The project also seeks to determine if faculty members' attitudes and perceptions toward computer technology in teaching will change as a result of using SMARTBoards. . Straub and Karahana (1999) argue that knowing the distinction between pre- and post-adoption beliefs and attitudes is important to understanding and managing the process of technology integration. To fulfill this goal, faculty and students are completing four separate evaluations. The first two instruments are an evaluation of the faculty training workshops and an attitudinal and skills survey (reported here).

Preliminary Results

As of this writing, 75 members of the ISU professional community have participated in the SMARTBoard training, preparatory to using the technology in the classroom. Of these, 61 identify themselves by faculty rank (19 Full, 11 Associate, 18 Assistant Professors, and 13 Instructors); the other 14 are staff positions, graduate students, or teaching assistants. The initial attitudinal survey indicates that many of these trainees already exhibit a moderate to strong disposition toward integrating technology in the classroom. Most respondents (more than 75%) indicated that they were comfortable using computers in instruction, that they believed technology could enhance learning, and that they wanted to learn more about integrating technology into their instructional methods. A slightly smaller majority disagreed that traditional lecture methods of teaching were preferable, or that computer technology had no place in their discipline. Almost all the participants indicated that they used both the Internet and email in teaching, but less than half were using WebCT (the on-line curriculum program used at ISU).

In terms of their skills, this faculty considered themselves as intermediate or advanced users of the Internet and word processing. A sizable minority considered their skill level as low on electronic presentations. Approximately half considered themselves as novices (or less) in terms of statistical software, spreadsheets, databases, and subject specific software. The majority rated their skill level as none or novice on the SMARTBoard technology, multimedia authoring software, and WebCT. Thus it appears that, if these faculty are indeed comfortable integrating technology into their teaching methods, the technology they use is primarily confined to word processing and the Internet, with PowerPoint skill levels still being developed. However, more "difficult" applications, or applications which have not been traditionally presented in direct-instruction environments, are not usually part of the faculty's technology repertoire.

In order to understand how faculty determines whether or not they can commit to learning a new technology, they were queried as to which factors they considered important. Although all of the factors were rated as important or very important by most participants, there was a pattern as to which of these factors were rated as very important by increasing numbers of participants. Figure 1 illustrates those factors, which were rated as very important. Surprisingly, faculty rated the simple, practical factor of *Availability* as Very Important, more than any other factor. *Time* to devote to the technology and *Ease of Use* were also rated as Very Important by a large number of respondents.

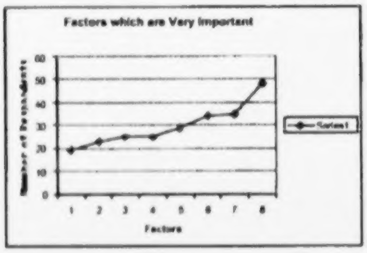

Figure 1. Number of faculty rating specific factors as Very Important to their integration of technology into classroom teaching. 1. Learning Curve; 2. Personal Comfort Level with Software; 3. Advantage of Technology over Traditional Teaching Methods; 4. Compatibility with Discipline; 5. Administrative Support; 6. Time; 7. Ease of Use; and 8. Availability.

Conclusion:

Although this project is on going, some interesting trends are already identified in the data collected. The most important appears to be that, although faculty are well disposed toward using computer technology in their communication with students and in teaching, they actually have limited skills and confine their use to email, the Internet, and word processing. Only a few produce electronic presentations for the classroom, and fewer still use the capabilities of the web to post presentations or other material for their students.

It is hoped that the SMARTBoard project will encourage faculty to expand their technological skills, producing original web sites, multimedia projects, digital video and audio, and other electronic media to incorporate into their instruction. Whether the project succeeds will be determined by faculty and student evaluation of courses, which are held in SMARTBoard-equipped classrooms by project-trained faculty. These final evaluations and surveys will be conducted at the end of spring semester 2002 and again in fall semester 2003.

References:

Bates, A.W. (2000). *Managing technological change: Strategies for college and university leaders.* San Francisco: Jossey-Bass.

Dusick, D. M. (1998). What social cognitive factors influence faculty members' use of computers for teaching? A literature review. *Journal of Computing in Education, 31,* 2; Retrieved July 19, 2001, from MasterFile Premier database.

Straub, D. W., & Karahana, E. (1999) Information technology adoption across time: A cross-sectional comparison of pre-adoption and post- adoption beliefs. *MIS Quarterly, 23,* 2; Retrieved November 4, 2001, from MasterFile Premier database.

Accommodating Learning Styles in Adaptation Logics for Personalised Learning Systems

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Abstract. This paper investigates the accommodation of learning styles research in personalised learning (PL) systems. The paper outlines some of the most well-known learning styles theories and models, as well as some criteria for selecting among them. It also outlines some PL systems which are utilising learning styles research, with emphasis on the system which is being developed in the context of the KOD "Knowledge on Demand" European Project.

Introduction

Personalised learning (PL) systems are attracting increasing interest, since they bare the potential to meet the requirements of the knowledge society and knowledge-based economy for high-quality education and training. PL systems can be defined by their capability to automatically and continuously *adapt* to the changing attributes of the "learning context", which can, in turn, be defined by the individual learner characteristics, the type of the educational material, etc.

In the context of this paper, PL systems are categorised and differentiated in terms of their *adaptation logic*, which is defined by:

- *PL constituents*: the aspects of the learning context which are subject to adaptations; that is, is the educational content being adapted? and if so, how do we categorise educational content so that we can select it?
- *PL determinants*: the aspects of the learning content which "drive" adaptations; that is, are adaptations based on the learner's profile? and if so, how is the learner profile defined?
- *PL rules*: the rules which define which PL constituents are selected for different PL determinants (Sampson, Karagiannidis, & Kinshuk, 2002).

PL systems can be quite diversified according to their adaptation logics, depending on the requirements of the specific learning context. For example, PL determinants can include learners' characteristics, which can, in turn, include learner's background, expertise, prior knowledge, skills, requirements, preferences, etc.

This paper addresses the incorporation of learning styles research in the adaptation logic of PL systems. That is, the definition of new PL determinants, constituents and rules which are based on, and reflect specific learning styles theories and models. The next section provides a short overview of the most well-known learning styles theories and models, as well as some criteria for selecting among them when developing a PL system. Finally, the paper outlines some existing PL systems which utilise learning styles research, with emphasis on the PL system which is being developed in the context of the KOD "Knowledge on Demand" European project (see acknowledgements section).

Learning Styles Research: A Brief Overview

There is no single way to describe learning styles, as a number of definitions appear in the literature. Learning styles can be generally described as "an individual's preferred approach to organising and presenting information" (Riding & Rayner, 1998); "the way in which learners perceive, process, store and recall attempts of learning" (James & Gardner, 1995); "distinctive behaviours which serve as indicators of how a person learns from, and adapts to his/her environment, and provide clues as to how a person's mind operates" (Gregorc, 1979); "a gestalt combining internal and external operations derived from the individual's neurobiology, personality and development, and reflected in learner behaviour" (Keefe & Ferrell, 1990).

Existing learning styles models can be presented through an onion metaphor (proposed in Curry, 1983), consisting of three basic layers which categorise learners in terms of instructional preferences (outermost layer), information processing (middle layer) and personality (innermost layer). Social interaction, a fourth layer placed between Curry's two outer layers, was proposed in (Claxton & Murrell, 1987).

The most well-known and used learning styles theories and models are presented in Table 1. For each model, the presentation includes

- the learners categorisations proposed by each model,
- the existence of an assessment instrument for categorising each learner in the above categories, and
- indicative references for each model.

Name	***Learners' Categorisation***	***Assessment Instrument***	***References***
Kolb Learning Style Inventory	Divergers (concrete, reflective), Assimilators (abstract, reflective), Convergers (abstract/active), Accommodators (concrete/active)	Learning Style Inventory (LSI), consisting of 12 items in which subjects are asked to rank 12 sentences describing how they best learn.	Kolb, 1984; Kolb, 1985
Dunn and Dunn – Learning Style Assessment Instrument	Environmental, Emotional, Sociological, Physical factors.	(i) Learning Style Inventory (LSI) designed for children grade 3-12; (ii) Productivity Environmental Preference Survey (PEPS) – adult version of the LSI containing 100 items	Dunn & Dunn, 1978; Dunn & Dunn, 1999
Felder-Silverman – Index of Learning Styles	Sensing-intuitive, Visual-verbal, Indicative-deductive, Active-reflective, Sequential-global	Soloman and Felder questionnaire, consisting of 44 questions	Felder, 1996; Felder & Silverman, 1988
Riding – Cognitive Style Analysis	Wholists-Analytics, Verbalisers-Imagers	CSA (Cognitive Styles Analysis) test, consisting of three sub tests based on the comparison of the response time to different items	Riding & Cheema, 1991; Riding, 1994
Honey and Mumford – Learning Styles Questionnaire	Theorist, Activist, Reflector, Pragmatist	Honey & Mumford's Learning Styles Questionnaire (LSQ), consisting of 80 items with true/false answers	Honey & Mumford, 1992
Gregorc – Mind Styles and Gregorc Style Delineator	Abstract Sequential, Abstract Random, Concrete Sequential, Concrete Random	Gregorc Style Delineator containing 40 words arranged in 10 columns with 4 items each; the leaner is asked to rank the words in terms of personal preference	Gregorc, 1979; Gregorc, 1982
McCarthy – 4 Mat System	Innovative, Analytic, Common sense, Dynamic	-	McCarthy, 1980; McCarthy , 1997
Gardner – Multiple Intelligence Inventory	Linguistic, Logical-mathematical, Musical, Bodily-kinesthetic, Spatial, Interpersonal, Intrapersonal	an instrument consisting of 8 questions	Gardner, 1993a; Gardner, 1993b
Grasha-Riechmann – Student Learning Style Scale	Competitive-Collaborative, Avoidant-Participant, Dependent-Independent.	90 items self-report inventory measuring the preferences of both high school and college students	Hruska-Riechmann & Grasha, 1982; Grasha, 1996
Hermann – Brain Dominance Model	Quadrant A (left brain, cerebral), Quadrant B (left brain, limbic), Quadrant C (right brain, limbic), Quadrant D (right brain, cerebral)	120 questions that refer to four profile preferences codes corresponding to each quadrant	Herrmann, 1982; Herrmann, 1995
Mayers-Briggs – Type Indicator	Extroversion, Introversion, Sensing, Intuition, Thinking, Feeling, Judgement, Perception	(i) MBTI (Myers-Briggs Type Indicator), (ii) Kiersey Temperament Sorter I, and (iii) Kiersey Character Sorter II	Myers & Kirby, 1994; Myers, et al, 1998

Table 1: Overview of Learning Styles

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Some Criteria for Selecting Among Different Learning Style Models in PL Systems

Given the variety of learning styles theories and models that are available in the related literature, we need to define a set of selection criteria for selecting the most appropriate learning style model to be accommodated in a specific PL system. Of course, the most important criteria are the theoretical and empirical *justification* of the model. In addition, the learning style model should be *suitable* for the specific learning context. For example, if all learners of a specific learning context are "experts" in the domain (e.g. an educational application for aircraft pilots), then it might not be reasonable to select a learning style model which categorises learners according to their expertise in the domain. Similarly, if all the educational material that is available for a specific case is in textual form, then it is not reasonable to select a model which differentiates content according to its medium.

A set of additional important selection criteria are briefly summarised below.

Measurability

We need to be able to "measure" whether learners belong to the categories defined by each model. For example, one model may differentiate learners according to their emotions. While this may be reasonable from a theoretical point of view, since emotions can affect learning, it may not be reasonable to select such a model for a PL system, since it may be difficult to measure learners' emotions. Felder and Silberman model, for instance, is supported by the Felder and Solomon questionnaire, which easily determines how a learner is categorised according to the dimensions proposed by the model. The lack of such an assessment instrument (questionnaire) can be a reason for *not* selecting one model.

Time effectiveness

The assessment instrument related to each learning style model needs to include a reasonable number of questions in order to be time effective. For example, if an assessment instrument consists of 200 questions, then the instrument may not be effective time wise. The user may not be willing to dedicate his/her time in order to complete a large questionnaire before starting using the system.

Descriptiveness and Prescriptiveness

From a practical point of view, it is important that the model describes not only how learners are categorised, but also how instruction should be adapted for each learner category; that it, apart from the *descriptive* information (e.g. learners are categorised into "active" and "reflective"), the model should provide *prescriptive* guidelines, which can lead to specific rules for designing instruction and adaptation (e.g. what types of educational content should be selected for active and reflective learners).

Cost

The cost of a learning style model along with its assessment instrument is another parameter that system designers may need to consider. The situation here varies, as some assessment instruments are only available for use after payment, while others are available to be used free-of-charge. In this case designers need to consider the cost of the model and its assessment instrument. Then, the availability of the test in relation to the number of users needs to be considered.

Some Examples of Accommodating Learning Styles Research in PLSystems

Learning styles research has formed the basis for the development of a number of PL systems. TrainingPlace.com is a notable example of a commercial PL system which is based on learning styles research. The system is based on Learning Orientation Theory, which categorises learners as transforming, performing, conforming and resistant. Based on this categorisation, the system presents different "learning experiences" to each learner. For example, the system selects "loosely structured environments that promote challenging goals, discovery and self-managed learning" for transforming learners, and "semi-complex, semi-structured, coaching environments that stimulate personal value and provide creative interaction" for performing learners (Martinez & Bunderson, 2000).

SMILE, a web-based knowledge support system aiming at promoting intelligent support for dealing with open-ended problem situations, utilises a learner profile which takes into consideration the learner's learning style, following Honey and Mmford's categorisation (Stoyanov & Kommers, 1999). The same learning style model is also used by the INSPIRE system, which aims to generate different lessons for each individual learner, for meeting his/her learning goals (Grigoriadou et al, 2001). The 3DE European Project (www.3deproject.com) categorises learners into activists, reflectors, theorists and pragmatists, in order to create courses customized to their needs.

The KOD European project aims to deliver an adaptive learning environment for personalised learning (Karagiannidis, Sampson, & Cardinali, 2001). In this context, the aim of the project is to facilitate the development of adaptive educational content which can be easily interchanged and re-used across different e-learning applications and services. In particular, the KOD project is working on the *knowledge packaging format* (an extension of the existing IMS Content Packaging Specification (IMS, 2001a), for the description, in a common format, of knowledge packages (i.e. collections of learning objects), together with the rules which determine which learning objects should be selected for different learner profiles. As a result, the KOD e-learning system (or any system compliant with the knowledge packaging format), can import a knowledge package (a collection of learning objects described through the knowledge packaging format), interpret the rules included in it, and present different knowledge routes to each individual learner, according to his/her profile, thus facilitating personalised learning.

The KOD project includes an authoring environment (the KOD Packager) for describing adaptive educational content through the knowledge packaging format. Through the KOD Packager, the user (learning material author, tutors, publisher, etc) can define the PL logic (determinants, constituents and rules) which drive the personalisation of the knowledge package.

In order to assist the developer of knowledge packages, the KOD Packager includes parts of different PL logics, which can be easily imported as 'templates". For example, the KOD Packager includes all the elements which are proposed by the IMS Learner Information Profile Specification (IMS, 2001b) for describing learner profiles. The designer can easily select which of these determinants are suitable for the specific learning context, and include them in a new knowledge package. Similarly, the KOD Packager includes the elements which are proposed by the IEEE Learning Objects Meta-Data Specification (IEEE, 2001) for describing learning objects characteristics; as well as a set of PL rules, which select different PL constituents (learning objects characteristics) for different PL determinants (learner characteristics).

Parts of the PL logics which are built-in in the KOD Packager are based on specific learning styles models, for assisting the user to easily accommodate these learning styles models into the development of adaptive educational e-content. For example, the user can select to accommodate the Felder and Silberman learning styles model; in this case, the learner profile which is created by the KOD system for each learner, includes an element for representing whether each individual learner is visual/verbal; similarly, the educational meta-data file which describes each learning object includes a specific element for representing whether the learning object is visual or verbal. Finally, the PL rule "IF Learner is Visual THEM learning object is Visual" is ready to be included in a knowledge package.

Conclusions

This paper has investigated the accommodation of learning styles research in PL systems. It has briefly reviewed the most well-known learning styles theories and models, as well as some criteria for selecting among them when developing a PL system. The paper has also outlined some PL systems which utilise this line of research for delivering personalised learning, with emphasis on the PL system which is being developed in the context of the KOD European project.

Our current and future work in this context includes the development of different knowledge packages (through the KOD tools), which are based on different learning theories and models. This will provide to us a testbed for further investigating the use of learning styles research in PL systems.

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References

Claxton, C.S. & Murrell, P.H. (1987). *Learning Styles: Implications for Improving Education Processes*. ASHE-ERIC Higher Education Report No 4, Association for the Study of Higher Education, Washington DC.

Curry, L. (1983). An Organisation Of Learning Styles Theory And Constructs. *Annual meeting of the American Educational Research Association*, Montreal, Canada.

Dunn, R., & Dunn, K. (1978). *Teaching Students through their Individual Learning Styles: A Practical Approach*, Reston Publishing Company.

Dunn, R., & Dunn, K. (1999). *The Complete Guide to the Learning Styles Inservice System*, Allyn & Bacon.

Felder, R.M. (1996). Matters of Style, *ASEE Prism* 6(4).

Felder, R.M., & Silverman, L.K. (1988) Learning and Teaching Styles in Engineering Education, *Engineering Education* 78(7).

Gardner, H. (1993a). *Frames of Mind: The Theory of Multiple Intelligences*. Basic Books.

Gardner, H. (1993b). *Multiple Intelligences: The Theory in Practice*. Basic Books.

Grasha, A.F. (1996). *Teaching with Style: A Practical Guide to Enhancing Leaning by Understanding Teaching and Learning Styles*. Alliance Publishers.

Gregorc, A.F. (1979). Learning/teaching styles: Potent forces behind them. *Educational Leadership* 36(4).

Gregoric, A.R. (1982). *Style Delineator*. Gabriel Systems.

Grigoriadou, M., Papanikolaou, K., Komilakis, H., & Magoulas, G. (2001). INSPIRE: An INtelligent System for Personalized Instruction in a Remote Environment. *8th International Conference on User Modeling*, Sonthofen, Germany.

Herrmann, N. (1982). *Herman Brain Dominance Instrument*, Applied Services.

Herrmann, N. (1995). *The Creative Brain*, Brain Books.

Honey, P., & Mumford, A. (1992). *The Manual of Learning Styles*, Peter Honey.

Hruska-Riechmann, S., & Grasha, A.F. (1982). The Grasha-Riechmann Student Learning Style Scales: Research Findings and Applications. In: Keefe, J. (ed.), *Student Learning Styles and Brain Behavior*, Reston, VA: NASSP.

IEEE Learning Technologies Standards Committee (2001). Learning Objects Meta-Data Specification. Electronically available at ltsc.ieee.org/wg12.

IMS Global Learning Consortium, Inc (2001a). Content Packaging Specification. Electronically available at www.imsproject.org/specifications.

IMS Global Learning Consortium, Inc (2001b). Learner Information Profile Specification. Electronically available at www.imsproject.org/specifications.

James, W.B., & Gardner, D.L. (1995). Learning styles: Implications for distance learning. *New Directions for Adult and Continuing Education* 67.

Karagiannidis, C., Sampson, D., & Cardinali, F. (2001). Integrating Adaptive Educational Content into Different Courses and Curricula, *Educational Society and Technology* 4(3).

Keefe, J.W., & Ferrell, B.G. (1990). Developing A Defensible Learning Style Paradigm, *Educational Leadership* 48(2).

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*, Prentice Hall.

Kolb, D.A. (1985). *LSI Learning-Style Inventory*, McBer & Company.

Martinez, M., & Bunderson, C. (2000). Foundations for Personalised Web Learning Environments, *ALN Magazine* 4(2).

McCarthy, B. (1980). *The 4MAT System: Teaching to Learning Styles with Right/Left Mode Techniques*, Excel Inc.

McCarthy, B. (1997). A Tale of Four Learners: 4MAT's Learning Styles. *Educational Leadership*.

Myers, I.B., & Kirby, L.K. (1994). *Introduction to Type Dynamics and Development*, Consulting Psychologists Press.

Myers, I.B., McCaulley, M.H., Quenk, N.L., & Hammer, L.A. (1998). *The MBTI Manual: A guide to the Development and Use of the Myers-Briggs Type Indicator*, Consulting Psychologists Press.

Riding, R.J., & Rayner J. (1998). *Cognitive Styles and Learning Strategies: Understanding Style Differences in Learning and Behaviour*. David Fulton Publishers.

Riding, R.J., & Cheema I. (1991). Cognitive Styles: An Overview and Integration", *Educational Psychology* 11(3&4).

Riding, R.J. (1994). *Cognitive Styles Analysis*. Learning and Training Technology, UK.

Sampson, D., Karagiannidis, C., & Kinshuk (2002). Personalised Learning: Educational, Technological and Standardisation Perspectives. *Interactive Educational Multimedia* 4.

Stoyanov, S., & Kommers, P. (1999). Agent-Support for Problem Solving Through Concept-Mapping. *Journal of Intractive Learning Research*, 10(3/4).

Dynamic Educational e-Content Selection Using Multiple Criteria in Web-based Personalized Learning Environments

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Abstract: In this paper we present the way a multi-criteria decision making methodology is applied in the case of agent-based selection of offered learning objects. The problem of selection is modeled as a decision making one, with the decision variables being the learner model and the learning objects' educational description. In this way, selection of educational content is based on dynamic data input collected at the time of the decision. This methodology is studied in the context of an agent-based e-market for educational content brokering, and is engaged by the broker agents recommending learning objects to learners, according to their cognitive style.

Introduction

In agent-mediated educational content brokering, artificial agents are responsible of locating offered learning objects, negotiating with the content providers on the terms of the service provision, and for presenting the learner with those offers that best match his/her needs and preferences. Successful completion of this task is based on two parameters: the capability of the mediating agent to understand and model the user needs, and its capability to evaluate all available learning objects and recommend the most suitable. The most common ways to introduce intelligent brokering for educational content are based on techniques from Artificial Intelligence (AI): knowledge representation, reasoning, and expert systems, often offer tools and techniques in the developers of such systems since they allow the agent to behave intelligently in two ways; first, with the ability to store the knowledge of the experts (for example using a knowledge base); second, using the previous knowledge to infer rational decisions.

In the last years though, most agent-based e-commerce systems engage methodologies and tools which originally come from sciences other than AI; these include methods and techniques from Game Theory, Optimization and Decision Making (Guttman et al, 1998). In this paper, we are going to approach the problem of content selection (know as the recommendation problem in e-commerce systems) from a decision-making point of view. We are going to introduce how a multi-criteria decision making (MCDM) methodology is applied in the case of agent-based educational content brokering, and we are going to discuss the benefits and drawbacks of this approach.

There is an interesting feature in this approach: it replaces searching knowledge inside a knowledge base, using constraints posed by logical expressions and logic rules, with an evaluation of knowledge using mathematical formulations. It can therefore provide measures of "how much better one decision is compared to another", even if both decisions are rational and solve the constraints problem. This usually sounds rather awkward though – how can we represent the expert knowledge in terms of mathematical expressions? Logic variables (CategoryOfUser='This') and logic rules (IF CategoryOfUser='This' THEN TypeOfContent='That') are simple, and easily comprehended; how is the learner going to be modeled using mathematical variables, and how is the expert going to express the experience in a mathematical form?

We will try to give answers to these questions by introducing the example of modeling the learners with the classic Honey and Mumford cognitive styles model (1992). We will introduce the basic principles of a multi-criteria decision making methodology, and study which parameters of the Honey & Mumford model serve as criteria for the selection of the available content (learning objects); we will also study a method that can be used to carry out this selection. Finally, we will present how this decision-making procedure is incorporated into an agent-based system, and how the broker agents operate it.

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The Honey & Mumford Model

Tennant (1988) defined cognitive style as "an individuals characteristic and consistent approach to organizing and processing information". There are several learning and cognitive styles theories and models, which categorize learners in terms of instructional preferences, information processing and personality styles, and are usually employed for the realization of individualized instruction (for a survey, see Sampson et al, 2002). In order to demonstrate how a cognitive style model can be used in order to create the multi-criteria selection model, we will engage the classic Honey and Mumford model. The Honey and Mumford model (1992) is a cognitive style model, developed for use in commerce, management and training situations. It categorizes learners according to the following dimensions of a person's learning style: Theorist, Activist, Reflector and Pragmatist. In order to rate learners on each one of the categories, the model uses the answers in a specially designed Learning Styles Questionnaire (LSQ) of 80 questions, with binary answers of "Correct" and "False", and after an internal processing of the results, it provides a percentage weight for each category. Therefore, the learner's style is defined depending on the weight at each learning style category.

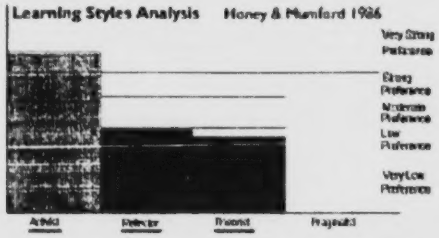

Figure 1: An example learner's model after a LSQ is processed. It provides a measure of how the learner 'scored' in every category (source: PSI-Press, http://www.psi-press.co.uk/)

From a practical point of view, it is important that a learner's model describes not only how learners are categorised, but also how the instruction method should be adapted for each learner category (Spector, 2001). The real complexity for the designers of e-learning systems arises when they try to match subject matter with learner characteristics and appropriate instructional methods. Such a process includes both learner modeling (using the Honey & Mumford model results – see Figure 1) and description of the educational properties of the learning content (that is e.g. a description of how suitable a course is for the learners having a specific cognitive style). The matching procedure involves all these parameters as input – and still a proper matching mechanism has to be found. We address this problem as a decision making one.

Multi-Criteria Decision Making Methodology

According to Roy (1996) the general methodology of decision making problems includes four steps: (i) defining the object of the decision, that is the set of potential actions, and the problematic of the decision; (ii) studying the parameters influencing decision and defining so a set of criteria; (iii) choosing an appropriate multi-criteria aggregation method; (iv) proceeding at the activity of decision aid.

Step One: The Object of Decision

The first step includes definition of the decision variables in a form of a consideration set *A*. In the case of educational content brokering, this set includes all the available learning objects, which will be evaluated by the decision maker (in our case, the brokering agent). What is called 'the problematic of the decision' is the definition of what kind of evaluation or choice does the decision maker want to make upon the different objects available in set *A*;

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in the case of broker agents recommending a learning object, the decision problematic is "selection of one". That is the selection of one action from the consideration set of the form *?* = [a_1, a_2, ..., a_n].

Step Two: The Criteria

The next step is deciding what will be the criteria upon which the learning object will be evaluated. This means defining a consistent family of criteria, assuming that these criteria are non-decreasing value functions, exhaustive and non-redundant. Each criterion is defined on *A* as it follows: $g_i : A \rightarrow [g_{i*}, g_i^*] \subset \Re / a \rightarrow g(a) \in \Re$, where $[g_{i*}, g_i^*]$ is the criterion evaluation scale, with g_{i*} the worst level of the *i*th criterion, g_i^* the best level of the *i*th criterion, $g_i(a)$ the evaluation or performance of action *a* on the *i*th criterion and $\underline{g}(a)$ the vector of performances of action *a* on the *n* criteria (Jacquet-Lagreze & Siskos, 2001).

In the case of educational content brokering, there are two ways to deal with the selection of the criteria. Recommendation is usually based on criteria as price, time of delivery, form of delivery, etc. – a common practice in e-commerce systems. We would like to introduce another aspect of recommendation in agent-based learning environments: based on the pedagogical profile of the learner. That is using the categories of the learner model as criteria; each learning object will be evaluated on how suitable it is for each category of learners. This is exactly the same as making an expression as " TypeOfContent='That' ". To be more specific, in a similar case an expert system would need a definition as: `TypeOfContent="SuitableForActivists"`. In the case multiple criteria are used for the description of the content, this definition is transformed (remaining fully equivalent) to something similar to this:

- `SuitabilityOfContentForTheorists= "NotSuitableAtAll";`
- `SuitabilityOfContentForActivists= "Perfectly suitable";`
- `SuitabilityOfContentForReflectors= "NotSuitableAtAll";`
- `SuitabilityOfContentForPragmatists= "NotSuitableAtAll";`

Therefore, as criteria we will use the four categories of the Honey & Mumford, which can take their values from a 5-scaled climax of qualitative descriptions ["Not suitable at all", "Not very suitable", "Moderately suitable", "Very suitable", "Perfectly suitable"] showing the evaluation of each learning object upon each categories. It is obvious that a learning object (e.g. an on-line course) is never "Perfectly Suitable" for a learner category and "Not Suitable At All" for the rest -it rather addresses some of the needs of other categories of learners too. Therefore, such an evaluation provides the expert with a way to precisely describe the pedagogical 'profile' of a learning object. This meta-data description is a criteria definition that fully complies with the definition of the criteria according to Roy (1996).

Step Three: The Utility Model

First of all, we have to define the preference model that will be used from the broker agent to make the decision; as we have already stated, in our case we are using the Honey & Mumford learner model as a preference model. The expression of the model is then p_i=[p_1 . p_2 . p_3 . p_4], where p_1, p_2, p_3 , and p_4 are the weights inferred after the learner has completed the Honey & Mumford LSQ and the results have been processed.

This is the point where the analyst has to define which evaluation method will be used; that is, which multi-criteria decision making method will be engaged in order for the decision to be best modeled and simulated. In this paper we will use one of the most traditional approaches, that leads to a functional representation *g* that can be formed directly from the criteria $g_1,...g_4$ that constitute *A*. The goal of using this approach is to present how the methodology works – depending on the application, other more complex methods can be used. Thus, the comprehensive preference model is characterized by a unique synthesizing criterion *g*: $g(a)=V[g_1(a),...,g_n(a)]$, where *V* is an aggregation function. The function will be in the form:

$$V(a) = \sum p_i g_i(a)$$

where $g_i(a)$ are the evaluations of each learning object *a* regarding the suitability for each category of learners. The weights p_i consist the preference model, which are the parameters calculated by the Honey and Mumford LSQ. The final value of *V* is the total utility of each learning object for the learner under study.

Step Four: The Activity of Decision Aid

Let us now introduce the way the activity of decision making will be carried out, in the context of an agent-based system We define a generic architecture, with agents capable of handling and communicating descriptions of learning objects, as defined in the previous paragraph. The three basic roles are:

The Assistant. The assistant agents are responsible for user needs and requirements elicitation, and formulation of requests into messages understandable by the broker repository system. The LAssistant is the agent that interacts with the user and can identify the request for a learning object. The CPAssistant is the agent that gets the learning object descriptions from the Content Providers, and publishes them as offers in the e-market. The TAssistant serves as the pedagogical counselor of the learner: it creates the learner model of the user and provides this model to the LBroker. The TAssistant can also be the expert that describes a learning object using the cognitive styles; this is a task that can be directly carried out by the Content Author too, so we will not focus more on this point.

The Broker. The broker agents represent each human user in the e-market and facilitate educational content seeking or advertising. The Broker agents interact among each other in the Brokerage Pool and either advertise published learning objects, or make requests when looking for them. The LBroker evaluates the available offers from the CPBrokers in the way described in the previous paragraphs. The LBroker then recommends the content selection to the LAssistant. The Brokers are also responsible for negotiation among the participating parties upon the terms of the service provisioning (beyond the scope of this paper).

The Matchmaker. This facilitator agent provides mediating services, by informing agents about other agents of the broker repository and their availability. The Matchmaker provides all necessary administrative support information to the human administrator of the agent pool.

We can see that the Broker agent engaging the multi-criteria methodology previously described is the LBroker. In order to pedagogically evaluate the available learning objects and recommend one to the learner, the LBroker needs the learner model (provided by the user) and the meta-description of the available learning objects (provided by the CPBroker or the Tutor). Other kinds of evaluation of the offers (e.g. based on the price, time, and other terms of delivery) are beyond the scope of this paper.

Usage Scenario

Let us demonstrate how the recommendation procedure works in this agent-based system. A content author creates different elearning courses concerning the same subject. The author wishes those courses to address different learner needs, depending on the cognitive style of the learner. When a learning object (course) is created, the content author also provides an evaluation of its suitability for each different category of the Honey & Mumford model. The author creates thus five different learning objects, with different pedagogical descriptions (as depicted in Table 1).

	LO1	LO2	LO3	LO4	LO5
Activist	3	2	5	3	5
Reflector	1	3	1	2	2
Theorist	4	5	2	1	1
Pragmatist	3	2	1	5	2

Table 1: The content author provides an description of each learning object (LO) on a scale from '1- Not Suitable At All' to '5-Perfectly Suitable', regarding each one of the cognitive categories.

	Activist	Reflector	Theorist	Pragmatist
LSQ values	90%	55%	25%	85%
Normalized	0,35	0,22	0,10	0,33

Table 2: The cognitive styles preference model, as derived from the Honey and Mumford Learning Styles Questionnaire (values are properly normalized in order to provide a sum of 1).

	LO1	LO2	LO3	LO4	LO5
Utility	2,67	2,51	2,51	3,25	2,96

Table 3: The total utilities of the available learning objects (a score upon the '1-Not Suitable At All' to '5- Perfectly Suitable' climax).

Introducing the multi-criteria methodology presented in the previous section the Broker will select a learning object according to these steps:

1. The Tutor provides a multi-attribute cognitive model of the user, according to the results of the Honey and Mumford model (Table 2).
2. When the Learner's Broker receives the five offers for learning objects, it calculates the total utility (that is suitability) of each one, using the methodology described in the previous section.
3. The Learner's Broker selects the most appropriate learning object to be presented to the user (Table 3).

It is interesting to note in this example the difference between the application of a simple rule-based selection of the learning object (in this case the agent would classify the learner as 'Activist' and would propose the learning object LO3) and the proposed methodology. Using the multi-attribute cognitive model and the multi-criteria evaluation model, we observe that the most appropriate learning object seems to be LO4, being the only one suitable for the combination of categories that characterize the specific learner's cognitive style.

Conclusions and Future Work

In this paper we presented an agent-based recommendation system for educational content brokering that implements a multi-criteria decision making methodology. Due to the differences of learners' cognitive models, recommendation can be either carried out by classifying learners into broader categories that then are directly linked to learning objects (e.g. with rules like IF 'thistypeoflearner' THEN 'thistypeofmaterial') or by enhancing the mediating agent with the appropriate intelligence to propose the most suitable learning object available at the market. By engaging a multi-attribute utility (MAUT) model, the brokering agents do not need to posses intelligence in the form of a knowledge base or hard-coded rules but only to include the multi-attribute evaluation logic in their decision making module. In this way learners are modeled in a multi-attribute way, instead of being simply classified into a general learning category, learning objects are described according to their educational scopes, brokering agents dynamically evaluate all available proposals of content, and select the learning objects most suitable for the specific learner's profile, and finally the knowledge the broker agents have to contain in permanent storage is minimized since only the MAUT evaluation formula is needed; all other input is provided at run-time.

In this paper, the decision problem was modeled using the Honey and Mumford LSQ parameters as the preference model, but we believe that the proposed methodology can be similarly applied in the case of other cognitive style models too. Future research will be focused on applying of several other LS models, either separately or combined. An issue to be also studied is the application of more complex multi-criteria decision making methodologies for modeling the user preferences; such methodologies provide easier and more realistic means of expressing preferences, but require more complicated MCDM methods to conclude to the best proposal for each learner, as one of the famous family of the ELECTRE methods (Roy, 1996).

Current international standardization efforts regarding syntax and semantics of a learner model that characterize a learner and his or her knowledge/abilities; i.e. IMS LIP (IMS, 2001), IEEE LTSC PAPI (IEEE, 2000) do not explicitly define information about the cognitive style of the learner. However, both the IMS LIP and IEEE PAPI Learner preference/performance data types provide data elements that allow cognitive style related information to be stored in an appropriate form. These data types could be used in order to represent a multi-attribute representation of the cognitive style model of the learner, by an appropriate extension of the corresponding XML schema.

The IST Project KOD "Knowledge-On-Demand" (KOD, 2001) engages a multi-agent brokering system for selection of learning objects and dynamic synthesis of on-line courses. In the case of KOD, intelligence is included into the learning objects in the form of rules that express the suitability of the object for each type of learners, so that courses can be constructed based on how the learning objects are characterized. This is a case very close to the problem we introduced, and we are currently studying ways to introduce the multi-criteria descriptions in the learning objects of KOD, in order for the KOD agents to be able to dynamically assess and synthesize courses based on the introduced decision making methodology and not on prescribed rules.

Acknowledgements

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References

FIPA - Foundation for Intelligent Physical Agents. (2002). http://www.fipa.org

GEM – Gateway to Educational Material. (2002). http://www.geminfo.org/

Guttman R., Moukas A., Maes P. (1998). Agent-mediated Electronic Commerce: A Survey. *Knowledge Engineering Review*. (Vol. 13:3).

Honey P., Mumford A. (1992) *The Manual of Learning Styles*. 3rd Ed., Maidenhead, Peter Honey.

IEEE Learning Technology Standards Committee. (2000). *Draft Standard for Learning Technology – Public and Private Information for Learners (PAPI Learner)*. IEEE P1484.2/D7. http://www.ltsc.org/wg2

IMS Global Learning Consortium Inc. (2001). *Learning Information Package (LIP) Best Practice & Implementation Guide*. IMS LIP Final Specification V. 1.0. http://www.imsproject.org/profiles

Jacquet-Lagreze E., Siskos Y. (2001). Preference disaggregation: 20 years of MCDA experience. *European Journal of Operational Research*. (130, pp. 233-245).

JADE – Java Agent DEvelopment Framework. (2002). http://sharon.cselt.it/projects/jade/

KOD - Knowledge on Demand. (2001). IST Project No 12503 KOD. http://www.kodweb.org

Roy B. (1996) *Multicriteria Methodology for Decision Aiding*. Kluwer Academic Publishers.

Sampson D. and Karagiannidis C. (2002). Accommodating Learning Styles in Adaptation Logics for Personalised Learning Systems. *Proc. ED-MEDIA 2002*. Denver, Colorado, USA.

Spector J.M. (2001). An Overview of Progress and Problems in Educational Technology. *Interactive Educational Multimedia*. (3, pp 27-37).

Tennant N. (1988). Theories, Concepts and Rationality in an Evolutionary Account of Science. *Biology and Philosophy*. (3, pp. 224-231).

An Educational Metadata Management System using a deductive object-oriented database approach

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Internet-based education and training offer many potential benefits specific to adult learners with emphasis given to learner-centered and self-directed instruction models empowered by web-based educational resources. Indeed, the recent growth of the World Wide Web (WWW) has greatly increased the amount of information and educational resources available to the education community.

The full exploitation of this mass body of knowledge resources available on the Web, can be, however, compromised, by the difficulty in describing, classifying and maintaining those resources in such a way that they can be retrieved in an "*educationally efficient and effective way*". Today, the web community has embraced the collection and use of metadata to characterise and index educational resources, which lead to semantically more accurate retrieval of information than search engines. In general sense, metadata is information about data. In the context of resource discovery, descriptive metadata is a characterisation that aims to represent the intellectual content of the resource. The most popular technology for representing metadata is XML (eXtensible Markup Language).

Typically, the educational content providers of an elearning scenario need an educationally oriented application facilitating editorial and management features for manipulating educational metadata documents. An efficient and effective educational metadata management tool should satisfy a number of requirements derived from different dimensions such as:

- The need of addressing user categories (i.e. learners, content providers)
- The availability of different educational metadata specifications/ standards (i.e. IEEE LOM, DC)
- The emerge of metadata enabling representation technologies (i.e. XML, DTD, XMLSchema).

The basic requirements towards an integrated and generic educational metadata management tool are:

- `creation` of new and `modification` of existing educational metadata documents
- data and structure `validation` of the educational metadata document
- support of `any` educational metadata standard / specification
- creation of `new` metadata specification that applies to user's requirements for each case study (e.g. extension of existing metadata standard)
- support `enabling` metadata technologies (XML, DTD, XMLSchema)
- `mapping` of educational metadata files between different specifications/standards
- facilitate `content management` of the educational metadata documents (e.g. search, retrieve, update data)

The proposed architecture of the EM^2 tool (Sampson, 2002), combines all the required components towards the implementation of an educational metadata management tool (editors, repositories, associations, management, validation and mapping components) and fulfills the above requirements (figure 1).

This paper proposes an educational metadata management system using a deductive, object-oriented database approach. The EM^2 tool can provide storage and retrieval of data from the XML metadata files in addition to its features (i.e. authoring, editing, etc) by integrating the X-DEVICE system (Bassiliades, 2000). In figure 2, a graphical representation of the proposed architecture for the cooperation between the two systems is presented.

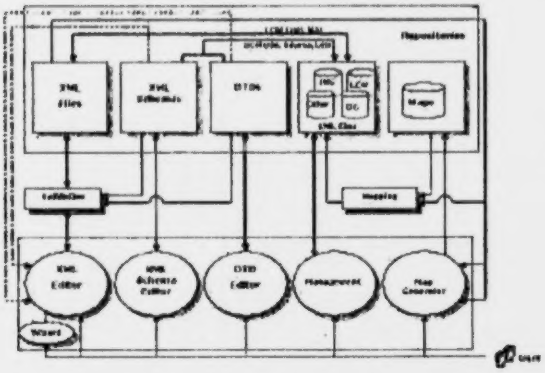
Repositories
XML Files
XML Schemas
DTDs
IMS
LOM
Other
DC
XML files
Maps
Validation
Mapping
XML Editor
XML Schema Editor
DTD Editor
Management
Map Generator
Wizard
User

Figure 1: Architecture of an Educational metadata management tool

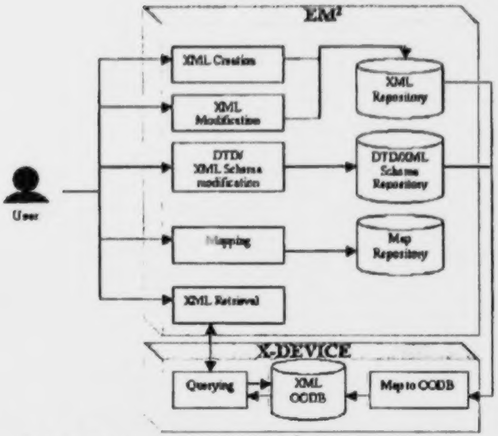
EM²
XML Creation
XML Modification
DTD/ XML Schema modification
Mapping
XML Retrieval
XML Repository
DTD/XML Schema Repository
Map Repository
User
X-DEVICE
Querying
XML OODB
Map to OODB

Figure 2: Architecture of EM^2 and X-DEVICE integration

EM^2 provides the graphical interface for the interaction with the user. The user can create a new educational metadata file based on metadata specifications, open or edit/update data on an existing one, convert metadata files between specifications as well as create maps for these conversions. The created or modified XML documents after structure and data validation (whenever it is possible) are stored to the associated XML repository of EM^2. The XML Repository is a system folder storing the XML documents as files, and it is not a database system. In addition the DTD and XMLSchema files are stored in their associated repositories respectively. By integrating ? -DEVICE to the EM^2 tool, database storage and data retrieval can be provided based on the user's queries. Each stored XML document, together with its associated DTD is passed to the X-DEVICE system where the mapping to OODB system takes place. The EM^2 tool can generate a DTD in case there is no DTD or XML Schema that defines the XML document. In addition, if only an XML Schema exists for a specific XML document then transformation from XML Schema to DTD is also an available feature. The transformation of XMLSchema generates a sample DTD, which may lack information compared to the XMLSchema. The OODB holds the data of every educational metadata file that has been created, updated or stored in the EM^2 XML repository. In addition, the EM^2 will provide an interface to the user, for query submission. When specific data is required from the XML documents, the user should compose his query following the syntax of the X-DEVICE system query language. The query is then passed to the X-DEVICE system, which will obtain the required information from the OODB. The information is in XML format and it will be presented to the user through the user interface of EM^2.

References

Sampson, D., Papaioannou, V., and Karadimitriou, P. (2002) EM^2: an Environment for Editing and Management of Educational Metadata. *Educational Technology & Society Journal* of International Forum of Educational Technology & Society and IEEE Computer Society Learning Technology Task Force. Special Issue on *Innovations in Learning Technologies*. 5(4).

Bassiliades, N., Vlahavas, I., and Elmagarmid, A.K. (2000). E-DEVICE: An Extensible Active Knowledge Base System with Multiple Type Support. *IEEE Transactions on Knowledge and Data Engineering*. 12(5).

Bassiliades, N., Vlahavas I., and Sampson, D. (2002) Integrating XML Data into an Object-Oriented Database System. David Taniar and Wenny Rahayu (editors). *Web-Powered Databases*, Idea Group Publishing, Hershey.

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Interactive educational software for exploratory learning of Geophysics

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Abstract. *GAIA* is a microworld-based learning environment aiming to provide means for exploratory learning to secondary school students in the fields of physics, mathematics and geosciences. This paper presents *Gilbert*, one of GAIA's microworlds aiming to familiarize students with contemporary geosciences.

Introduction

Unlike in other fields of studies, such as physics and mathematics (Thornton and Sokolo, 1990), most of the available commercial educational software related to Earth School Studies, is either *drill-and-practice oriented*, where students are presented with problems to solve and they receive feedback about the accuracy of their responses, or tutorial-*based oriented*, following the archetypal form of text, graphics or multimedia information associated with relevant self-evaluation tests. ·However, such environments (Kali *et al.* 1997) do not strongly facilitate students towards constructing their own knowledge through open-ended experimentation (Jonassen, 2000). On the other hand, microworld-based educational software can provide the means for exploratory learning, by providing the environment for students to learn-by-doing, rather than just watch or listen to a description of how something operates. Briefly, a *microworld* is a computer-assisted problem exploration and experimentation space in which one can explore and construct. Typically, they are constrained versions of reality that enable learners to manipulate variables and experiments within parameters of some system. Furthermore, the most advanced microworld-based educational software provides the means to educators and learners to construct their own exploration spaces. This is this the case of *GAIA* which allows learners to represent their own thinking in the ways that they explore, manipulate and experiment with the environment.

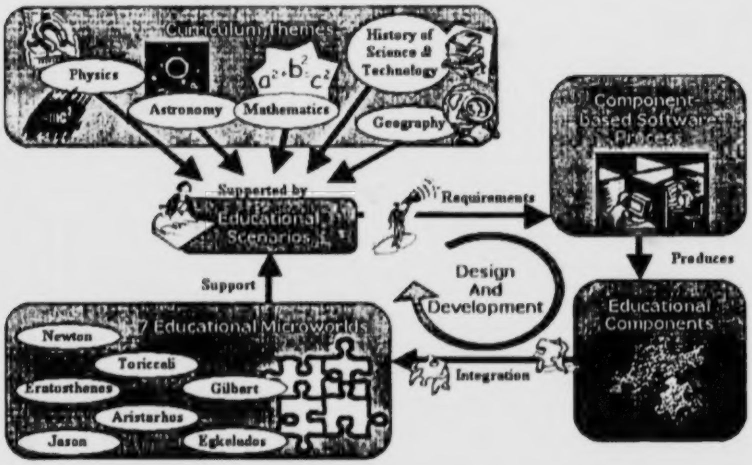
Curriculum Themes
Physics
Astronomy
Mathematics
$a^2+b^2=c^2$
History of Science & Technology
Geography
Supported by
Educational Scenarios
Requirements
Component-based Software Process
Produces
Design And Development
Support
7 Educational Microworlds
Newton
Toriccali
Eratosthenes
Gilbert
Aristarhos
Jason
Egkeludos
Integration
Educational Components

Figure 1. Overview of the GAIA Project Design and Development Process (Papageorgiou et al, 2001)

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GAIA is a microworld-based exploratory learning environment in the field of geosciences education, physics and mathematics. This is accomplished through constrained simulations of real-world phenomena in which students can navigate, manipulate or even create objects, and experiment with their effect on each other. In the current version of *GAIA*, seven microworlds -named after great scientists - are designed and developed to provide the environment for replicating the essential functionalities needed to explore phenomena about the Earth and the planets, regarding their interior, atmosphere, morphology, magnetic field, their orbits in space as well as their astronomical environment. Figure 1 gives an overview of the *GAIA* project design and development process (Papageorgiou *et al*, 2001). The development of *GAIA* is based on the component-based educational authoring environment "E-Slate" (Birbilis G. et al, 2000), which provides a workbench for creating highly dynamic software with rich functionality (Roschelle et al, 1999).

The *Gilbert* microworld, presented in this paper, deals with Earth's magnetic field, within the frame of the school curriculum. This microworld aims to the comprehension of Earth's magnetic field concept and how contemporary science studies and explores this field. The Earth's magnetic field is one of the most attractive concepts to students' imagination, but its teaching becomes difficult as it is hard for them to resolve its vector within the 3D space in relation to geographical coordinates, and to precisely comprehend its existence as they do for instance with the concept of temperature. The *Gilbert* microworld contributes to all the aforementioned and familiarizes students with the existence and nature of Earth's magnetic field.

Earth's magnetic field study through *GAIA* software

The Earth's magnetic field can be directly noticed by the students with the use of a magnetic needle and that is the reason why they must be familiarized with the compass use in school laboratory. This is usually done through the measurement of the field's direction. Although laboratory measurement is useful, it limits students to identify and measure earth's magnetic field, only at the place they are.

The *GAIA* interactive software presented in this paper allows students to virtually travel everywhere on Earth, and measure earth's magnetic field elements (Figure 2). Students have also the possibility, besides the compass, to use a total magnetic field magnetometer. The selection of the virtual site for the experiment is accomplished either on a 3D rotating globe (see Figure 2: top left window) or on a plane geophysical map. The altitude where the measurement is taken place is set in another window (see Figure 2: top right window), by pointing the mouse on a magnetometer sketch on the screen, or alternatively by regulating a properly designed "slider" (see Figure 2: bottom right window). The perspective of earth's projection is done in such a way, as to show the magnetometer's sketch on the screen. In another window (see Figure 2: bottom left window) students can observe and use three instruments: a horizontally positioned compass that measures declination, a compass placed in the magnetic meridian plane that measures magnetic inclination and a total field magnetometer.

In parallel to the virtual measuring of the field, students can also observe the resolved components of the magnetic field vector at any point around the Earth (see Figure 2: top middle window). In this resolution the quantities of field's intensity, declination and inclination are clearly noticeable. The students have also the possibility to visualize and resolve the vector within the Cartesian system coordinates. In addition, they can rotate the projection of the vector representation for more convenient observation of the relative angles and vectors.

At a higher knowledge level, students can also change the value of the measurement date parameter, provided that they have been introduced in the field's variation with time. Of course, it is assumed that the students have also learned some basic notions about the origin of the Earth's magnetic field. Measurement values are simulated to real ones as they based on the IGRF (International Geomagnetic Reference Model) geomagnetic field model of International Association of Geomagnetism and Aeronomy (IAGA 1995). This model is designed to approximately calculate Earth's magnetic field from Earth's interior upwards into space without taking into account external magnetic field sources. It is based on the usual expansion of the spherical harmonics of the potential in geocentric coordinates (Campbell, 1997; Lowrie, 1997) and describes the field's variation within time. At regular times, new spherical harmonics coefficients supplement it in order to renew and fix its anticipation in the future. In view of the educational purposes for which the model was used, the magnetic field values had no higher accuracy than that of the order of 1 μ?.

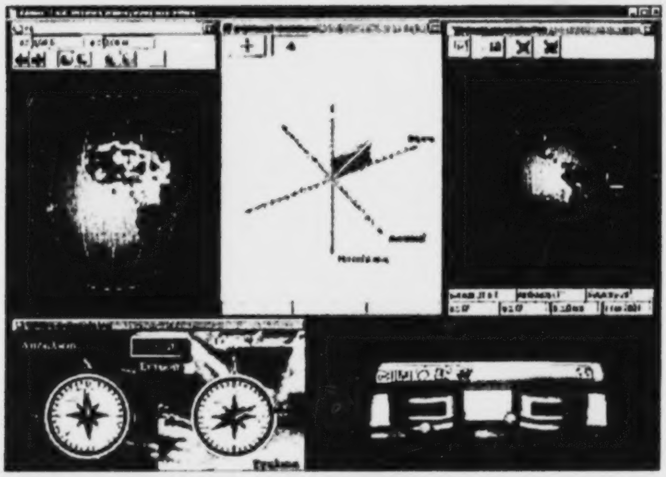

Figure 2. In a special configured environment, students can select whichever place of the world they like on a 3D rotating globe or on a plane map, and to measure the magnetic field's elements at a certain height, meanwhile they can see the field's vector analysis.

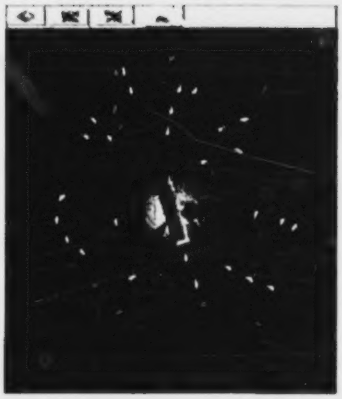

Figure 3. A window of *Gilbert* microworld that presents Earth's magnetic field main dipole component. Students experiment with placing and moving a number of compasses and finally become accustomed to the lines of force notion.

The dipole component of the Earth's magnetic field, which consists the 95% of the total field, is presented in another window of the *Gilbert* microworld (Figure 3). In that window, students can test the field's existence around the whole planet Earth by a number of compasses that can freely move into space. In this environment, students can easily learn the lines of force as well as to magnetic poles natural position. Field's lines of force may be displayed at student's choice.

Displaying the three elements of the magnetic field (intensity, declination, inclination) on maps (Figure 4), it helps students to realize that these three elements coexist in every point and are modified at the same time. For instance, students can observe the magnetic poles in the three maps, to compare their observations and to realize that in all of these three plots the poles have characteristic features. Students also realize that in many places on earth, compass points out to a direction deviating considerably from the North. The coincident display of these three maps reveals the value of the "multiple representations" as well as the "direct manipulation" of the objects (Teodoro, 1990; Shama and Layman 1997).

The introduction of examples from an Applied Geophysics geomagnetic survey was one of the essential innovations of *GAIA* in the teaching of the magnetic field in secondary education level. Beyond the comprehension of notions as the induced magnetization, the addition of the induced field vector to the Earth's field and the magnetic permeability of the materials, the microworld further aimed to present a simplified example of a practical application of Earth's magnetic field measurements, such as the detection of mineral deposits and the antiquities.

In the environment shown in Figure 5, students experiment with a buried plate of square or rectangular section. The plate is considered infinitely elongated in order to simplify the problem from the existence of edge anomalies. The plate is oriented E-W while the magnetometer is moving and measuring vertically to the plate, to N-S (Figure 6). The plate's magnetization is considered only induced and its material can be selected out of a large variety of geological rocks with different values of magnetic permeability. For each rock, typical values of permeability and susceptibility are given, in companion with the range of these values in the real state.

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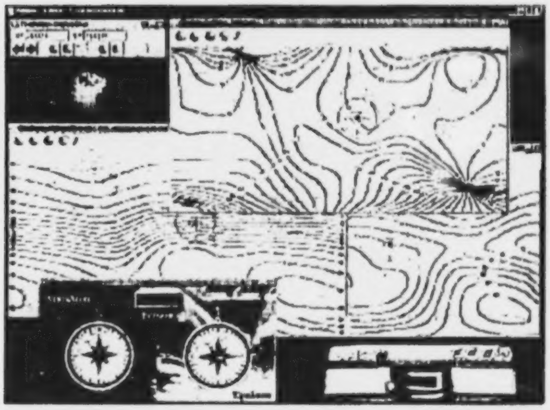

Figure 4. The coincident display of the magnetic maps facilitates the observation and modification of all Earth's magnetic field elements at the same time.

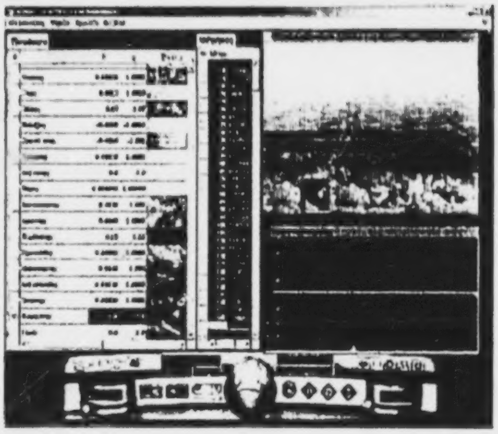

Figure 5. In the magnetic survey environment, students can expertise with the buried plate detection by the implementation of a magnetometer. They can also select the material of the plate, and the location where the experiment takes place. Here the experiment takes place with a magnetite plate of square section, at an area close to the North Pole.

Although the virtual experiment can take place everywhere on Earth, we suggest the choice of three places with characteristic inclination (?) values. These are: the North magnetic Pole (? = 90^7), the magnetic equator (? = 0) and an intermediate place like North Africa with inclination equal to 45^7. Anomalies observed in measurements of the total field above the buried plate in these three areas are advisable for the induced magnetization presentation to the high school students.

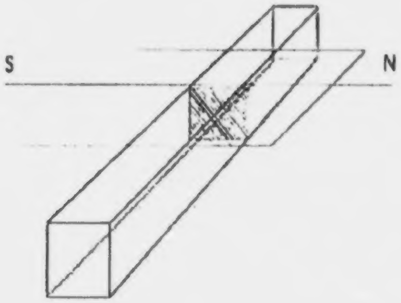

Figure 6. The orientation of the buried plate is E-W while this of the survey traverse is N-S

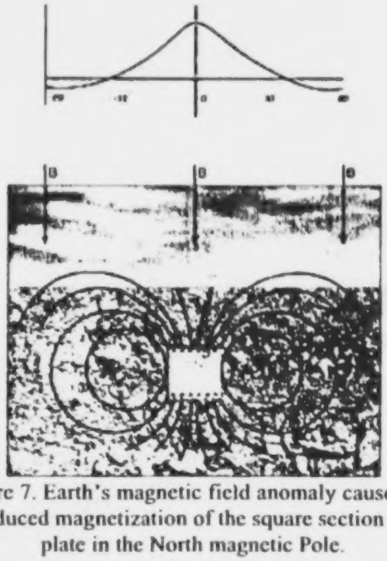

Figure 7. Earth's magnetic field anomaly caused by the induced magnetization of the square section buried plate in the North magnetic Pole.

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At the North magnetic Pole the Earth's magnetic field vector is perpendicular to the plane of measurements. Since the particle magnets of a paramagnetic material are polarized according to the field (a diamagnetic material causes the opposite effect) the induced magnetization will be also perpendicular to the plane of measurements. In the case of paramagnetic materials, which are the most common in nature, the plate's induced magnetization is shown in Figure 7. The lines of force of the induced magnetization field of the body are symmetrical relative to the vertical axis that passes through the centre of the body's section. The values of the measurements are increased at the points where the body's field has the same direction with Earth's field, while are reduced where the two vectors are opposed. At the points where body's field is horizontal (like on body's sides), no essential variation is resulted.

In magnetic equator (? = 0^7) Earth's magnetic field vector is horizontal. Following the aforementioned technique, it is easy to find out that the diagram of the measurements is also symmetric to the body but inversed in sign in relation to the one of the North magnetic Pole (Figure 8). In body's centre, the lines of force of the body's induced magnetization are opposed to the Earth's magnetic field and thus the field's anomaly is negative. In the case that inclination is 45^7, the lines of force are symmetrical to body's diagonal (Figure 9). The magnetic field's anomaly has an asymmetrical pattern and therefore its interpretation regarding body's position becomes more complicated. The point where Earth's field vector is vertical to that of dynamic lines is just above the body, and there we observe that field's anomaly is practically zero. With exception to the magnetic poles and equator the diagram is asymmetric at all the other positions (More details in Dobrin and Savit, 1988).

By the final stage of the microworld *Gilbert* students can comprehend the notion of induced magnetization and how it is depending on the magnetic properties of materials. From the example of the magnetic survey the students are introduced to the field of Applied Geophysics and its contribution to the detection of oil deposits, minerals, antiquities, etc. Contemporary science can provide students with many such examples, possibly exciting their interest for acquiring new knowledge.

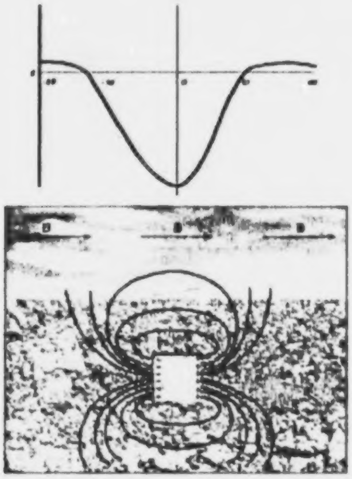

Figure 8. Earth's magnetic field anomaly caused by the induced magnetization of the square section buried plate in the magnetic Equator.

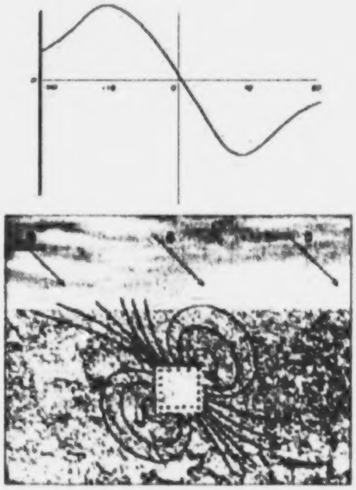

Figure 9. Earth's magnetic field anomaly caused by the induced magnetization of the square section buried plate in position with magnetic inclination equal to 45°
(e.g. North Africa)

Conclusions

The GAIA software was designed and developed to allow to operate a virtual educational laboratory addressed in secondary school students. Students may comprehend basic notions of Earth's magnetic field and become accustomed to them as well as with other more fundamental notions of magnetic field theory, such as induced magnetization. A number of activities based on *Gilbert* microworld have been already created. Students, working in teams under teacher's guidance, can enhance their knowledge on Earth's magnetic field by experimenting with *Gilbert*. Initial evaluation of students performance indicate a significant advantage in their understanding on basic Geoscience concepts when using GAIA as compared to their traditional school teaching methods.

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References

Birbilis, G., Koutlis, M., Kyrimis, K., Tsironis, G., and Vasiliou, G. (2000). E-Slate: A software architectural style for end-user programming. *Proceedings of 22nd International Conference on Software Engineering*, Limerick, Ireland.

Campbell, W. (1997). *Introduction to geomagnetic fields.* Cambridge University Press.

Dobrin, M., B., and Savit C. H. (1988*). Introduction to Geophysical Prospecting.* McGraw-Hill.

IAGA, (1995) Division V, Working Group 8, International Geomagnetic Reference Field. *J. Geomag. Geoelectr.*, 47.

Jonassen, D. H. (2000). *Computers as Mindtools for Schools: engaging critical thinking*. Prentice-Hall

Kali, Y. Orion N., and Mazor, E. (1997). Software for assisting high-school students in the special perception of geological structures. *Journal of Geoscience Education*, v. 45

Lowrie, W. (1997). *Fundamentals of Geophysics*. Cambridge University Press.

Papageorgiou, A., Sampson, D., Kotsanis, Y. and Dapontes, N. (2001). Gaia: Curriculum-based Exploratory Educational Software Using 3D Components. Proceedings of *The World Conference on Educational Multimedia, Hypermedia and Telecommunications ED-MEDIA 2001*, Tampere, Finland, 25-30 June 2001

Roschelle, J., DiGiano, C., Koutlis, M., Reppening, A., Phillips, J., Jackiw, N., and Suthers, D. (1999) Developing Educational Software Components. *IEEE Computer.*

Shama, G., and Layman, J. (1997) The Role of Representations in Learning an Interdisciplinary Mathematics and Physics University Course. *Research Conference in Collegiate Mathematics Education*, Central Michigan University, Mt. Pleasant, Michigan. September 4-7, 1997.

Teodoro, V. (1990). The computer as a conceptual lab, Learning dynamics with an exploratory environment: *NATO Advanced Research Workshop Technologies in the teaching of Mathematics and Science*, Milton Keynes.

Thornton, R., K., and Sokolo, D. R. (1990). Learning motion concepts using real-time microcomputer-based laboratory tools. *American Journal of Physics*, v. 58.

Learning Statistics in the net

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Abstract: In this communication we present how to design and to develop a course in an asynchronous on-line university. It is based on three key aspects: a detailed working plan, interactive and multimedia learning resources and the teacher coaching activity during the course. As an example of a Mathematical course implementation we discuss some aspects of a Statistics course of the Computer Science curricula at the UOC.

Introduction

La Universitat Oberta de Catalunya -UOC [The Open University of Catalunya]- was born at the end of the 1990's to offer university undergraduate and postgraduate degrees in Spain. The UOC is an on-line university based on an asynchronous model, both in time and space. The relationship between the student and the UOC is established through a Virtual Campus, an Internet-based communications environment. The Virtual Campus allows students and lecturers to interact, without having to occupy the same time or space; it also facilitates communication with the other areas within the university itself (the Secretary's office, library, I.T. helpdesk, etc.) through a PC connected to the Internet.

In general, mathematics' subjects suppose a stumbling block for all the students who have to overcome them, more in particular; in distance learning environments the difficulties that are detected are even bigger. In fact, the students who attend a kind of subject like this one only can make use of a text and the possibility of getting in contact with the teacher by writing a message to him. In these conditions, the difficulties for the learning process are, in general, considerable. With the purpose of facilitating the learning process of this type of subjects, a detailed planning of the activities and the use of technological resources compatible with the environment are proposed and also the redefinition of the teacher's role.
The teacher becomes more a learning facilitator rather than an information or content transmitter.

On-line learning strategy

Every semester the student enrols the different courses selecting those ones of interest from the curricula. Each one of them has a detailed planning. This planning consists on a set of weekly working packages. A working package includes general objectives, theoretical contents, examples, practical activities, and assignment criteria. In an on-line learning environment the student has a computer connected to the net. So, the planning presentation and the most of the learning resources take advantage of the information and communication technology. The learning resources are any kind of multimedia document (even printed text), interactive simulations and self evaluation systems [Mor 2000]. This kind of resources are fundamental to overcome the limitation of learning material based on printed text [Vallverdu 1999]. On the other hand, the planning presentation evolves depending on the student activity and his or her interaction with the teacher. The role of the teacher is no more focused on the information transmission but the learning facilitation. This means that the teacher coaches the student, promoting activities, moderating debates and reflection, and, of course, has to make the assignment.

An example: a course of statistics

In almost all areas of learning, from engineering and sociology, through to biology and economy, certain issues arise and they are hard to describe using mathematical models which are often too complex or, conversely, too simple. In practice, results are often obtained from experience and from a series of well-organised and appropriately-treated data. Statistics studies how to obtain relevant information from a series of data and can become a fundamental tool in the decision-making process. In view of this, we had a special interest in design and develop a course of statistics, which would help the student attain the objectives established for the subject for which he/she has enrolled. We present a course of Statistics of the Computer Science curricula at the UOC [Sancho 2000].

By following a 'Learning by doing' methodology [Smith 98], the chance to perform a statistics-related task is offered to the students, the interest of which lies both in the conclusions he/she can draw from it and the processes and tools used. This task is made up of several parts: collection and organisation of data, descriptive analysis of the data, interpretation and meaning in relation to populations and conclusions and decision-making. Each student's learning process is built up adaptively, based on how he/she resolves these practical tasks, requiring the student to apply the various concepts he/she has assimilated. The teaching strategy for the student to assimilate the necessary content is provided by the scheme of work in which targets, content and the activities necessary to attain these targets are determined in a personalised fashion.

With the purpose of assimilating by the students the basic contents which have to allow them to accomplish the statistic works, the consultant will propose a pace of work and some weekly activities where the most important aspects to discuss, according to the timing of the subject, will be pointed out. The consultant will also comment the most relevant video units for the weekly theme and the convenience of visiting certain web pages to strengthen the ideas, which have been introduced to the study notes.

It is, then, important to highlight the fact that this learning process takes place on a network where the different agents involved can interact: students, lecturer and content. Interaction takes place through the resolution of exercises and experimentation using simulation tools via the Internet (XML standards, Java applets, J2EE) that helps to set the rhythm of the student's progress.

Conclusions

The work we have done has given us a new perspective on both the creation process and the design of teaching materials required for a virtual teaching and learning system. This perspective is based on the atomisation of contents and on the creation of all the possible links between them. In this way, we can achieve an adaptive environment, which will help personalise the teaching provided and ensure that the course objectives are met.

In terms of the common, adaptive learning environment for different university degrees, which include "Statistics" within their syllabus, we have explored different didactic materials for the teaching of quantitative subjects. By paying particular attention to the methodology, the content and the technology, the basic pillars which support the following have been established: the basics of knowledge, the interface, specialised strategies and the necessary technology to make everything work correctly.

References

[Smith 1998] Learning Statistics By Doing Statistics.
G. Smith and P. College
Journal of Statistics Education v.6, n.3, 1998

[Vallverdu 1999] An Interactive e-book applied to mathematical learning
F. Vallverdu, T. Sancho
17th ICTE

Tampa, 12-X-1999

[Sancho 2000] Zelig: Statistics for all
T. Sancho, A. Meseguer, F. Vallverdu
Mathematics/Science Educations & Technology, M/SET 2000
San Diego, 6-II-2000

[Mor 2000] Building A Virtual Learning Environment Using Agents
E. Mor, A. Abad, F. Santanach
Computers and Education in the 21st Century
Ed. Kluwer, 2000

WebSaber: Solving Problems in a Computer-Supported Cooperative Learning Environment

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Abstract: With the Web now providing the infrastructure for cooperation, the opportunity is ripe to create virtual community of problem solvers. We are working to create WebSaber, a computer-supported cooperative learning (CSCL) environment in which teachers have a set of communicating and coordinating tools, for promoting cooperative activities of problem solving. To explain WebSaber, we offer an overview of cooperative learning, and CSCL, describe WebSaber, detailing its features, and, finally, point out the conclusions and future works.

Introduction

Cooperation is acting together, in the pursuit of shared goals, the enjoyment of the joint activity, or simply furthering the relationship (Argyle, 1991). The educational system may not be concerned with fostering cooperation in learning but learners' work together, depending on the particular context. Cooperative learning is a teaching technique that develops problem solving and critical thinking skills through student teamwork. It consists of small groups working together to complete academic tasks, which involve a range of objectives, such as searching for facts, applying concepts and principles, problem solving and creative thinking, and teacher as facilitator and coordinator, setting the guidelines, encouraging cooperation, reviewing performance and joining to the groups.

Cooperative learning can be sustained by learning theories based on the same underlying assumptions that individuals are active agents that purposefully seek and construct knowledge within meaningful context. Sociocultural and Constructivism theories can play this role. In the other hand, the Internet can provide the infrastructure to foster cooperative learning activities.

Despite the potential, CSCL environments met serious problems. Frequently, cooperative learning is assumed as a natural output of teamwork. It is also assumed that the availability of CSCL tools is enough to motivate peers cooperation. However, cooperation cannot occur naturally and needs to be articulated by the teacher. We believe that CSCL environments should provide teachers with a comprehensive set of cooperative tools, able to be customizable according to teachers' pedagogical goals. Face the expressive number of CSCL environments, WebSaber was created to offer to the teacher safe, flexible and customizable cooperative learning setting.

WebSaber – an Environment for Cooperative Problem Solving

WebSaber was developed following the four phases of Software Engineering classic life cycle: analysis, design, implementation and evaluation and tests. The analysis phase aims to define and clarify the problem to be solved with the proposed software. In Brazilian software market, CSCL environments available in Portuguese, are lacking. Addressed solution was the development of an open CSCL environment for the domain of problem solving to be publish in the Internet and oriented to elementary school teachers and learners. The design phase requires the understanding of the nature of what is to solve problems in a cooperative way. In WebSaber, to solve problems is a social and technical step-by-step process. Five steps of a simplified approach of classic scientific method was adopted: the analysis of the problem, the building of preliminary ideas, the choice of good ideas, the planning of solution and its implementation. Current online system basically contains coordinating tools, with which teachers pose problems to be solved, choose steps and tools and control tasks, goals, dates, and cooperative tools, with which the learners cooperate and communicate among them, and built shared solution. The prototype main interface provides links to system components: Available Problems library, Selected Texts, the Tutor Mode and the Environment itself. Available Problems is a library that lists existent problems.

The Tutor Mode is the teacher working space. Accessing system at the first time, teachers must to fill a form for obtaining free access. They can choose one of the available problems to be solved, in the problem library, or register a new problem. The system automatically includes the new problem into the problem library. Two distributed tools help the coordination of the work: a schedule form allows the teacher to include, manage and publish activities, tools and dates; and an distributed agenda informs the learners about synchronous meeting dates and schedule adjustments. Teachers can also register URLs to be used as online complementary bibliography. The system automatically displays and distributes the information. Planned the tasks, the system opens its infrastructure to support cooperative problem solving activities. For that, it displays selected steps, allocates tools, creates a mailing list and a forum room and opens a room chat, allowing users to access the Environment it self.

The Environment it self is the learners working space. The system metaphor is a meeting room, where users can interact and work in. WebSaber provides three main locales: a Hall, a SittingRoom and a WorkRoom. Each locale has a clear purpose, its own activities, communicating and coordinating tools and a temporal dimension. The Hall displays available problems in a virtual wall. The Sitting Room is the space for social changes, where users can chat, send messages and write and show off personal annotations. The WorkRoom is the work place and it supports the problem solving dynamics. The dynamics follows enchained steps, and these steps are related to specific tools and to the teacher coordination support. Some steps of problem solving demand a shared whiteboard. The WebSaber central component, that makes it different from similar environments, is precisely the whiteboard. Cardoso, Lima e Silva (2000), in the context of a Computer Science bachelor degree project, advised by the author of this paper, developed a whiteboard, that can be accessed from WebSaber environment. The tool is composed of the whiteboard it self, a chat software, an individual notepad and mechanisms for awareness, brainstorming and voting. The whiteboard allows file downloading and importing. The multi-user interface is based on the tightly cooperation mode, using the WYSIWIS (what you see is what I see) approach. It assures the sharing of the work context for all logged users. System scalability does not restrict the number of participants, whose access the whiteboard by typing valid username and password. It is the security mechanism. WebSaber also has its own e-mail and chat servers.

The evaluation and tests phases met problems. A critical point in the trajectory of WebSaber 1st version was the lack of a community of users, whose could evaluate the system in real use, and give feedback to enhance future versions. Maybe, the system security politics had inhibited its use. Tests indicated that WebSaber fulfils technical requirements. Over 100 Computer Science undergraduate students tested the prototype performance, attesting its scalability, extensibility and security. In these cases, the protocols, the priorities and restrictions mechanisms have performed well. These users related that it is easy to work in the Tutor Mode, but they are not the intended audience.

Conclusions and Future Works

The Internet client-server architecture allows the WebSaber gradual extension and upgrading. We received Governmental grants to rethink and improve the system. We are, at the moment, refining coordinating mechanisms, designing a new interface and developing a set of tools (a forum, a graphics editor, a new whiteboard) and adding two software agent to improve cooperation. WebSaber is primarily a work-in-progress and an academic project. Our research goal is to put available an experimental space, where teachers, undergraduate students and researchers can think and rethink about cooperative learning, new ideas and innovative features for CSCL environments.

References

Argyle, M. (1991). *Cooperation: The basis of sociability*. Routledge, London.

Cardoso, A. L.M., Lima, M.M., & Silva, R.T. (2000). *ECoopNet: A Shared Whiteboard to Support Cooperative Learning*. Dept. of Computer Science/UERJ. Rio de Janeiro, Brazil (Unpublished).

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CyberBiblio: an Interactive Multimedia Digital Library

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Abstract: The way to obtain information has exceedingly evolved thank to the development of new technologies and the possibilities that multimedia offers. The project presented in this paper aims to create a Community of Digital Libraries that allow *euskaltegiak* (schools to learn Basque), and more concretely, their students, study Basque language by using multimedia applications. CyberBiblio, our particular Digital Library, is a local solution with contents of general interest. It is based on a simple scalable architecture and uses resource-sharing mechanisms to achieve its objectives. This paper describes in detail aspects that should be considered if one wanted to implement such a service, highlighting some problems one must resolve.

Introduction

The explosion of educational multimedia applications is a reality, and some *euskaltegiak* (schools to learn Basque) have embraced this option. These *euskaltegiak* have added some workspaces where people can develop their Basque language skills on their own through books and computer programs. The first step begun in 2000 with HEZINET (Pérez, T. A. et al. 1999), a system for distance language learning called Hezinet. This product uses multimedia and artificial intelligence techniques to offer adaptation to the user. At the moment the system is being used in about 2500 workstations in the Basque country and Latin America.

In order to complete the system more reference material is demanded. Not only books, but also interactive programs to complete the workspaces already mentioned. The use of one of such programs is simple, but when there are several ones to manage the use becomes not so easy. For example, some of them need to have the original CD in the drive to work properly. This would be fine if we used only one of such CDs, but becomes unmanageable when the number of these systems increases. If we also wanted to optimize the number of CDs, we had to restrict the use or install and uninstall such systems based on the users' demand.

To overcome these drawbacks we have developed a digital library (DL) to be used in the environment previously described. We call this DL *CyberBiblio*. It contains interactive multimedia programs. Users have the opportunity to access every material included in the system from their workstations without being worried about which CD is in a drive, or which requirements the software has or without having to install or uninstall any of the programs in their workstations.

The challenge has been to build such a system having in mind the idea that the system would grow in the near future and the architecture for the system would have to be stable to support that problem. Besides the response time would have to be acceptable in such cases. In other words, the system was required to be scalable: if we wanted to increase the number of workstations or the quantity of material included in the system the architecture have to adapt itself to those changes without [major] changes in the system. Even to add new services the system has to be able to include them. Also, the architecture has had to be simple: easy to understand and build. The users of the system would be non-specialized people. The administrators of the system will be people with a limited experience on computers. So a complicated organization can guarantee the failure of the system. Finally, the system has to be fault tolerant and economically affordable, that is to say that some of the requirements can vary slightly in order to get a cheaper (let us say, not so expensive) system.

In this paper we present the major problems we have faced to build a system like the one described before, and the way we have solved them. To do this we first introduce a taxonomy for digital libraries, then we describe with some detail the library and then the architecture of CyberBiblio. Afterwards, we discuss some problems overcome during the implementations of our particular DL and some conclusions and future lines.

A Taxonomy for Digital Libraries

There are several criteria to classify DLs These include (1) the *media* used on their documents, (2) the kind of documents they store, (3) the *geographic scale* of the network they use, (3) *deployment of the information* and (4) user-access policies.

According to the *media* used on their documents, DLs may be classified in text file, audio, image libraries or multimedia libraries. The library created by the Gutenberg Project (http://www.promo.net/pg) contains basically texts. Texts are usually formatted or digitized form a printed book, a map or even from an Egyptian papyrus such as the documents in *Tebtunis*, one of the sections of the Berkeley Digital Library (http://sunsite.berkeley.edu). Texts usually also include some pictures or graphics. The *Printed and Photographs Online Catalog* (PPOC) from The Library of Congress (LOC) (http://www.loc.gov) or the *Microsoft Design Gallery Live* (http://dgl.microsoft.com) are examples of image libraries. The LOC also contains a catalog of its audio section of the library, called *SONIC*. Another audio library can be the "*biblioteca de voces*" (library of voices) included in the *Miguel de Cervantes Digital Library* (http://cervantesvirtual.com), which is a result of a project to make available best-known books (such as Don Quixote) to visually challenged or illiterate people. Even the *Napster Community* (http://www.napster.com/) can be considered an audio library which requires a specific software to browse it. Although a library can contain several of these types of documents, we cannot say it is multimedia unless it works and relates with all those media altogether (or, at least, some of them). We could describe some of the libraries as *"multiple libraries of one specific media"*.

Considering the *contents* of the documents, there are different kinds of libraries. There are *general purpose* DL such as the LOC. This DL is open to many topics, whilst other are devoted to a more *specific purpose*, such as the ACM Digital Library (http://www.acm.org/dl), which is about computer science.

If we look at the *geographic dimensions* of the network, two types of DLs can be found. On the one hand, those that cover the worldwide area, based on the use of *Internet*. On the other hand, the ones that constitute a local solution, based on an *intranet*. The former ones are accessible from any computer connected to Internet while the latter ones offer their services to a more concrete audience, restricting access to a local area network.

Another criteria are the number of places used to store the documents. In that sense, *centralized* libraries store the documents in one place and *distributed* ones have several document containers spread out according to the geographic dimensions of the network they use.

Finally we include the *user-policy* as another criteria to consider. *Free-access* libraries allow users to browse through their virtual premises and read or consult anything they want. Some other libraries only allow browsing and charge users for reading. Others charge even for browsing. The latter ones are *restricted* libraries. Of course, we have to take into account their geographic dimensions. An example of the former can be a library in a town that allows users to access to the e-books in their computers, and the only thing you have to do to access that books is to go in and use the computer. We would consider that library as an example of the latter if that library would only let use the computers to women, people over 18, those who had paid an amount, etc. Usually, free-access library are owned by public entities such a city hall, a University, a non-profit foundation, etc. Restricted ones are owned by groups of people with some common interest.

CyberBiblio

The project CyberBiblio has been carried out between the Hypermedia and Multimedia Group of the University of the Basque Country and with the help of a private foundation dedicated to the development of Basque Language called *Aurten Bai*. The principal tasks have been done during 2000. In 2001 we have started to install some units of these community of libraries through the Basque Country (in either *euskaltegiak* or city libraries).

CyberBiblio is a DL of interactive programs published in the Basque Country. The catalog shows a list of the available titles at that time (Fig. 1). The main characteristic of the shared material is that use multimedia presentations like animations made with Macromedia Director, Flash, ToolBook, etcetera. Also, users could find other documents, like mp3 audio files, pdf or word documents, and so on. In general, all kinds of material available on CD-ROM. Usually, it contains atlas, encyclopedias, learning material for children, games, monographs, Basque music... everything one can use to learn Basque or increase his/her knowledge about Basque culture.

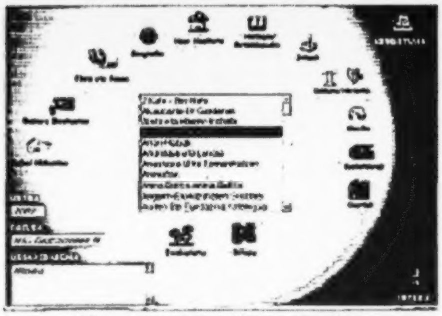


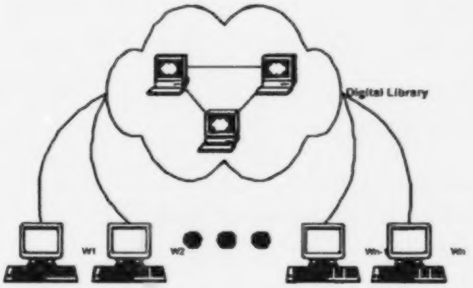
Figure 1: CyberBiblio Catalog

Corresponding to the criteria given in section 2, we could say that CyberBiblio is to be used in an Intranet. Since we do not hold the copyrights of all the programs we use in the DL, we are not entitled to share them with all users in Internet. There would be no problem to show the catalog, but anything beyond that point would violate the rights of some of the programs the DL includes. It also has been designed as a distributed library since the programs can be stored in different computers. The catalog is in charge of indicating where to find the desired resource. The target environment would decide the user policy. In the case of CyberBiblio we have both policies. When it is installed in a *euskaltegia* the only users allowed to use it are the students of that school. However, we have also installed the same DL in public libraries, in which every user of the library (or a visitor) can access to the computers (of course, if there is some space available).

In order to classify the purpose of CyberBiblio, we should say that the main purpose was to provide contents to learn Basque. Nevertheless, these contents have grown and the purpose is to spread Basque culture, as a traditional library could do. So we can say that it has a specific purpose for a group of population (Basque students) and a general purpose for those who already know the language. Currently the contents are limited to Basque Country issues. The implementation is always in a library either in the Basque school or a public library.

Architecture of CyberBiblio

Since CyberBiblio has been developed to share multimedia applications distributed on CD-ROM, it is necessary to find a way to do it. During de design phase of the system we consider two main ideas: *install on-demand* and *resource sharing*.



Install on-demand

This configuration emulates the behavior of a jukebox. When users browse the catalog, they can select (ask for) any application included. The system first controls whether the application has been already installed in the system, if not, it searches through the CD-ROM base and installs the application on the corresponding PC. When he stops using the software required, the catalog would be shown again.

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This option assumes than periodically the system would clean the workstations, because the installation, uninstallation and reinstallation process leaves sometimes files on disks and the registry is not left as it was found at the beginning. Also, the system has to be able to uninstall some software due to space requirements (there is not enough disk space for another application). Finally, the process of install and uninstall applications add a delay (usually several minutes) to the system that may not be assumed by the users.

To accomplish this alternative, there is some software available. For example, WinInstall from Micromouse (www.micromouse.com) or Microsoft Windows Installer (http://msdn.microsoft.com/library/default.asp?URL=/library/devprods/vs6/vstudio/vsinstal/vcconmicrosoftwindowsinstallertechnology.htm) from the Microsoft's Zero Administration Kit (ZAK) or Microsoft System Management Server (http://www.microsoft.com/catalog/display.asp?subid=22&site=650&x=22&y=11).

Resource Sharing

In this approach, the resources are shared from the place(s) they are stored. This is not a new concept. In fact, every operating system includes this functionality. Microsoft Windows 2000 includes, for example terminal server services and sharing of file system.

This alternative presents some advantages when compared to the previous solution. First of all, it is not necessary to wait for the applications to be installed. Although they have to be installed, this process is done only once. Besides, there is no need to use the network to do that. However, in this case the network is more frequently used.

The terminal server let each terminal establish a session in one of the computers that contains the required resource. The user works directly against the application container, but the execution seems to be happening on the local computer. This is a cheap and simple solution unless you have to use local peripherals from the server execution (for instance, if you want to listen to an audio file on the speakers of your computer instead of the ones on the server; or local disk drives; etc.). This problem can be overcome using the Independent Computer Architecture (ICA) from Citrix (http://www.citrix.com/products/clients/ica/technology.asp) at a not so cheap price as the operating system software like Windows 2000.

An alternative is to use the file-sharing feature of the operating system. Using this approach, each workstation would have to have access to the files installed in one common place and there will be necessary to do several small actions in each workstation (modify the register when appropriate, add some dll's, etc.)

Decision taken

Our choice has been resource sharing using the file system sharing of the operating system. The aspects we have taken into account to make a decision include the quality of the solution, the difficulty of its implementation, and its cost (one of our main handicaps). In our case, the price avoided the election of ICA protocols, one of our best choices. We also consider using Windows 2K, but its price push us to choose to use it only in a server machine and use other operating systems like Windows Millenium, also from Microsoft. This choice implies a more difficult way of implementing the security in the system but accomplishable (although less transparent to users).

Problems Overcome

Most of the problems of the implementation of CyberBiblio arose when adding applications to the library (at installation level) and others to maintain system security (avoid users misuse the system). In the following paragraphs we will detail both.

Problems at application level

Multimedia and interactive applications shared in a system usually try not to overload the computers in which they are executed. So only a small part of data is copied in the user disk, being necessary the CD-ROM to access the rest of information. Based on our experience with the installation of multimedia applications, we can distinguish four types of installation:

1. *Direct copy.* In fact the applications in this category do not need to be installed. There are some executable programs and data files. The installation process is as easy as copying the files to a shared device (commonly a shared hard disk).

2. *Files with a specific reader.* In this case, the installation process is similar to the one above. However, there are common (freeware) reader programs to access to these types of documents. In this category we could find pdf, word or postscript documents; audio files in mp3 or wav; video documents in quicktime or mpeg format. Or even navigable documents in HTML. In this case it is necessary to install the specific reader at each workstation.
3. *Simple install applications.* Our experience tells that most of the applications belong to this type. In this group we include those applications that include an installation program responsible of putting the files in the appropriated location. This program is generally called *install* or *setup*. What makes this process simple is that the program does not need to modify the workstation computer registry. Sometimes it is necessary to include some library files (DLL) on the workstations to achieve a correct execution. Sometimes there are incompatibilities between requirements of one application and another. For example, two applications use the same DLL. But one of their installation programs do not care about which one is available in the system at one moment. So, they allow the substitution of newer DLLs with older ones interfering with the other application execution.
4. *Complex install applications.* The applications in this group include installation program as the previous ones, but during this process or during executions some problems arise. For example, some of the applications check if the CD-ROM is present on the machine during their execution. These types of applications have being the most difficult ones to install in order to achieve sharing access. Though we installed most of them, there are only two that we couldn't share through the network. In these cases we should establish an alternative method to use them. For example, traditional CD-ROM borrowing.

Problems at security level

We have considered very important to prevent the workstations from potential malicious use. Sometimes users know more about computers than librarians. So we have spent some time determining a security policy. This alternative could prevent from actions that do not let the system remain configured. We have considered that the best option is to prevent people to access the workstations with other purposes than accessing the catalog. The operating system can help to reach the desired security level. For example, in Windows 2000 Server in combination with Windows 2000 Professional it is easy to establish a security policy and to spread it to the workstations.

However, if we want to do it in simpler operating systems (like Windows 9x or Me) it is necessary to work directly with the registry. Also, we must define which resources we want to show in the desktop (none) or which ones at the start menu (only applications from the catalog). And disable some common functionalities (for example, right mouse button at desktop).

In our case, we decided to limit the access to the resources. Users only have access to the catalog and the applications it shows. So, if the identification is correct, he/she will be able to access the information, but only to CyberBiblio (Fig. 2). If identification fails, the only available option is to close de session and back to the user identification screen.

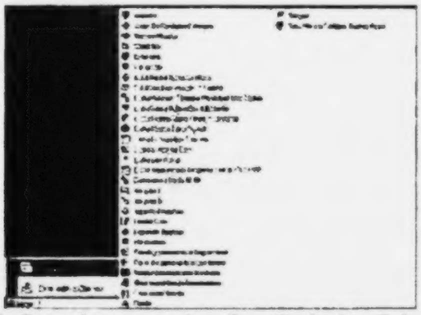

Figure 2: Operating system interface (limited to CyberBiblio)

Another problem we had to solve during CyberBiblio implementation process has been the need to write some own data of several applications. Some applications need write permission in some folders. For

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example in those that contain configuration files. Other folders, also, offer some free space where user can write information. This has been a very important aspect considered, because it is not recommendable to let users modify system files and folders in order to prevent an stable behavior of the system.

Conclusions and Future Work

In this paper we have presented CyberBiblio, a DLs community centered on Basque culture. CyberBiblio represents a significant contribution to scientific community, because, as far as we know, there is no other DL within CyberBiblio characteristics. Also to Basque society, because its installation will notably improve the Basque language learning and normalization. And by extension, to society in general, because it is very simple to implementing DLs with similar characteristics in other sites and in other contexts.

Introduction of CyberBiblio, the first DLs community in the Basque Country, has being a revolution in divulgation of multimedia material. This is because it guarantees almost all population access to a large amount of multimedia information published on CD-ROM. And everything in a quickly simple way.

As a result of this project there is a commercial product now implemented in different places of the Basque Country. At the moment there are three DL in the local libraries at *Amorebieta*, *Balmaseda* and *Baracaldo*. There is another DL located at *Zornotza-Amorebieta Barnetegi*, a school dedicated to the learning of Basque language. Now we are in contact with other town or city halls of the Basque Country to show them the product, its possibilities and characteristics. Our main objective is creating the major number of public places dedicated to Basque language learning and practice. Also we pretend to include there other computing tools like HEZINET.

Apparently, this is only the beginning of a progressive and constant settlement of Multimedia DLs in the Basque Country. Librarians' experience by now has been very positive. As well as users' opinion, which has flooded all our perspectives, and give us enough courage to improve the library and introduce new services. In fact, we are now working on a version of CyberBiblio to Spanish culture.

References

Pérez, T. A., & Gabiola, K., & Gutiérrez, J., & González, A., & C., J. A. (1999). Hezinet: Interactive (Adaptive) Education Through Activities. *Proceedings of the World Conference on Educational Multimedia, Hypermedia and Telecommunications*. Seattle, WA (EE.UU.). 1837-1842

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Sharing Best Practices and Resources in Multi-Instructor Courses

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Abstract: In most universities, the required undergraduate courses have high enrollment (multiple sections) and are frequently taught by part-time instructors or graduate students. Part-time faculty are an important asset to any university, but this group can also present a wide range of professional qualifications and teaching experience which can result in significant variations in the depth and quality of instruction This paper reports on the collaborative effort by full and part-time faculty in an urban Midwestern College of Education to improve the consistency of course content and quality of instruction between multiple sections of a core undergraduate course. One strategy used to reduce the threat of "course drift" was the development of web-based resources to support both the instructor and student.

In most universities, the required undergraduate courses have high enrollment (multiple sections) and are frequently taught by part-time instructors or graduate students. The National Center for Education Statistics reported that as of Fall 1998, 43 percent of postsecondary instructional faculty and staff were employed part time as defined by their institution (2001, p. 2). An additional survey by the Coalition on the Academic Workforce of humanities and social science disciplines showed that less than half of introductory undergraduate courses were taught by full-time tenured faculty, and approximately 43 percent of all undergraduate courses in those disciplines are taught by part-time faculty or graduate students (Townsend 2000, p. 2).

Part-time faculty are an important asset to any university, but this group can also present a wide range of professional qualifications and teaching experience which can result in significant variations in the depth and quality of instruction (Lankard 1993, p. 1). In the case of large classes with multiple sections, the use of part-time instructors or graduate students contributes to significant problems with consistency and coherence to learning objectives (Roberts 2001, p. 2).

This paper reports on the collaborative effort by full and part-time faculty in an urban Midwestern College of Education to improve the consistency of course content and quality of instruction between multiple sections of a core undergraduate course. One strategy used to reduce the threat of "course drift" was the development of web-based resources to support both the instructor and student. The web site of shared course materials was intentionally designed to:

1. Improve consistency and quality of instruction throughout all sections of the course.
2. Reduce the preparation time for faculty.
3. Provide class materials such as PowerPoint presentations, web links, assignments, and other related materials in one easy to find location.
4. Model Internet resource use

The web site was developed using Microsoft Word, PowerPoint, and FrontPage, and was made accessible to students and instructors approximately one month after the start of classes in the Fall 2001 semester. The web site has been enhanced and modified during its use in the Spring 2002 semester. A survey and set of interview questions have been developed to collect data from students and instructors on the utility of the shared web resources. Student work will be collected from sections that used the web resources and from sections that did not to compare the quality of the products. Additional sources of information include grades, course evaluations, and student comments on those evaluation forms.

References

Lankard, Bettina A. (1993). *Part-Time Instructors in Adult and Vocational Education.* (ERIC Document Reproduction Service No. ED363797).

National Center of Education Statistics. (2001). *The Condition of Education: The Context of Postsecondary Education.* Retrieved March 28, 2002, from http://nces.ed.gov/programs/coe/2001/section5/indicator50.html

Roberts, Lowell. (2001, December 18). *The Pew Learning and Technology Program Newsletter (3)* 4. Message posted to PLTP-L@lists.rpi.edu Retrieved March 28, 2002 from http://www.ualberta.ca/htbin/lwgate/ATLNET/archives/atlnet.2002-12/Author/article-3.html

Townsend, Robert B. (2000). *Summary of Data from Surveys by the Coalition on the Academic Workforce.* Retrieved March 28, 2002, from the American Historical Association Web site: http://www.theaha.org/caw/cawreport.htm

Online Discussion Techniques for Teacher Trainers and Language Learners

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Abstract: Are there online activities that can encourage exploration, risk-taking, cooperation and experimentation that both teacher and learner can benefit from? This brief paper will include a discussion of two effective discussion techniques for teacher trainers and second language learners that have been used in an online format. *Kiva,* a discussion technique adapted from the Native Americans of the America Southwest, can be used as a forum for discussing issues of professional interest such as the role of the teacher trainer and contemporary topics of interest to language learners. *Six Colored Hats* is a technique that promotes whole brain thinking and problem solving from varied points of view. Both techniques can be used in an online forum to invite reflection upon issues related to teaching, teacher training, and learning. Both *Kiva* and *Six Colored Hats* are carried out in a CALL lab using the LAN to post questions.

Introduction

Techniques for creating successful online discussion are similar to techniques used to facilitate face-to-face discussion. Both are characterized by the following:

- They emphasize active participation and interaction
- They have a task, theme or goal
- They gather a range of ideas, opinions and concerns
- They are usually run by a group leader or facilitator

There are many discussion activities that encourage exploration, risk-taking, cooperation and experimentation that both teacher and learner can benefit from. "Talk is a major means by which learners explore the relationship between what they already know and new observations or interpretations which they meet." (Barnes, 1976; in Cullinan, 1993)

Computer Mediated Communication (CMC) and Discussion

Computer mediated communication permits the learners to benefit from the shared experience of a group engaged in the same study and the opportunity to measure his or her ideas against those of others in the group. (Tam, 2000) Many group discussion techniques can be facilitated through the use of a Computer Assisted Language Lab (CALL). Two such techniques, *Kiva* and *Six Colored Hats* have been used in a CALL lab to great advantage.

KIVA

Kiva is a discussion technique that has been adapted from the Native Americans of the American Southwest. It develops critical thinking skills by causing participants to identify and cite reasons for their decisions making within the group. *Kiva* also encourages creative language learning as second language learners combine (orally) ideas and responses in novel ways to produce complex thinking patterns.

How does it work in the CALL lab?

Traditionally, participants in the *Kiva* are placed in two concentric circles, the inner circle consisting of four to five members. Only the inner circle speaks, discussing the chosen topic. Members of the outer circle listen. After a set time has been called, inner and outer circle members exchange places with each other and the discussion continues. In the CALL lab, the format is basically the same. The teacher/facilitator posts a question to 4 – 5 students/participants. These members of the "inner circle" discuss the discussion topic in an asychronchrous discussion. After three days, the "inner circle" changes, teacher appointed or participant volunteers, and the discussion continues. After a week or 10 days, the discussion ends with the teacher/facilitator summarizing the salient points of discussion. If the topic was a problem solving one, then a course of action is recommended and posted to the group. An example of an appropriate question for teacher trainers might be: What is the role of the teacher trainer? A student topic might be: English should be the official language of the United States.

Six Colored Hats

Six Colored Hats is a management technique developed by Edward DeBono (1985). It has been adapted to the classroom in order to promote whole brain thinking and problem solving. It also incorporates lateral thinking as well as critical thinking.

How does it work in the CALL lab?

Six Colored Hats represents six modes of thinking, represented by six colors, which are considered directions to think in rather than labels for thinking. For example, when given a topic to discuss, the white hat represents facts and figures, the red hat: feelings and emotions, black hat: judgment and caution, yellow hat: positive aspects, green hat: creative ideas (related to topic) and the blue hat: a summary of topic discussion. In the online environment, the topic for discussion is posted and the group is divided evenly to one color apiece. Each group is therefore responsible for discussing the topic according to the aspect of the hat color they are assigned. The blue hat group will provide a summary at the end of the discussion. This online discussion activity requires advance in-class preparation before it is attempted online. An example of an appropriate question for teacher trainers might be: Egyptian university graduates are often assigned to teach English whether they want to or not. Is this an appropriate policy and what can be done to solve it? (actual question used in teacher training session in Egypt by author). An appropriate problem solving task for students might be: Students are talking while others are talking or teaching. What can be done?

Conclusion

Kiva and *Six Colored Hats* both provide a means of initiating online asynchronous discussion between teacher/facilitator and student/participant. With effective moderation and preparation by the teacher/facilitator, participants will be able to achieve their educational and professional goals. The potential of telecommunication technology lies in its ability to function as a gateway; a gateway to resources, collaborative learning and individual achievement. (Tam, 2000)

References

Cullinan, B.E. (1993). *Children's voices: Talk in the classroom.* Newark, Delaware: International Reading Association.

DeBono, E. (1985). *Six Thinking Hats*. Boston: Little, Brown, and Company.

Tam, M. (2000). Constructivism, Instructional Design, and Technology: Implications for Transforming Distance Learning. Educational Technology and Society, 3 (2), (68 paragraphs) Retrieved January 29, 2002 from http://ifets.ieee.org/periodical/vol_2_2000/tam.html.

Teaching the Woburn Case Study

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Abstract In this presentation we will demonstrate an instructional CD-ROM, Investigating Community Environmental Health Problems, and describe how it was incorporated into the cooperative learning technique called structured controversy to teach public health students in a Masters level course in Environmental Health. The program was designed as a resource for students regarding the various lessons that were learned in a well-known case. The CD-ROM was produced to help users determine the environmental health of a community, particularly as it relates to the presence of hazardous chemicals. The CD-ROM relies heavily on the experiences of citizens and public health professionals working in the community of Woburn, Massachusetts around the contamination episode publicized in the book and movie "A Civil Action".

Background of the Course

The Woburn Case Study was used in a survey course in Environmental Health, **EH708 Introduction to Environmental Health**. EH708 is a required course enrolling approximately 100 students not concentrating in Environmental Health. Although student interest in the course content is highly variable, the course must introduce students to the widest range of environmental health problems. This may be the their only exposure to an environmental health course. However, it is highly likely that these students will work in communities facing environmental health challenges, which have implications for other dimensions of public health within that community.

The used of the traditional case method and a classroom strategy called structured controversy was enhanced through the use of multimedia CD-ROM technology. The Woburn CD provides a rich context for students to identify environmental health data, to better understand the implications of epidemiological principles and how to apply these principles in community settings. We tell the Woburn story through audio and video segments taken from local cable documentaries and expert panels, as well as documents, photographs and other media used in or produced in connection with the trial.

Using the Case Study and Structured Controversy

Several weeks before the scheduled class during which the case was discussed students were asked to explore the CD-ROM, *Investigating Community Environmental Health Problems*, along with several printed study aids, study questions and websites. One week in advance of the scheduled class meeting, the class was divided into six groups, each group taking the role of one of the key players in the Woburn story. The six groups were organized into three pairs, forming the basis for the structured controversy exercise. During the first 30 minutes of the two-hour class period each group met separately. Each group was given a controversial question and was asked to prepare a response directed to the other group in their pairing. During the second part of the class period a facilitated, spirited discussion ensued with students speaking in their roles as lawyers, scientists, etc.

Pairings and Discussion Questions

Question for citizens group and Department of Public Health group:
Like many environmental health problems, the possible link between drinking contaminated water and risk of childhood leukemia in Woburn was laden with uncertainty. Which kind of error do you think would be worse in assessing a situation like that in Woburn: incorrectly concluding that there was an association between the water and leukemia if in fact there wasn't; or incorrectly concluding that there wasn't an association if there was?

Question for scientists group and press group:
In Woburn, government agencies, scientists, local residents, and the legal system all tried in their own ways to figure out whether industrial pollution of drinking water was causing excess leukemia. What role do you think community members should play, if any, in scientific studies of pollution and health in their neighborhoods?

Question for WR Grace (the industry named in the civil lawsuit) group and plaintiffs' lawyers group:
Local activists who took on WR Grace and Beatrice Foods had a lot of community support from residents who were concerned about their health. On the other hand, some residents accused the activists of giving Woburn a bad name, pushing property values down, and driving industry out of town. How do you think a community can best balance its concerns for environmental health and economic development?

Session Objectives

1. At the end of this session, students will be familiar with some of the details of the Woburn case, such as the scope of the childhood leukemia cluster, the source of drinking water contamination, the various health data and follow-up studies, the lawsuit, and the clean-up activities.
2. At the end of this session, students will be able to articulate problems faced by various stakeholders in Woburn, including the difficulties citizens faced in getting health studies done and clean-up begun, the concerns of health officials not to create false alarm but also not give false reassurance, and the conflict between economic development of the community and health and well-being of its citizens.
3. At the end of this session, students will have an understanding of the role that citizens and citizen organizations can play in creating pressure on government agencies to act, in engaging and working with scientists in conducting health studies, and in following through on efforts to reduce harmful exposures.

Observed outcomes from using the case study

The case study, as presented via the CD-ROM, met the objectives of familiarizing students with many details of the Woburn case. More importantly, when combined with the structured controversy class activity, it allowed students the opportunity to "walk a mile in another person's moccasins," or understand another point of view about the meaning of the toxic contamination problem for a community. Because the format of the class activity required students to consider and articulate their answers to specific questions, several commented that they had learned something in a new way. The level of energy and interaction in the small groups and the class wide discussion combined with student feedback on course evaluations confirmed that this was an active learning process that largely succeeded in meeting our objectives.

Summary

During our presentation we will demonstrate this highly engaging CD-ROM and share video clips of these paired dialogues and subsequent class wide discussion. We will also discuss our lessons learned from producing the CD-ROM and facilitating its use in a public health curriculum.

References

Johnson, D.W. and Johnson, R.T. (1988). "Critical thinking through structured controversy." **Educational Leadership** 58-64.

Accessible Distance Education Based on Collaborative Learning – A Research Approach

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Abstract: This paper provides a short description of the theoretical foundation, accessibility criteria, and the research approach related to the project "Accessibility and learning in higher education" conducted by Malmoe University in Sweden. The criteria of accessibility are developed in connection with a pilot course under the projects' management, and the research approach is related to course accessibility and how disabled students participate in the collaborative work within a course.

Introduction

Many disabled people do not enter universities even though they have the intellectual ability. The situation in Sweden and US is similar (Horn & Berktold, 1999; National Agency for higher education, 2000). New technology has given disabled people better opportunities to get information and to communicate with people from different places all over the world. Distance learning can be a good studying alternative for disabled students, just as it is for non-disabled students. Malmoe University in Sweden is conducting a project entitled "Accessibility and learning and higher education", which is an integrated research, development and training project. The theoretical goal of the project is to combine recent contributions in collaborative learning theory with advances in information technology. The programme focuses on making online university education more accessible to students by intelligent use of the potentials of computer support. In November 2001 a pilot course started under the projects management. The course design is based on a theoretical foundation and on criteria of accessibility that have been formulated within the project. To receive more information about the project, read Schenker's and Scadden's paper "The design of accessible distance education environments that use collaborative learning" (Schenker & Scadden, 2002). The theoretical foundation, the criteria of accessibility and a research focus of the project will shortly be presented below.

Theoretical foundation

In the social oriented learning theory the context for learning is central. The existing situation drives the learning process (Lave & Wenger, 1991; Vygotsky, 1978). The theoretical foundation is partly based on Bakhtin's and Vygotsky's theories which have been developed by Dysthe (1996). According to these theories, dialogue promotes learning, and understanding is seen as an active process. Learning through dialogue means that it is important to give and to receive responses. Trying to understand the other person's thoughts and intentions is necessary, when giving a response. Dysthe outlines also that the differences between thoughts presented orally or in written text, are a learning-potential. Furthermore, there must be a confrontation between voices to make learning occur – people must meet in a dialogue (Bakhtin, 1981; Dysthe, 1996). The viewpoint is thus that learning is a social process. Even if learning is a social process, the process is also individual. It is important to help students to be aware of and reflect upon their learning approaches. Bruner (1996) states that a teacher who supports and encourages students' learning processes is more important than a lecturer.

Criteria of accessibility

The degree of course-accessibility for disabled students depends on several issues. The section below identifies some of these issues. For every issue, one or more criteria are formulated. The criteria are a synthesis of the theoretical foundation, experiences carried out by project members, and their recommendations. The criteria relate the entire spectra from course providers, students, educational design, and technological issues.

1. Educational design: (A) Course assignments help students to explore their personal learning preferences. (B) Flexibility in the conduct of course assignments and activities is provided to ensure that students can select the most appropriate learning environment and style.

2. Presentation of course content: (A) Course materials that are obligatory are accessible for all students. (B) The design of the course content and its presentation in formats allow students to select the most appropriate and preferred mode to meet their learning needs and preferences. (C) The guidelines for the design of accessible educational software developed by the CPB/WGBH National Center on Accessible Media [1] are followed.
3. The courseware system (a web-based environment for distance education courses): (A) It is possible to enroll in the course without installing additional software beyond that which is normally needed to use and communicate via the Internet. (B) The courseware system is built using guidelines for accessible web content developed by the World Wide Web Consortium (W3C) [2].
4. The approach used by the course providers: (A) The course providers are service minded and give individual support when it is needed. (B) The course providers are flexible and prepared to make decisions that promote course accessibility.
5. The capacity of the student's hardware, browser, and adaptive technology: (A) Students with disabilities have current computer hardware, modems with speed adequate to handle the kind of presentations required in the course, and the most appropriate adaptive technology and display parameters. (B) Course providers assist students by providing guidance and hints on improving accessibility through optimal use of students' hardware and software.
6. The student's disability and degree of functional limitation: (A) No student is disconnected from any part of the course due to his or her functional impairment.

Research focus

The research focus relates to disabled students who are participating in a distance-learning course that has a collaborative net-based environment. The first sub-focus is to test the criteria of accessibility in the course. The students will be asked to rate the accuracy of the criteria. The students will also be asked to give feed back on how the criteria can be developed further. Another sub-focus is to interview the students about their written contributions in the courseware system. Are the written contributions comparable with the student's actual participation in the dialogue? The purpose is also to learn more about the context in which collaboration on the web are experienced as engaging and touching. Research will attempt to assess whether Bakhtin's and Dysthe's theories appropriate in this context.

References

Bakhtin, M.M. (1981). The dialogic imagination. Holquist, C. (Ed.), Austin: University of Texas Press.

Bruner, J. (1996). The culture of education. Cambridge, MA: Harvard University Press.

Dysthe, O. (1996). The Multivoiced Classroom. Interaction of Writing and Classroom Discourse. Written Communication, 13 (3). 385-425.

Horn, L., & Berktold, J. (1999). Students with disabilities in postsecondary education: A profile of preparation, participation, and outcomes. Washington DC: U.S. Dept. of Education, Office of Educational Research and Improvement, National Center for Educational Statistics.

Lave, J. & Wenger, E. (1991). Situated Learning. Legitimate peripheral participation. Cambridge: Cambridge University Press.

National Agency for higher education (2000). Högskoleverkets rapportserie, 2000:4 R.

Schenker, K., & Scadden, L. (2002). The design of accessible distance education environments that use collaborative learning. Information Technology and Disabilities, 8(1).

Vygotsky, L.S. (1978). Mind in society: The development of higher psychological processes. Cambridge, Mass: Harvard University Press.

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[1] http://main.wgbh.org/wgbh/pages/ncam/cdrom/ guideline
[2] http://www.w3c.org/TR/WCAG10/

Hypertext for Discovery: Having The Whole Library to Oneself

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Abstract: A recent article in *Educational Technology Review* describes 3 types of learning. The tendency today is towards the lesser-planned associative methods seen in electronic learning. Teachers would like to combine such 'surfing' methods with their more traditional Information Retrieval techniques (IR) tailored to their own acquisition needs, and habits. *Metaphor* is the concept we use to construct a way of envisioning the tools of the future for exploring specialized information through multi-link media. The proper manipulation and communication of facts will depend on such tools.

What KING *et al* define as "Exploration without Objectives" or "Serendipity" in their article on e-learning is the type of activity the scholar of literature loves to delve into. Learning 'within the framework of' the total freedom of thought can be quite exciting. One of the greatest tools for knowledge transfer of all time offers such liberty: the Internet. E-learning simply through looking at various web pages and discovering the links they offer—and then the links they offer—is a leisure that lends itself very nicely to general long-term knowledge acquisition. There is room for improvement though.

Personal goals-driven e-learning (exploration) or e-learning by chance (serendipity) when "stumbling across seductive details on a page irrevelant to the individual's initial purpose for browsing" (KING *et al* 2001) breaks away from the traditional setting—good ol' in-school, in-person education. It is thus totally different from performance-related information accumulation through programmed "Instruction" 'shoved' at us *by the Other* (the teacher). As many teachers and researchers get in the know using the rather unstructured approaches, we will follow-up on this trend to learn on one's own and endeavour to build an approach for improving it.

Ad hoc information research devices on the World Wide Web impede writers of web pages from effectively *communicating* their knowledge to us.

The problem with having too much freedom in learning is that the links one follows—say in an hour's time—will most likely yield information pieces that have little in common with each other. This will not do if e-learning is to be taken up by specialists of any sort, whether in literature, medicine, technology, sports, business or handicrafts. In order to succeed, the structure of e-learning must show a few constraints.

We take professors as our example; we however could have used top-notch students, children or the inquisitive retired as our example of a user. Our idea is that professors, say of Philosophy, are quite apt of *refusing* to read texts on the screen because they cannot circle important passages, they cannot write their comments in the margin, and the pleasure of fondling a book written by an inspiring writer or just flipping through its pages is lost. Indeed, targeting finicky users challenges the interface designer. Professors tend to opt for the more traditional setting, i.e. having 7 or more books open on the desk in front of them, on their lap and on the floor, and of course having the gall to earmark pages, sitting pen-in-hand to question their *earlier* annotations... some professors in this situation are even inclined to ask a loyal wife/husband or a mediocre student to bring them another book! Why can't they just use computers like everyone else?

Their behaviour is only suitable to have at home with one's *own* books. So can't the Internet be the professor's big in-home book? Quite often, his computer is in his home.

Just as "serendipity" is a little too unconstrained a framework for a professor to learn in, being limited to one screen will not do. But isn't reading out of 9 books at once a little too 'loose' of an approach to constructively learning something?! No. The reader must not lose track of the fact that a professor is bright and always *chooses* books and articles from within the domain he is very at ease with. In fact, few professors truly like the Internet because they never know which section they are in (in a regular library, you can always find your professor next to the same rack of books unless they change it around).

In the end, e-learning and constructing technological responses for others who desire to learn is about the business of correctly communicating information over the Internet. In communication, since the linear image of the *telegraph* proposed by SHANNON & WEAVER (1949), we have seen metaphors like the *orchestra* conceived at Palo Alto by BATESON (1981), and the *desk-top metaphor* from Apple Inc. just to mention a few. The latter is the least important, as it is used simply to communicate to users how a new work environment should be perceived in order to better use it. The other two endeavour to explain *ex post facto* how human communication functions. What *we* are trying to do is define a metaphor to be used before hand, that is in communicating to designers and programmers of software—and eventually hardware builders—the functionality required by professors who like to 'hog' a small bit of the library in order to read and quote related passages and "wear out" books. This would require an original interface integrating the activities of *more than one person*. Perhaps we should modify the activity.

Today we have the capability to surpass the present library work environment taking into account the goals of specialists. Until now, the friendly librarian would simply help a philosopher put Physics, Math and Cooking, etc. to find just Philosophical texts, eventually pinpointing certain authors. But can a librarian out-perform a specialist on, say Descartes, when it come to IR on Descartes texts? Such a user has half of the information he will use in his head *already*, though he is not sure of the rest yet. He will only know what he is looking for once he has it. Here the problem of reference (JACQUES 1990; SCHMIDT 1997) surfaces; the specific information-seeking context of the problem is nicely formulated by Le Coadic (1994): "A user tries to describe something he wants to another person (librarian) without being sure of what it is, and that person will quite likely not know what it is either"[1]. Our specialist is calling out for a more individualized activity.

Apart from putting the total works of Descartes on-line, we propose to offer, thanks to indexing techniques, the specialist simultaneous reading of his favourite passages. Displaying a number of documents all at once (possibly using depth as a further dimension) would enable a parallel reading of this precious material. The main question is twofold: *1.*/just how much complexity should he have at his finger tips? …should he be required to take a course? ; and *2.*/in what form exactly should he see it? He is so used to doing this at his desk, on the floor or the kitchen counter. Obviously, his efficiency as a teacher or researcher is at stake. Once these questions are answered, we can implement an on-line version suitable to our *enthusiastic scholar* or the *mad scientist metaphor* outlined here (to be developed to guide design).

We are therefore entering into the era of the personal e-library in which one may 'treat books mischievously', scribbling notes on then so as to establish a multi-linked environment suitable to being accepted as a new on-line professors' workbench. Professors always try to find their way back to the bookrack where they read a related passage 3 years before, so keeping track of milestones and the lesser important stops on their voyage through a large corpus of literature could be useful too. Scholars do have difficulty convincing themselves to use two-dimensioned vertical glass screens. And in a domain-bound multi-link Hypertext system it is important to be able to set one's own "home" or anchor text (i.e. *Discourses*). Weeding out the non-pertinent is a challenge to e-learning.

References

BATESON G. (1981) Le télégraphe et l'orchestre, WINKIN Y., *La Nouvelle communication*, p. 13-26, Paris : Seuil.

BOUGNOUX D. (2001), *Introduction aux sciences de la communication*, Paris : La Découverte.

BUSH V. (July, 1945), "As We May Think, *Atlantic Monthly*, p. 101-108.

GYGI K., (1990), "Recognizing the Symptoms of Hypertext… and What to Do About It", in LAUREL B., *The Art of Human-Computer Interface Design*, New York: Apple Computer/Addison-Wesley.

JACQUES F. (1990), « De *"On Denoting"* de B. Russell à *"On Referring"* de P. F. Strawson, l'avenir d'un paradigme », *Hermès*, Paris: Éditions du CNRS, p. 91-100.

KING F. B., YOUNG M. F., DRIVERE-RICHMOND K. ET SCHRADER P. G. (2001), "Defining Distance Learning and Distance Education", *Educational Technology Review*, Vol. 9 N° 1.

LE COADIC, Y.-F. (1994), *La science de l'information*, Paris : PUF.

SCHMIDT, C. (1997), "The Systemics of Dialogism: On the Prevalence of the Self in HCI Design", Special Topic Issue on 'Human-Computer Interface', *Journal of the American Society for Information Science*, vol. 48 n° 11, New York: John Wiley & Sons.

SHANNON C. & WEAVER W. (1949), *The Mathematical Theory of Communication*, Urbana: University of Illinois Press.

WATZLAWICK P., BEAVIN J., JACKSON D. (1972), *Une Logique de la Communication*, Paris: Seuil.

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[1] LE COADIC, Y.-F. (1994), p. 53. Translation courtesy of the authors.

Community, Content and Collaboration Management Systems: Socio-Constructivist Scenarios for the Masses?

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Abstract: While there are dozens of "e-learning" platforms, not many systems support the "orchestration" of rich socio-constructivistic learning scenarios. We suggest to explore the pedagogical potential of the increasingly popular portals we call "Community, Content and Collaboration Management Systems" and we present our work strategy.

The Problem

Currently, there exist many variants of web-supported pedagogies, e.g. transmission of contents, web-based instruction, learning by apprenticeship in virtual environments, pedagogical work flow scenarios. Constructivist (e.g. project or problem-based) scenarios are quite popular (Wilson & Lowry, 2001) but supporting technology is hard to find and there is a particular need for tools that support socio-constructivist learning at the activities level. Empirical research (e.g. Dillenbourg 1999) reveals that collaborative or collective constructivist learning is not per se an effective learning method. It is more effective if individuals and groups have to evolve within well-specified scenarios, i.e. sequences of phases within which group members do tasks and play specific roles. While teachers can orchestrate complex scenarios with very little technology, the effort can soon become cumbersome.

Remember 1993's slogan of "shifting the focus from teaching to facilitating"? Todays "E-learning" systems are mostly anchored in the behaviorist CBT tradition. They focus on content delivery and the teacher's "facilitator" role is degraded to deal with web contents, quizzes and grading. They fail to support rich socio-constructivist scenarios engaging students in active project-based learning. Therefore we argue that R&D in educational software should not just focus on improving passive "interactive" courseware but on tools supporting students to solve more complex and open-ended tasks.

The Work Plan and Strategy

Implementation strategy #1: **Imitation of "Internet culture"**. Web pages, forums, e-mail and FTP are successful because they support the basic needs for exchange, communication and collaboration. While simple web technology does enable creative educational scenarios it has 2 drawbacks: (1) Maintaining static web-sites is time-consuming and simple discussion systems do bad knowledge management. (2) More sophisticated scenarios (like co-authoring or work-flow) are badly supported. Now, community web-sites facing the same problems found an answer. Within the last two years have sprung up what we coin C^3MS (Community, Content and Collaboration Management Systems). Inspired by personal weblogs, news systems, simple CMS and various groupware like file-sharing or calendars, C^3MS are modular tools for configuring interactive community web-sites. Systems like PostNuke or PhPWebSite offer a good set of core portal functionalities, such as user administration, a news/journal system, web-links sharing, search, FAQs and polls. Extension mechanisms allow third parties to contribute additional functionalities like collaborative hypertexts, picture galleries, simple content management systems, event calendars, chats, project managers, file-upload, and glossary management. Since we believe that a large number of rich educational scenarios can be supported by modular C^3MS systems at reasonable cost, we started deploying a few systems with teachers to investigate.

Implementation strategy #2: **Adapt to teachers**. Success stories of new technologies in education are often related to the teachers' ability to insert it into existing knowledge. It is easier to promote change when technology is simple and when teachers can relate to "models" they know, even if they are not necessarily related to teaching. Teachers must have an operational awareness (vonGlasersfeld) in addition to operational control. Inspired by

Guzdial's (2002) work with CoWeb, we start by presenting simple activities that can be enhanced with C^{3}MS. At the same time, we also introduce these portals as community tools (for teacher support) and we hope that the perception of their usefulness for "professional life" will help introducing them to education in the narrow sense. A first version of the catalog of educational scenarios and C^{3}MS bricks is available (http://tecfa.unige.ch/proj/seed/catalog/) and we hope to observe and report interesting experiments within the next 2 years.

Implementation strategy #3: **Support different user categories**: Such a system in order to be acceptable by the teacher community should appeal to different levels technical competence and "activeness". We discriminate four levels of use with respect to how teachers appropriate learning technologies: (1) Reusing: teachers who appreciate ready-to-use material. In our case, this is a scenario that has been instantiated with content. (2) Editing: teachers who feel the need to modify the content of a scenario they appreciate. (3) Designing: this means in our case to compose completely new scenarios by re-assembling basic components. (4) Programming: some teachers like to program and we can expect them to develop modules. The originality of our approach is to enable teachers to work according to their technical skills, to the personal investment, to what is available.

Implementation strategy #4: **Use synergies**. C^{3}MS are by definition a space for communities. This first means that we could integrate educational activities into existing community portals, e.g. create campus portals that are actually useful to education and not just an underused presentation/information tool designed by some central service. Conversely, since people learn a lot from informal exchange within tightly or loosely defined communities (fellow learners, professors, experts), we could open educational portals to other activities (news, sharing of links and contents, forums for professional activities). Additional synergies can be gained from making contents available (as MIT's OpenCourseWare or Berkeley's IU Project) and allowing the outside world (other classes, teachers, parents, experts) to annotate. Lastly, while each small community may want to run its own portal, contents can be syndicated. Building information and communication networks has become easier than ever.

Implementation strategy #5: **Don't overdo it**. We do not know yet the boundaries of C^{3}MS portals. One major drawback seems to be the lack of provision for integration (e.g. data-flow) between applications which are required for more complex CSCL scenarios. Another drawback is the management of contents over time. Handling these issues require the same sort of planning that a traditional user-driven educational web site does and future systems (on which we started design work) should address these issues.

Conclusion

This research on the use of "Community, Content and Collaboration Management Systems" for socio-constructivist scenarios is at its beginning stage. So far, we initiated a few field experiments and we produced an initial catalog of socio-constructivist activities with C^{3}MS bricks. We plan to support further sites, will prepare more dissemination materials and hope to report results within the next 2 years. We are aware that C^{3}MS portals are not fit for complex CSCL workflow scenarios, but we believe that there is an important need to actively support educational scenarios with simple technology under the control of teachers. Finally, C^{3}MS may be a chance to maintain the Internet Spirit in education which is threatened by the philosophy of many e-learning systems.

References

Wilson, B.& Lowry,M (2001), Constructivist Learning on the Web, in Liz Burge (Eds.), *Learning Technologies: Reflective and Strategic Thinking*. San Francisco: Jossey-Bass.

Dillenbourg P. (1999) What do you mean by collaborative learning?. In P. Dillenbourg (Ed) *Collaborative-learning: Cognitive and Computational Approaches*. (pp.1-19). Oxford: Elsevier.

Guzdial, M. et al. (2000) A Catalog of CoWeb Uses, *GVU Tech Report 00-19*. URL: http://coweb.cc.gatech.edu/csl/24

Guzdial, M., Rick, J., and Kehoe, C. (2001) Beyond Adoption to Invention: Teacher-Created Collaborative Activities in Higher Education, *Journal of the Learning Sciences*, 10 (3). URL: http://coweb.cc.gatech.edu/csl/24

von Glasersfeld, E. (to appear) "Radical Constructivism and Teaching", URL: http://www.umass.edu/srri/vonGlasersfeld/onlinePapers/html/geneva/

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User-centered Design of a Web-based Tool for Medical Residency Training

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Abstract The aim of this project is to design a prototype for a web-based tool to provide direct feedback regarding clinical content and outcomes experienced in residency training to both medical residents and their educators. This tool, the Resident Assessment Performance System (RAPS), will provide residents, program directors, and, eventually, accrediting organizations with a comprehensive record of residents' patient care experiences. To ensure the tool's usefulness and before any actual programming is done, it is essential to have an understanding of the stakeholders' needs and desires. Thus, our initial effort was a needs analysis, structured around specific individuals and themes. The results were combined with pilot data to develop draft screens that were reviewed by residents and educators to illustrate how resident profiling might improve the quality of resident training.

RATIONALE

Because of the greater variety of medical treatments available today, more emphasis is being placed on making evidence-based medical decisions and documenting the patient outcomes achieved from treatment. Also, changing patterns of medical practice, including reduced length of hospital stays and increased use of ambulatory services, necessitate increased experience in ambulatory settings for internal medicine residents. These changes are increasing the need for appropriate accountability measures that will assure the profession and the public that the medical education system is both monitoring the content of training and documenting how well it prepares graduates for future practice. As such, residency program directors need to assess and continually monitor the content, balance, and outcomes of both the inpatient and ambulatory care clinic experiences of their residents.

Methods often used to assess resident competency, such as surveys and knowledge tests, are limited in scope and do not provide a complete assessment of the residency experience. The Accreditation Council for Graduate Medical Education (ACGME) Outcome Project outlines criteria for evaluating residents and residency programs, including use of dependable measures to assess residents' competence in patient care and mechanisms for providing timely feedback. Residency programs are encouraged to use these outcome assessment results in their evaluation of educational effectiveness (ACGME 2000).

The RAPS project aims to address these needs and requirements through the design of a new user-specified and user-friendly web-based tool that would record and evaluate a resident's patient care experience and outcome performance, track hospital resource utilization, and compare performance to local and to national peer groups. Our review of the literature did not reveal any projects similar to RAPS. The development and evaluation of the RAPS tool will be an ongoing, iterative process. In keeping with our user-centered design methodology, tryout and revision cycles will continue as usability testing is done and end-user stakeholders will be actively involved to provide feedback on the content and usability of RAPS to meet their requirements.

METHODS

RESIDENT RECRUITMENT

We chose the University Medical Associates (UMA) Clinic as our study site. UMA is the primary site for general medical care of adults at the University of Virginia Health System. It is also where Internal Medicine residents receive most of their training in primary care. We recruited a cohort of fourteen internal medicine residents from the University of Virginia Department of Internal Medicine to participate in the design of the RAPS tool. From these residents, we solicited specific content and display recommendations by conducting a formal needs assessment using individual interviews and focus groups. We also conducted interviews with the residency program directors and faculty.

SYSTEM ARCHITECTURE

The RAPS project uses routinely collected electronic data contained in the University of Virginia's Health System's Clinical Data Repository (CDR) (Scully et al. 1997). The CDR is a relational data warehouse that was developed beginning in 1985 to support research and education at our institution. It integrates data from disparate systems and now includes eight years of inpatient data (approximately 30,000 admissions per year), eight years of physician billing data, five years of outpatient data (450,000 outpatient visits per year), six years of clinical laboratory results (750,000 lab results recorded per month), and eight years of surgical outcomes data from the University of Virginia Heart Center Thoracic Cardiovascular (TCV) departmental database. Last year, death registry data from the Virginia Department of Health, Division of Health Statistics was added. Currently, the database contains over 40GB of information representing approximately six million patient visits.

The CDR resides on a Dell PowerEdge 1300 (Dual Intel 400MHz processors, 512 MB RAM) running the Linux 4.3 operating system and Sybase 11.9.1 relational database management system (RDBMS) (Sybase Inc., Emeryville, CA). It uses a custom-built Web-based front end that allows local users to formulate ad hoc queries and download data to their own PC's. Alternatively, experienced users may submit their own Structured Query Language (SQL) statements directly to the Sybase Server or, with the installation of Sybase drivers, may access the Sybase tables directly with Microsoft Access or Excel.

NEEDS ASSESSMENT

The RAPS tool is designed to meet the needs of both internal medicine residents practicing in a general medicine clinic and their program faculty directors and advisors. As such, the results of the needs assessment were analyzed to determine the goals for the RAPS interface tool. A consensus list of priority conditions, patient information, and measurement end-points were assembled from the interviews and focus group feedback.

Overwhelmingly, residents and faculty expressed interest in information to help them manage specific populations, such as diabetes and hypertension patients, and health screening practices compared with published guidelines. Residents are interested in detailed information about their assigned patient panels, such as most common diagnoses, procedures, and demographic information. In addition to this information, faculty desire information describing the continuity of care, such as whether the same resident is seeing the patient on an ongoing basis. Measures of resource utilization are of interest to both residents and faculty. Information desired includes medication compliance, laboratory tests, procedures completed, costs and reimbursement, the amount of time physicians spend with patients, and follow-up appointment time. Other patient care outcomes of interest include hospital length-of-stay, emergency room visits, mortality, hospital re-admissions, patient and nurse satisfaction data, and missed and canceled appointments. To be meaningful, information used for resident physician profiling must associate variation in resource utilization with differences in the disease burden of the residents' patient panels.

CONTENT SELECTION

Our content selection was based on the following decision criteria:

- *RAPS project objectives and scope*
- *Data readily available*
- *Potential sources of new data*
- *Patient-identified data and surrounding confidentiality issues*

OBJECTIVE AND SCOPE

The RAPS project is intended to provide aggregate retrospective patient data to evaluate a resident's patient care experience and outcome performance. It is not intended for direct patient care. A pilot study conducted by the Association of Program Directors in Internal Medicine of its membership identified desired components of quality in residency training. Assessment outcomes of training indicators that were rated highly include appropriate amount of evaluation and feedback to residents, adequacy of patient mix, and applicability of the overall curriculum to future practice as general internists (Klessig et al. 2000). In keeping with the original intent and scope of the RAPS project, we focused on data elements that provide a broad view of residents' patient care experience such as diagnoses most commonly seen, aggregate measures of hospital resource utilization, and disease screening with appropriate guidelines and comparisons.

DATA SOURCES

The core data source for the RAPS tool is the Clinical Data Repository (CDR), a relational data warehouse with a Web browser interface that provides direct access to data for education, clinical research, and quality improvement initiatives at the UVA Health System. The CDR contains inpatient billing and administrative data, physician billing data, clinical laboratory data, the state death index, and various departmental databases. Much of the data desired by the residents and program directors is currently contained in the CDR. Additional data feeds are planned, including outpatient clinic pharmacy data and clinic scheduling data. Both will provide important data elements for our project.

CONFIDENTIALITY ISSUES

The Clinical Data Repository has the functionality to provide detailed information at the patient level. Users can "click" on a patient identification number (an encrypted version of the medical record number) or account number and "drill-down" to detailed patient information such as the results of individual laboratory tests. We decided not to provide this feature in RAPS because the intent of the RAPS tool is to provide aggregate, retrospective data for assessment. Also, patient identifiable data for use in direct patient care is not within the defined scope of either the CDR or the RAPS project. Second, in light of increased emphasis on security and privacy standards brought about by HIPAA legislation (The Health Insurance Portability and Accountability Act of 1996), further assessment is needed before we make patient identified data available via the Web.

RESULTS

RAPS PROTOTYPE SAMPLE SCREENS

The screens contain actual sample data collected during a pilot data collection period, January-March, 2001. The screens have not yet been integrated into the CDR; rather they are mock-up design prototypes. (Figure 1 depicts one of the sample screens.)

Screenshots of the RAPS web-based tool screens may be accessed at the following site:
http://www.people.virginia.edu/~jrw5d/RAPS/

EVALUATION

We made substantial revisions (mostly additions) to the content of the RAPS tool following the focus group conducted with the participating residents and presented the revised screens to three of the faculty program directors. In individual sessions, faculty navigated through the RAPS screens, asking questions and making comments. We recorded their suggestions in order to make additional revisions to the content and clarity of the presentations. In June 2001, we sent an e-mail survey to a representative group of residency program directors soliciting feedback about the draft formats and reports for the RAPS tool. Questions were asked about the usefulness of the data and the usability of format. Respondents were all program directors of internal medicine residency programs and were all very positive.

DISCUSSION

DATA ISSUES

RAPS is designed to view information in two basic ways: patient-level and admission- or visit-level. Patient-level data includes information about all of a patient's encounters with the University of Virginia Health System, both hospital admissions and outpatient clinic visits. Admission- or visit-level data includes only data about a particular encounter, either a single hospital admission or clinic visit. Both views are important and desired by residents and faculty. In some instances, it is important to have access to information about a patient's entire encounter with the Health System, regardless of whether the assigned resident saw the patient or not. Patient-level information is most useful for disease screening and management. In other instances, it is more meaningful to look at admission- or visit-level information. For instance, evaluating the breadth of a resident's exposure to various diagnoses would require only information particular to encounters where the resident of interest saw the patient.

MEANINGFUL PRESENTATION

CLUSTERING METHODOLOGIES

An assessment of the content of residents' ambulatory care experiences necessitates a method to describe the illnesses seen by individual residents in various outpatient settings (Bordley et al. 1987). We used the Clinical Classification Software (CCS), a 1999 update to the former Clinical Classifications for Health Policy Research (CCHPR) Version 2. This classification scheme, which is in the pubic domain, was developed by the Agency for Healthcare Research and Quality (AHRQ) and, in previous studies, has shown promise for comparing resource utilization among physicians and managed care organizations (Cowen et al. 1998). Diagnoses and procedures for inpatient hospital stays are coded using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM), Fifth Edition (Public Health Service and Health Care Financing Administration, 1994). ICD-9-CM consists of about 12,000 diagnosis codes and 3,500 procedure codes. The CCS methodology aggregates these codes into clinically meaningful categories, providing a reasonable method for cataloging the illnesses seen by residents. This methodology will accommodate evaluation of individual residents and comparison of the UMA Clinic residency experience with national norms.

COMPARATIVE DATA: WHAT'S USEFUL, "FAIR"

Because variation in utilization of health care resources is associated with differences in disease burden, adjustments for comorbid illnesses are needed before accurate comparisons can be made between patient groups. In addition, comparative data should be useful and "fair". The RAPS report screens are designed to permit each resident to view his or her own patient data and comparative data that will include national guidelines where available (i.e., disease screening) and aggregate data for meaningful comparative groups such as year of residency training, all UMA residents, all internal medicine residents, and total hospital. System logic will be applied to adjust the RAPS screens when comparative data are not meaningful. For example, messages will alert the user when sample sizes are insufficient to yield valid comparisons.

CONTINUITY OF CARE

The value of physicians caring for patients over time includes opportunities to observe the course of illness and treatment and stronger physician-patient relationships. Of the 120 medical school respondents to a 1998 survey, 96% with longitudinal programs indicated that teaching continuity is valuable, yet only 73% were designed to foster such continuity. The logistics of accomplishing continuity of care are often the most difficult obstacle (Vogt et al. 2000). We developed a measure of continuity of care for the RAPS tool to enhance tracking. This measure provides an index of how many of a resident's patients' visits have been with that resident.

CONTENT ORGANIZATION

RAPS is designed for both residents and their educators. At the logon screen, users select either the resident or faculty screens to view. The logon identification determines which screens the user will be able to access. The screens are grouped into two main categories: 1) the resident's outpatient panel, and 2) the resident's patient care experience. The outpatient panel selection provides information related to a resident's assigned panel of patients from the UMA Clinic. This information will provide patient-level data whether or not the resident actually saw the patient. The second grouping of screens provides information about only those patients that a resident actually saw, whether or not the patient belongs on the resident's panel, in the case of the UMA Clinic choices. Faculty will have access to all resident data, individually and compared to various desired groups.

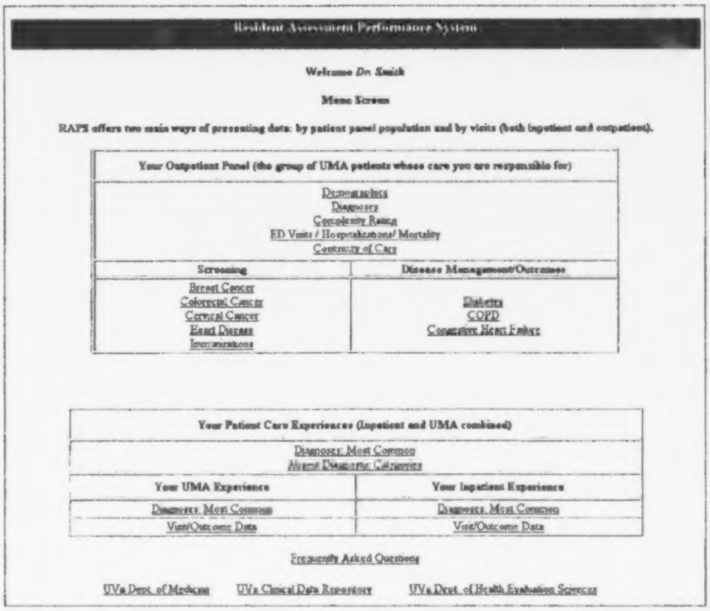
CONCLUSION

We have completed the initial design of the RAPS web-based tool, both its content and technical specifications, and have developed prototype screens. Our user-centered design and iterative tryout and revision strategy is an ongoing process that will continue as we operationalize the tool over the next year. Internal and external reviews have been extremely positive.

The value of RAPS as an assessment method to evaluate individual residents and the overall residency program will require selection and application of appropriate techniques. We will address the question of whether residents who use RAPS perform better. Event tracking and other administrative tools will be implemented within the RAPS tool to calculate usage statistics. Surveys and interviews will be used to collect feedback. Resident evaluations, in-service exam scores, and other metrics will be used to measure differences in performance by residents who use RAPS to those who do not.

Historically, medical residency programs have been designed using a rotation-based format, based on the premise that by rotating through a series of educational experiences residents will assimilate the skills needed to become competent physicians. An alternative educational approach focuses on attainment of competency, rather than completion of a set of educational experiences. Within internal medicine there is interest in the application of competency-based education, also known as mastery learning or outcomes-based assessment (Bell et al. 1997). RAPS is designed to encourage the transition within graduate medical education from experience-based to competency-based training by providing aggregate information to evaluate a resident's patient care experience and outcome performance. It is our hope that RAPS will also help clinicians develop the independent quality reporting and accountability skills needed for future practice.

FIGURE 1. RAPS MENUSCREEN



Resident Assessment Performance System

Welcome *Dr. Smith*

Menu Screen

RAPS offers two main ways of presenting data: by patient panel population and by visits (both inpatient and outpatient).

Your Outpatient Panel (the group of UMA patients whose care you are responsible for)	
Demographics Diagnoses Complexity Rating ED Visits / Hospitalizations/ Mortality Continuity of Care	
Screening	**Disease Management/Outcomes**
Breast Cancer Colorectal Cancer Cervical Cancer Heart Disease Immunizations	Diabetes COPD Congestive Heart Failure

Your Patient Care Experiences (Inpatient and UMA combined)	
Diagnoses: Most Common Major Diagnostic Categories	
Your UMA Experience	**Your Inpatient Experience**
Diagnoses: Most Common	Diagnoses: Most Common
Visit/Outcome Data	Visit/Outcome Data

Frequently Asked Questions

UVa Dept. of Medicine   UVa Clinical Data Repository   UVa Dept. of Health Evaluation Sciences

REFERENCES

Accreditation Council for Graduate Medical Education. (2000). ACGME Outcome Project: General Competencies. [cited 2000 Jul 25] Available from http://www.acgme.org/Outcomes/comp2.asp.

Bell, H.S., Kozakowski, S.M., & Winter, R.O. (1997). Competency-based education in family practice. *Family Medicine*. 29(10), 701-4.

Bordley, D.R., Dolan, J.G., & Hall, W.J. (1987). Monitoring and improving the content of medical residents' ambulatory care experience: a microcomputer-based method using diagnosis clusters. *Journal of General Internal Medicine*. 2, 174-77.

Cowen, M.E., Dusseau, D.J., Toth B.G., Guisinger, C., Zodet, M.W., & Shyr, Y. (1998). Casemix adjustment of managed care claims data using the clinical classification for health policy research method. *Medical Care*. 36(7), 1108-13.

Klessig, J.M., Wolfsthal, S.D., Levine, M.A., Stickley, W., Bing-You, R.G., Lansdale, T.F., & Battinelli, D.L. (2000). A pilot survey study to define quality in residency education. *Academic Medicine*.75(1),71-73.

Scully, K.W., Pates, R.D., Desper, G.S., Connors, A.F., Harrell, F.E., Pieper, K.S., Hannan, R.L., & Reynolds, R.E. (1997). Development of an enterprise-wide clinical data repository merging multiple legacy databases. *AMIA Annual Symposium*. American Medical Informatics Association. 32-36.

Vogt, H.B., Lindemann, J.C., & Hearns, H.C. (2000). Teaching medical students about continuity of patient care. *Academic Medicine*. 75, 58.

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Virtually There: Online Case Studies

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Abstract: The candidates enrolled in one of three degree programs offered through the Greenfield Coalition (GC) have a unique learning situation where classroom exercises link with their job experience. Situated at the Focus: HOPE Center for Advanced Technologies, candidates work in a real manufacturing production environment by day and attend courses by night. In order to export these experiences to students enrolled in other manufacturing engineering programs, GC developed case studies accessible online. Cases currently available support courses in engineering economics, statistics in manufacturing product launch, forming technologies, and tool and fixture design. A wealth of resources including interview transcripts, WWW links, raw data and expert advice are accessible online for learners to investigate each case and complete the required tasks.

The Need for Online Case Studies at Greenfield Coalition

The candidates (Greenfield Coalition (GC) students) at the Focus: HOPE Center for Advanced Technologies (CAT) have a unique learning environment. They have an advantage over students enrolled in traditional manufacturing engineering curricula because they have the daily opportunity to apply new concepts learned in the classroom to real situations on the manufacturing shop floor. This characteristic of the curricula at the Greenfield Coalition is not only unique but also provides a natural contextual environment for the application and transfer of new knowledge and skills. In terms of teaching and learning, a better environment could not be simulated. Therefore, it became a critical component of the teaching and learning strategies at GC.

However, in order to share this advantage and paradigm with other students enrolled in similar engineering programs so that they might learn from the experiences of the CAT candidates, GC had to somehow export these experiences. Presenting case studies from the CAT in an online environment seemed the obvious choice.

The Value of Case Studies

Case studies are ideal for illustrating complex concepts, especially common in engineering. Horton (2000) suggests the use of case studies as an excellent way for learners to practice judgment skills necessary in real life situations that are not as simple as textbook problems. As instructional strategies are concerned, engaging critical thinking skills through case studies is among a recommended set of activities (Bonk & Reynolds, 1998).

GC has developed several case studies that challenge learners in ways a manufacturing engineer would. The majority of the case examinations come from real situations faced by Focus: HOPE and other industry partners of GC (such as Society for Manufacturing Engineering, Ford Motor Company, General Motors, and DiamlerChrysler). One case developed as a capstone experience in engineering economics involves identifying the source of lost dollars for a tier one supplier to the automotive industry. Another case involves the redesign of a tie-rod end component used in the HMMWV (commonly known as the Hummer), whose primary customer is the U.S. Department of Defense. As part of a course in Integrated Product Realization, a case requires learners to apply processes and procedures for the launch of a new product. Yet another case supporting a course on statistics in manufacturing requires the analysis of variances of post-production part specifications in order to utilize statistical methodologies to explain scrap lost dollars. Many other cases have been developed by GC to support courses in tool and fixture design, forming technologies, operations management and facilities design. These cases require students to identify appropriate processes to apply in various situations, generate cost/benefit information and make appropriate decisions on the basis of that information, respond to requests for bid for a formed part, investigate and recommend solutions to eliminate tolerance irregularities during machining of parts as well as many other tasks typically found in manufacturing engineering environments.

Through these case studies, learners get practice applying newly learned skills and knowledge to authentic situations not found textbooks.

Online Environment for Case Studies

In the online environment, GC has captured a wealth of resources related to each case and provides it for learners to examine and contemplate much like a student could do if s/he were enrolled in an onsite course. These resources are organized by typical activities that would be performed, to prevent the learner from feeling overwhelmed at any given time during the case analysis.

Case Study Orientation

The home page for the case serves as the learner guide. From this page, students are able to view the recommended set of investigation activities, expectations for assessment of their investigation as well as the full list of resources provided for their perusal. Basic navigation, similar to GC courses, is accessible at any time, from the left-hand side and across the top of the interface, providing constant availability of broad level course information. Further, the web interface is organized to keep learners from becoming frustrated or lost. Figure 1 shows that once a case is selected, the specific scenario is depicted, and instructions and activities are outlined. One level up, at the module level, it is possible to link to several case studies that all meet the same objective and, therefore, would be grouped into the same learning module.

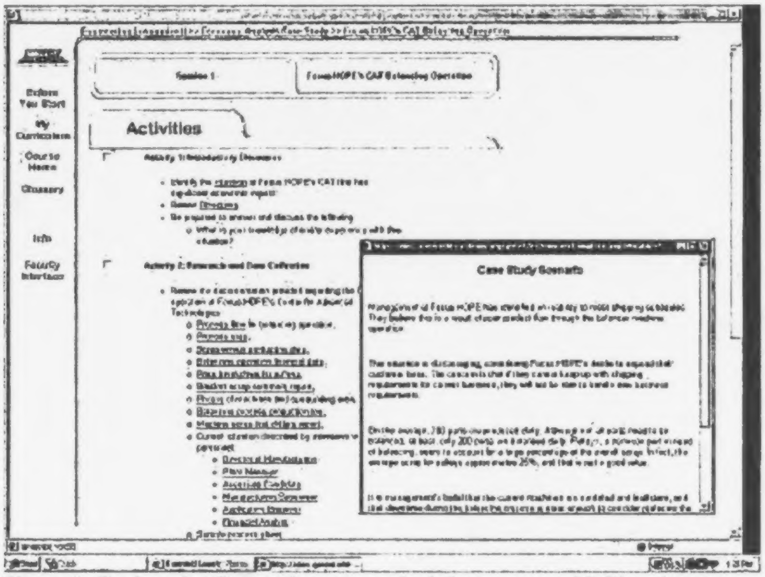

Figure 1: Engineering Economics case analysis home page with Situation pop-up

Learner Responsibility

Given the situation or scenario description, it is the responsibility of the learner (or team of learners) to investigate and uncover what they believe to be the real problem. Students are challenged to determine what is relevant to the case and process its importance. Exploring the resources helps them achieve this . While each case has a different set of resources, many media formats are used throughout all of the GC cases. In a case examining the scrap rate through the balancing operation for pulleys, a process map and product path are depicted using still images with mouse-overs for additional information (see Figure 2 & 3). Further, MSWord and Excel documents such as part price data, scrap rates and subsequent lost dollar reports are viewable in the web browser (see Figure 4).

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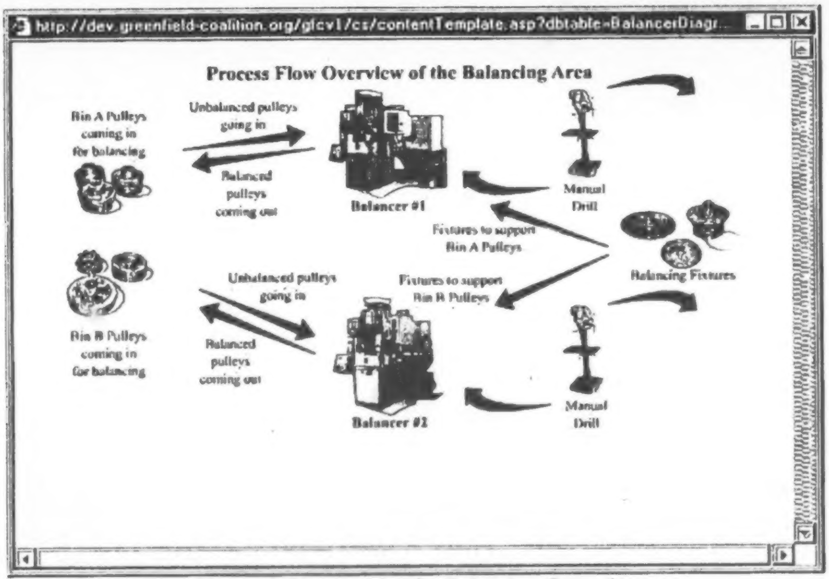
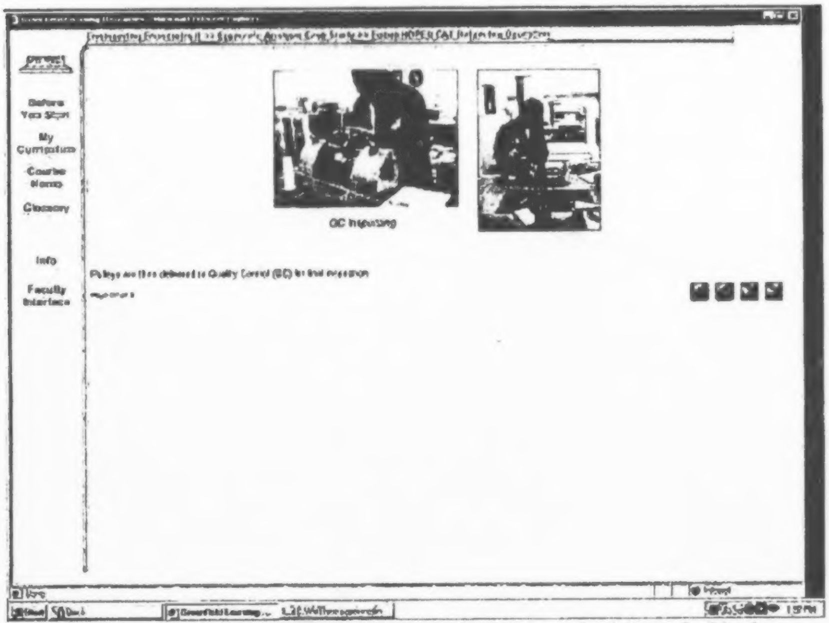

http://dev.greenfield-coalition.org/glcv1/cs/contentTemplate.asp?dbtable=BalancerDiagr...
Process Flow Overview of the Balancing Area
Bin A Pulleys coming in for balancing
Unbalanced pulleys going in
Balanced pulleys coming out
Balancer #1
Manual Drill
Fixtures to support Bin A Pulleys
Balancing Fixtures
Bin B Pulleys coming in for balancing
Unbalanced pulleys going in
Balanced pulleys coming out
Fixtures to support Bin B Pulleys
Balancer #2
Manual Drill

Figure 2: Process Map for Balancing Operation


Before You Start
My Curriculum
Course Home
Glossary
Info
Faculty Interface
QC Inspecting

Pulleys are then delivered to Quality Control (QC) for final inspection

Figure 3: Photographic product path for pulleys from arrival through shipping

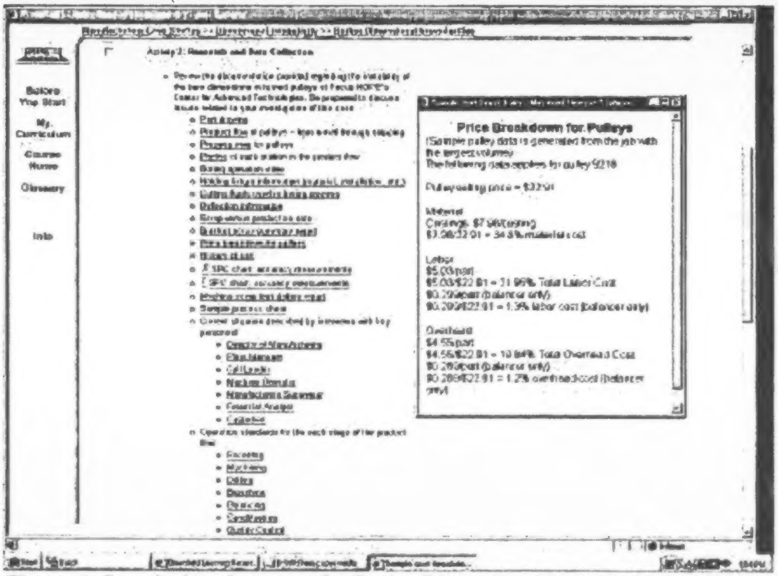


Figure 4: Sample data document for Boring Dimensional Irregularities case study

Students can even simulate a conversation with important personnel by reviewing the interview section of the resources. Here, streaming video clips and transcripts of real interviews conducted by CAT candidates can be viewed (see Figure 5). WWW links to vendors of balancing machines and/or information about new balancing technology make it possible for learners to research new technology or uncover how other companies resolved similar situations (see Figure 6).

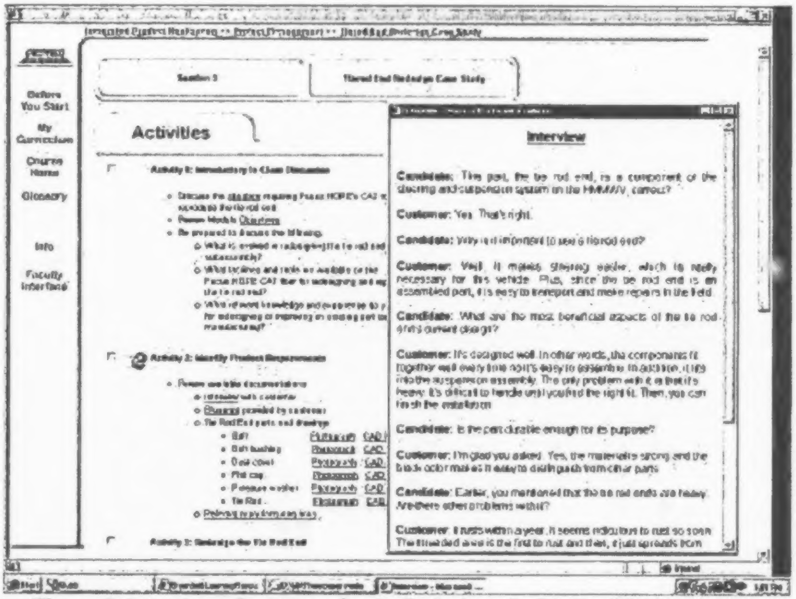


Figure 5: Interview of customer for the Redesign of a Tie-Rod End case study

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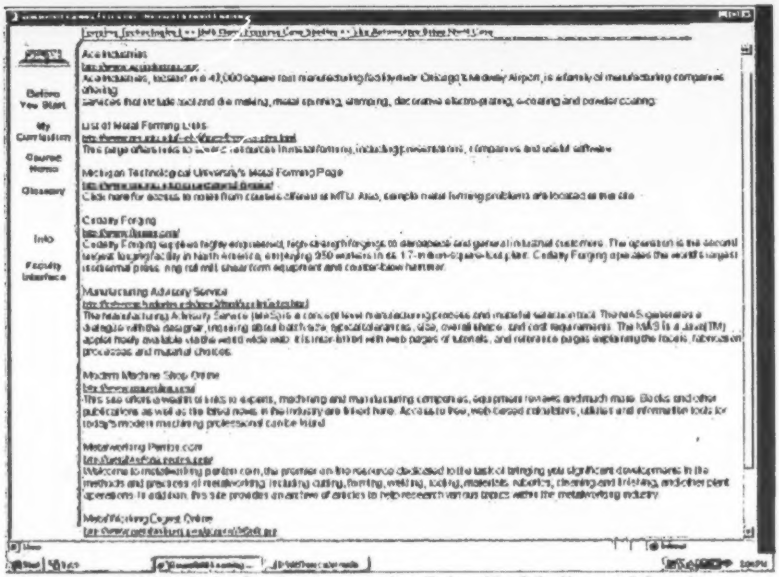

Figure 6: WWW links for the Automotive Drive Shaft bulk metal forming case

Recommendation for Resolution

Once the learner(s) has investigated the case thoroughly, s/he must prepare a report aligned with the guidelines for that specific case. For Engineering Economics, this report requires a comprehensive economic analysis of the situation and related data, and must include the student's recommendation for resolution to the problem. Supporting documentation such as a decision tree and sensitivity analysis also complement the report.

Although not explicitly required for each subsequent delivery of this case, a presentation to Focus: HOPE management was a component of the pilot of the economics case study. The experience of presenting the alternatives to the stakeholders made the needs of the client perfectly clear to the candidates and had a greater learning impact than initially expected. They were able to better understand the urgency for resolution and the impact in terms of time and money that implementing any one of the alternatives would cost. At the pleasure of the instructor using these materials, this experience could be simulated for other cases by simply asking classmates or industry experts to pose as the customer.

Supporting Teaching and Learning In The Online Environment

Learner Support

If, at any time, the learner feels overwhelmed by the rich set of information provided and feels that the exploration through the resources seems unproductive or inefficient, they may consult the mentor notes. Mentor notes, a series of tasks and issues related to the case and its objectives, serve as a tour guide and give necessary learner support when they need and want it. The learner is not required to follow the tasks and/or consider the issues in a lock-step fashion. Rather, Mentor Notes help to orient the learner to the items necessary for consideration in a thorough investigation of the situation. Filipczak (1996) refers to this as scaffolding or "guided discovery", by retaining learners opportunity to explore while still making certain that the established objectives are attainable. Candidates may choose to execute all, some, or none of the suggested tasks. Additionally, this compilation of expert notes can be applied to many situations. As a result, it functions as a tool for learning as well as a job aid for real manufacturing engineering situations.

Often case studies at GC serve as a capstone for the courses, however, they are not tests. Therefore, learners may refer to the mentor notes as often as necessary without negative consequence. The most important purpose is

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that students can apply previously learned concepts and principles, and practice decision-making and problem-solving processes in a non-threatening but very real situation.

Instructor Support

Scaffolding is also provided for the course instructor in an area entitled Faculty Interface, in the event that the instructor using the case study materials is not as knowledgeable about a particular topic as the case study designer and/or developer. These notes, similar to the mentor notes, were recorded during the pilot offering of the case study to assist subsequent instructors adjusting to their new roles as a facilitator of learning and a manufacturing plant supervisor posing a variety of questions and concerns common in a real engineering setting.

Integration with Other Instructional Methods

It is critically important to be aware that the use of the web-enabled case studies does not occur without the leadership of an instructor. The instructor at GC plays several roles simultaneously: traditional instruction of course concepts, mentoring and coaching during the case investigation, and finally that of a supervisor challenging the recommendations from a manufacturing enterprise perspective (Schuch-Miller & Plonka, 2001). Moreover, follow-up classroom discussions, an integral component of the case design, allow learners to reflect, summarize and solidify their own learning and structure it in a way that is meaningful to them (Hidi & Anderson, 1986).

At GC, we strongly believe in a blended approach to teaching and learning, involving the integration of instructor-facilitated classroom activities, sharing of manufacturing experiences of the candidates at the CAT, bestowing course credit for experiences on the shop floor as well as utilizing the web-enabled technology wherever possible in order to enhance manufacturing engineering education. The result is a very fulfilling learning experience that includes learner collaboration, learner support, and innovation. By replicating these experiences in an online environment, it is hoped that other instructional programs can be enriched by using these resources as well.

For more information about Greenfield Coalition or the case studies discussed in this paper, access the following website: www.greenfield-coalition.org

References

[1] Horton, W. (2000). *Designing Web-Based Training*. New York, NY: John Wiley & Sons; Inc.

[2] Bonk, C. J., & Reynolds, T. H. (1998). Learner-Centered Web Instruction for Higher-Order Thinking, Teamwork, and Apprenticeship. In B. Khan (Ed.), *Web-Based Instruction*, 167-178.

[3] Filipczak, B. (1996). Engaged! The Nature of Computer Interactivity. *Training*, 33 (11), 52-58.

[4] Schuch-Miller, D. & Plonka, F.E. (2001). Emulating Real-World Engineering Experiences Using Web-Enabled Case Studies. Proceedings of the 2001 International Conference on Engineering Education, Oslo, Norway.

[5] Hidi, S., & Anderson, V. (1986) Producing written summaries: Task demands, cognitive operations and implications for instruction. *Review of Educational Research*, 56, 473-493.

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Japan's Widespread Use of Cellular Telephones to Access the Internet: Implications for Educational Telecommunications

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Abstract: In the three years since their introduction, Internet-capable cellular telephones are used by over 47 million Japanese (37% of the population) which nearly equals the number of people using personal computers to access the Internet. If this trend continues, the cellular telephone will overtake the personal computer as the most widely used Internet access device in Japan. However, this development has gone largely unnoticed by researchers. Such a trend deserves greater attention, both to understand the nature of Japanese use of communication technologies and to assess these technologies' potential for educational application. This paper examines the impediments that slowed Japan's early acceptance of the Internet, describes how these barriers were overcome by Internet-capable cellular telephones, considers the strengths and weaknesses of these emerging technologies, and assesses the potential for using portable wireless communication devices in educational settings.

Introduction

Despite nearly a decade of general economic stagnation, Japan's telecommunications industry has continued to grow by developing innovative and sophisticated wireless communication devices. These products, most notably Internet-capable cellular telephones, have been readily accepted by Japanese consumers and the increasingly widespread use of these devices has both changed popular culture and, more importantly, greatly expanded Internet use in Japan. Indeed, the number of Internet-capable cell phones in use has grown dramatically since they first appeared in 1999, and the cell phone may soon overtake the personal computer as Japan's Internet-access medium of choice.

Despite this trend, few, if any, scholars have formally asked what role Internet-capable cellular telephones may play in educational telecommunications. Certainly, the limitations of current cell phone technology make its near-term use in educational contexts doubtful. However, Japan's rapid and widespread adoption of cellular telephones as an Internet access medium make this an important area of study to determine if these technologies can be used in educational settings. Examining Japan's use of these technologies is appropriate as Japanese cellular technology is estimated to be several years ahead of America (Despeignes 2000). Thus, understanding the Japanese case could be a strong indicator of the kinds of communication tools and opportunities that may become available in America.

This paper begins with an description of the conditions that restrained Japan's early use of the Internet relative to other countries. The next section describes Japan's rapid acceptance of Internet-capable cellular telephones and shows how these devices overcame the barriers to Internet use. The following section assesses the strengths and weaknesses of current cell phone technologies and the concluding sections considers how these devices might be used in educational settings.

Impediments to Internet Acceptance in Japan

Personal computer and Internet use in Japan have lagged behind the United States and other industrialized countries according to a Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications' report (MPHPT 1999). Scholarly research on the nature of Japanese computer and Internet use is limited, but Aoki's assessment of barriers to wider Internet access in Japan reflects the conventional thinking behind Japan's slow acceptance (Aoki 1995):

1. Businesspeople prefer face-to-face communications, and access to e-mail in the office is limited.
2. Phone rates are calculated by the minute which inhibits extended online time.
3. Computer use is considered as unfashionable and computer users are often characterized as nerds.
4. Typing is still a relatively uncommon skill among Japanese people, and involves using four types of written Japanese characters.

It should be noted that since Aoki's report was written, flat-rate ISDN Internet access (among others) has flourished in Japan bringing online costs down to more accessible levels. However, lingering negative images of computer users and the QWERTY keyboard interface continue to be strong disincentives to increased computer-based Internet access in Japan. For comparison, one estimate indicates that only 14% of Japanese people use computers to access the Internet versus 37% in the United States (Schmetzer 2000).

In contrast to the slow pace of computer-based Internet use, using cellular telephones (or keitai, pronounced "kay-tie") for Internet access has increased dramatically in Japan since its introduction in February, 1999, and is rapidly becoming a, if not the most, popular way to access the Internet. Computer access of the Internet has shown a large increase over the past couple of years, but cellular phone access rose at an even greater rate; MPHPT statistics show (MPHPT 2001) that between 1999 and 2000, households using personal computers to access the Internet almost doubled (19.1% to 34.0%), but the percentage of households using cellular phones to access the Internet tripled (8.9% to 26.7%).

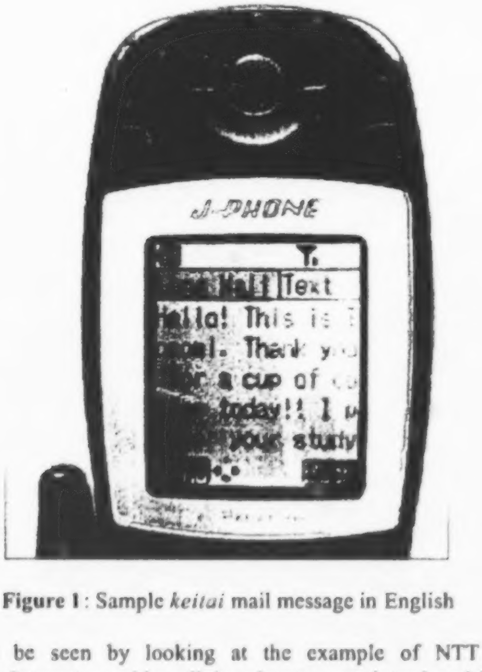

Figure 1: Sample *keitai* mail message in English

Additional quantification can be seen by looking at the example of NTT DoCoMo, Japan's largest telecommunications company. Internet-capable cellular phones were introduced by the DoCoMo in Japan in February, 1999, under the brand name "i-mode." Starting in mid-2000, all DoCoMo cell phones were

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"compatible with Internet standards such as HTML, http, gif, and Java," so users can surf the Web in addition to checking their mail (Legace 2001). In less than three years, nearly 29 million people subscribe to DoCoMo's Internet cell phone service at the end of 2001 (TCA 2001). The total number of Internet-capable cell phones in Japan is just over 47 million out of an installed base of over 66 million cell phone service subscribers according to the Japanese Telecommunications Carriers Association's monthly data (TCA 2001). Based on these numbers, nearly 40% of all Japanese people carry Internet-capable *keitai*.

Keitai Use Increases Japanese Internet Access

Clearly *keitai*, especially those with Internet capability, have been rapidly and widely accepted by the Japanese consumer. This high rate of acceptance indicates that *keitai* have successfully overcome the barriers to Internet access–which personal computers failed to do–despite having been on the market for only three years.

Internet access from the office: The first barrier to wider Internet access posed by Aoki was in the business realm where face-to-face meetings and limited in-office e-mail access limited greater use. Certainly, face-to-face communications will edge out most technology-mediated communications in certain business situations. However, business people can use their own *keitai* to be able to access the Internet despite restrictions on using company computers for personal e-mail or WWW use (see, for example, Schmetzer 2000).

Low cost: As noted above, computer online time has become less expensive since Aoki released her paper. However, since that time, increased competition between *keitai* service providers has made monthly calling packages more affordable and inexpensive e-mail messages are among the most popular services Indeed, my students emphatically state (see the next section for additional details of these empirical data) that low cost is the primary motivation for using written communications rather than making a voice call.[1] Perhaps more importantly, the initial cost of buying the necessary hardware (in some cases the phone is free), makes a *keitai* an attractive choice over even the most affordable computer.

Socially acceptable: While it is rare to see a commuter on a train in Tokyo using a laptop computer (besides himself, the author has seen only one other person using a computer on the train in the last 12 months), it is rare *not* to see several commuters engrossed in reading and writing *keitai* mail. Indeed, *keitai* mail users are so common at coffee shops, on public transportation, and in parks that they would only be conspicuous in their absence. *Keitai* use has become an acceptable means of communicating with others in public without the negative images still assigned to computer mail users. Indeed, we may have already entered a situation in Japan where *not* carrying a cell phone is seen as socially unacceptable. A straw poll of 104 of my students in an large, private, Japanese university indicates that *all 104 of them have a cell phone*, and that 68 of the 104 used their cell phone to access the Internet before using a personal computer. Another indication of how indispensable these devices have become, over half (18) the students in a class of 32 do not wear a watch but rather use their cell phone clock to tell time.

Unique Input Method: The most common input method is using one or both thumbs on the phone's keypad (see Fig. 2). Typing is possible (using an attachable keyboard) but few people use them in public. While the author, a novice at *keitai* mail, taps out only a few words per minute, experienced users can achieve remarkable speeds using only their thumb to input text and select graphic emoticons (French, 2000). French also notes that one heavy *keitai* user can reportedly type out messages solely by touch; this is not as rare a skill as it might sound: Several of my students claim to be able to type *keitai* mail without looking at the keypad.

Taken together, these points indicate that the barriers to Internet use cited by Aoki concerning Internet access seem to have been largely, if not completely, overcome by the Internet-capable cellular telephone. However, while its ability to enhance Japanese Internet use may be established, the *keitai* faces greater challenges if it is to become a widely used Internet appliance for educational telecommunications.

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[1] Each *keitai* e-mail message costs about 2.5 cents to send and is free to receive compared with voice messages which run about 45 cents per minute to send but are also free to receive. This difference can add up when one realizes that it is not uncommon for young people to send 10 or more messages per day.

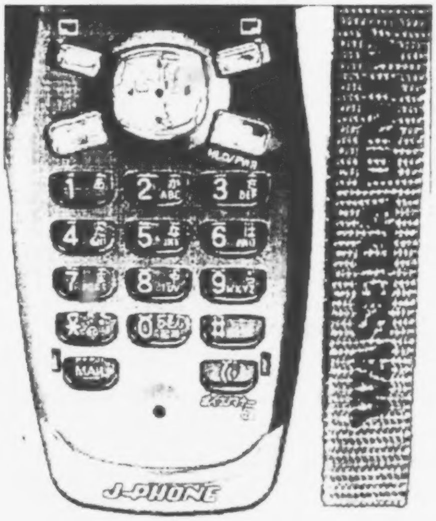

Figure 2: Input Keypad Showing Japanese and English Characters

Limitations and Challenges

Despite the many advantages to the *keitai*, several obvious limitations will need to be overcome to enhance this device's potential as a general-use Internet application. Initially, the small screen, especially when typing in English, is a clear limiting factor. Generally, the screen can only display 64 characters at one time (see Fig. 1), although total message length depends on the options allowed by the telephone and the service provider. For instance, the author's phone (shown in all the images in this paper) is capable of creating messages up to 128 characters, or "long mail" messages of up to 5910 characters. However, even with a good resolution color screen, reading (let alone keying in!) a 5000+ character message would strain the recipient's eyes to the point of exhaustion. Using a *keitai* for educational purposes would require tasks that can be easily completed within a few hundred characters or modifying the *keitai's* output ability to enable the user to read or hear longer messages.

As indicated above, inputting a lengthy *keitai* mail message is impractical for the average user. External keyboards are available–ranging from roughly the size of a credit card to approximately the size of a postcard–but the author has never seen one being used in public. It is unclear if the difficulty of inputting text can be overcome with practice, but empirical reports from Japanese college students indicates that their typing speed increased the longer they used their *keitai*. However, after several weeks of inputting English-language messages using my *keitai's* keypad, my typing speed is still painfully slow and I prefer leaving voice messages despite the increased cost. Emoticons and preset phrases are one answer (see, for example, French 2000). However, I would welcome a personal digital assistant-like character recognition system using an input stylus. This is still slower than typing on a keyboard, but retains much of the *keitai's* portability.

The Potential for *keitai* in Educational Settings

The Japanese case shows that a large number of people are using their cellular phone to exchange e-mail and receive information from the World Wide Web. Such widespread use should not be ignored as such devices may have a place in educational telecommunications. Despite its potential, it seems clear that *keitai* technology will require additional development if it is to receive widespread use in educational settings.

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Attitudinal Challenges: Many American schools had bans on bringing and using cellular telephones. After the terrorist attack on September 11, 2001, however, some schools are rethinking this prohibition ("Schools Rethink" 2001). While greater access to cell phone use in schools may have started with a national tragedy, additional access will increase only if the potential to provide meaningful educational opportunities can be shown.

Despite gains in many areas, actual computer and Internet use in Japanese and American classrooms is still in its early stages. Access issues in both countries have largely been addressed and more attention is being paid to inservice education and curriculum development. However, computer use in schools is still far from established and commonplace and there is a strong sense that educators in both countries are still in the experimental stage. The prospect of purchasing new hardware, educating teachers, and devising curricula to incorporate a new type of technology may get a cold reception at many schools. It seems reasonable that any new communications technology would have to prove its utility up front, and may need to start with a supplementary role alongside existing equipment and projects, enhancing rather than replacing what is already in place. One can imagine, for instance, a cell phone-like device being used by one group in the field to communicate sounds, text, and images back to their home station computer where these data are stored and manipulated.

Hardware Challenges: The expense of personal computers has usually been borne by schools and made available to students in the form of a classroom computer(s) or a computer lab. Cellular telephones are usually personal communication devices, purchased and maintained by an individual, and are rarely shared. Certainly allowing students to use their own telephones as part of a school exercise has some appeal, as the cost of the phone and connection service is borne by the student. But unlike my economically comfortable university students all of whom carry cell phones, many college and high school students in Japan and America are unable to afford this service. If schools are to provide wireless communications devices to students, they must be able to exert some control over how these devices are used. It may be that this need can be filled by a portable wireless communication device similar to a personal digital assistant-cell phone hybrid that enables the exchange of text, sound, and graphics with a restricted number of other units. In any event, current cell phone technology shows some promise, but may require modification and development before it can be comfortably used in K-12 classrooms.

Conclusion

The greatest benefit of Internet-capable cell phones in Japan has been their ability to bring large numbers of Japanese people onto the Internet in a way that has been useful and entertaining for them. The learning curve is negligible compared to personal computer-based access, and the cost of setting up and using this service continues to attract large numbers of new users. Cellular phones have largely overcome Internet-access barriers where personal computers failed, and future developments should be monitored to see if these devices can be adapted to educational use.

Despite the limitations cited above, the continued development of cellular phone technology, and the potential to blend it with personal digital assistants or other palm-top devices, may allow fourth- or fifth-generation wireless devices to be incorporated as one part of a larger information and telecommunications strategy for use in schools. As schools, in Japan and elsewhere, become more accustomed to using technological tools in the classroom, and the cost of hardware continues to decline, we may see a division of labor where cellular telephones are primarily used for transmitting voice, text, and images while the personal computer is used primarily for more extensive communications and production work.

When NTT launched its i-mode service three short years ago, few observers could have guessed that millions of users would be exchanging text messages on their cell phones, performing online banking services, or reading restaurant reviews on the Web. There is a sense that attempts to speculate where these technologies will be in three more years will fall woefully short. However, I firmly believe that this trend deserves our attention, and we should follow the progress of portable wireless communication devices like *keitai* with an eye to incorporating them into our arsenal or educational telecommunications technologies.

References

Aoki, K. (1995, March). Virtual Communities in Japan: Their cultures and infrastructure. *Asia-Pacific EXchange (Electronic) Journal.* ISSN:1077-114X Hawaii: University of Hawaii - Kapiolani Community College. 2(1). Retrieved December 16, 2001 from gopher://leahi.kcc.hawaii.edu:70/00/Kapi'olani%20Info/APEX-J/Vol%202,%20No.%201/Kumiko%20Aoki

Despeignes, P. (2000, March 3). Japan leaves U.S. behind in Web race. *Gannett News Service.* Retrieved December 16, 2001 from http://www.usatoday.com/life/cyber/tech/review/crh024.htm

French, H.W. (2000, June 8). In e-mail wrinkle, cell phones are chatterboxes. *The New York Times.* Retrieved December 16, 2001 from http://www.nytimes.com/library/tech/00/06/biztech/articles/08japan.html

Legace, M. (2001, February 26). The minimalist invasion of i-mode. *Harvard Business School Working Knowledge Special Reports, Cyberposium 2001.* Retrieved December 16, 2001 from http://www.hbsworkingknowledge.hbs.edu/pubitem.jhtml?id=2057&sid=2090&sid=0&t=special%20reports%20cyber%202001

Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT). (1999). *sekai no tokei.* Statistics Bureau, Statistical Research and Training Institute, MPHPT (Ed). (Reprinted from *World Telecommunication Development Report, 1999.* International Telecommunication Union). Retrieved December 16, 2001 from http://www.stat.go.jp/english/data/it/index.htm

Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT). (2001). *IT indicators in Japan, 2001.* Statistics Bureau, Statistical Research and Training Institute, Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications (Ed). Retrieved December 16, 2001 from http://www.stat.go.jp/english/data/it/index.htm

Schmetzer, U. (2000, May 29). Computer? Who needs it? Japanese teens have I-mail. *seattletimes.com, The Seattle Times Company.* Retrieved December 16, 2001 from http://seattletimes.nwsource.com/news/nation-world/html98/keit29_20000529.html

Some schools rethink cell phone ban. (2001, November 12). *Associated Press.* Retrieved December 16, 2001 from http://www.cnn.com/2001/fyi/teachers.ednews/11/12/schools.cellphones.ap/index.html

Telecommunications Carriers Association (Japan). (2001). *Number of subscribers by Carriers (as of November 30, 2001).* Retrieved December 17, 2001 from http://www.tca.or.jp/eng/daisu/yymm/0111matu.html

Facilitating Learning Through Different Forms of Interaction With Visual Abstractions

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Abstract: Visual abstractions play an important role in many learning situations. They refer to visual structures that represent abstract ideas and encode the meaning of these ideas in themselves. Interaction with these visuals, when well-designed, enables the decoding of their meaning. When using visuals in educational software, designers need to know the different forms of interaction available to facilitate learning. This paper briefly discusses some points to be considered when designing interactive visual abstractions.

Introduction and Background

Visual, image-based representations play an important role in learning. Sometimes, they facilitate reasoning and thinking in ways that may be impossible to achieve using sententially-based representations [Goldstein, 1996]. Visual abstractions (VAs) refer to visual structures that represent abstract ideas and encode the meaning of these ideas in themselves [Pimm, 1995]. An example of a VA is the representation of the concept of rotation in two-dimensional transformation geometry as an arc of rotation found in mathematics textbooks. This VA not only represents the concept of rotation, but also its embedded sub-concepts of angle and center of rotation. Another example of a VA is the representation of the concept of force in physics as an arrow. Researchers have studied the different forms of representation and how people reason using visuals [Peterson, 1996], most of which have focused on the static form of these representations. With the advent of powerful graphics systems, there is an ever greater use of visuals in interactive contexts. Interaction with VAs can play an important role in sense-making and active learning [Card et al., 1999; Sedig et al., 2001].

It is important for designers of learnware to know about different ways of designing interaction with VAs to facilitate active learning. However, literature on the subject is very limited. Instructional technology books, research handbooks, and encyclopedias rarely discuss interaction design techniques, much less interaction design for VAs.

Our research group has been designing a number of systems to investigate different forms of interaction with VAs. This paper briefly discusses a few factors we feel need to be considered when designing interaction that facilitates learning.

Some Design Considerations

One of the first considerations is whether the learner should interact with a VA *directly* or *indirectly*. The former refers to acting on and interacting with a VA directly via a pointing device. The latter refers to interacting with a VA through an intermediary representation. The choice depends on the educational goal to be achieved. In general, indirect interaction requires more mental effort [Holst, 1996], which can be an important factor in deep learning. However, direct interaction, combined with visual scaffolding, can also support the learning of concepts very effectively [Sedig et al., 2001].

Another important consideration is whether the learner should interact with a VA by manipulating ("handling") it, navigating ("walking on") it, or issuing commands to ("conversing with") it. These three modes of interaction can serve different purposes. *Manipulation* can be used to decode the internal meaning of a VA. For instance, in the case of the arc of rotation, mentioned above, performing an operation on its visual representation—e.g., dragging the center of rotation—can help the learner understand the structure and its constituent elements [Sedig et al., 2001]. *Navigation* can be used to help the learner construct a cognitive map of the visual abstraction [Chen, 1999]—that is, a mental map of the VA's structure which is internally available for inspection and sense-making. Rather than manipulating the VA and affecting changes in its form, navigation allows the learner to "walk" on the VA to internalize the structure's landmarks, geometry, and topology. For instance, given a semantic network as a VA, by navigating the network, the learner can discover its landmark nodes and essential paths. However, if the goal of learning was to have the learner construct the network, then the preferred mode of interaction would be manipulation. *Conversation* can be used when the goal is to allow the learner to ask for the properties of a VA in a linguistic, sentential manner. Conversation usually requires more mental effort than manipulation or navigation since linguistic commands and visual representations are not cognitively congruent.

An example of an application that uses two modes of interaction is a cognitive tool we have designed intended to facilitate learning of Platonic and Archimedean solids, shown in Figure 1. The learner can manipulate the geometric structure on the right to change its form and observe how it morphs to another geometric structure [Morey et al., 2001]. The learner can navigate the map on the left to understand the relationship among the solids. The learner can also click on the linguistic buttons to select a new visual representation. Although this is not a purely conversational mode of interaction, one can design the interface such that the learner could type a command to query a given geometric structure about its properties.

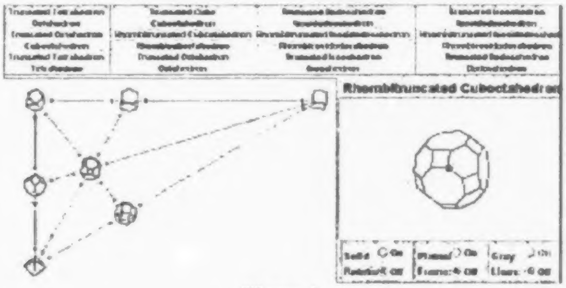

Figure 1

This paper has presented some points to be considered when designing interactive VAs for learnware. The understanding of many educational concepts can be facilitated using VAs [Glasgow et al., 1995]; therefore, it is important to further investigate different forms of interaction with VAs so that they can support active learning.

References

Card, S. K., Mackinlay, J. D., & Shneiderman, B. (Eds.) (1999). *Readings in information visualization: Using vision to think*. Morgan Kaufmann Publishers.

Chen, C. (1999). *Information visualization and virtual environments*. London, UK: Springer-Verlag.

Glasgow, J., Narayanan, N. H., & Chandrasekaran, A. B. (eds., 1995). *Diagrammatic reasoning: Cognitive and computational perspectives*. Cambridge, MA: The MIT Press.

Goldstein, L. (1996). Representation and geometrical methods of problem-solving. In D. Peterson, *Forms of representation*. Exeter, UK: Intellect Ltd.

Holst, S. J. (1996). Directing learner attention with manipulation styles. *Proceedings of CHI '96*, ACM Press, 43-44.

Morey, J., Sedig, K., & Mercer, R. (2001). Interactive metamorphic visuals: exploring polyhedra relationships. *The 5th International Conference on Information Visualization (IEEE Computer Society)*. London, UK, 483-488.

Peterson, D. (1996). *Forms of representation*. Exeter, UK: Intellect Ltd.

Pimm, D. (1995). *Symbols and meanings in school mathematics*. London, UK: Routledge.

Sedig, K., Klawe, M., Westrom, M. (2001). Role of interface manipulation style and scaffolding on cognition and concept learning in learnware. *ACM Transactions on Computer-Human Interaction*, 1(8), 34-59.

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TileLand: A Microworld for Creating Mathematical Art

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Abstract: Many children find mathematics uninteresting and irrelevant, never appreciating its role in artistic endeavors. Computer-based interactive tools can help introduce children to the artistic aspects of mathematics. This paper presents TileLand, a multi-faceted constructionist microworld intended to engage children in the creation of mathematical art. TileLand employs the metaphor of a *Magic Tile* to introduce children to the world of regular polygons and colorful visual patterns and tilings. It integrates several types of pedagogical interactions: open-ended exploration, goal-directed game play, experiential and reflective thinking, and visual and linguistic information processing.

Introduction

Many children find mathematics uninteresting and irrelevant. This is partly due to the fact that most of their encounter with mathematics is algebraic [Kinsey and Moore, 2002]. As a result these children never develop a mathematical eye. Without a mathematical eye, they never realize the role of mathematics in artistic expressions such as painting, sculpturing, and designing architectural artifacts. It is important for non-mathematicians to experience the beauty of mathematics by venturing into its art form, as visualization of patterns and relationships [Peterson, 2001]. Tilings, tessellations, and visual patterns are examples of mathematical art. The National Council of Teachers of Mathematics [1989] emphasizes the importance of young learners experiencing the deeper aspects of geometry. Novel computer tools can help introduce children to the visual aspects of mathematics (for instance, see [MECC, 1995]).

However, designing technology that is motivating, supports children's deep learning, and is not gender-biased is not an easy task [Alessi and Trollip, 2001; Druin, 1999; Sedig, 1998; Sedig et al., 2001]. This is especially true if the design is aimed at a broad spectrum of children, ranging from kindergarten to the 6th grade. This paper presents TileLand, a microworld designed to engage children in geometric reasoning and analysis through the creation of mathematical art in the form of tiling patterns. As a microworld, TileLand is a self-contained conceptual system embodying underlying geometric principles related to five regular polygonal shapes. Through interaction with the system, it is intended that children develop a sense of spatial visualization, notice the relationship among polygonal figures, and discover the role of different polygons when creating tiling patterns – thereby constructing their own knowledge of the embedded concepts and ideas in the system [Forman and Pufall, 1988].

TileLand

TileLand is a multi-faceted microworld. It allows children to construct colorful tiling patterns using regular polygons, engaging them in creative, mathematical art. TileLand is also a logic-based, problem-solving game, in which children need to re-produce a series of given patterns in order to advance through the game. It is also a programming microworld, where using a simple command-based language, children can describe how to create a tiling pattern, test the program, and observe its behavior.

TileLand is aimed at children who are five years and older. Consequently, it has simple interaction rules. There are only a few commands that children need to learn. Nevertheless, TileLand allows children to construct fairly complex geometrical patterns. Figure 1 shows a screen capture of TileLand. The screen is divided into three sections: *Action Panel*, *Sample Tilings*, and *Pattern Area*. The Action Panel contains the command buttons used to create tiling patterns. The Sample Tilings contains a number of pre-created patterns, with varying degrees of complexity. These patterns are intended to introduce children to a range of possible visualizations that can be created using the environment. Finally, the Pattern Area is where children construct their patterns. Figure 1 shows a constructed pattern made of four types of polygons: triangles, squares, pentagons, and an octagon.

There are five types of tiles with which children can construct patterns. All five tiles are regular polygons: triangle, square, pentagon, hexagon, and octagon. To provide an easy-to-understand conceptual model for how tilings are created, TileLand uses the metaphor of a *Magic Tile*. The Magic Tile is represented in the Pattern Area by any one of the five polygons. One of the sides of the Magic Tile is designated as a *Connecting Side*. This side is highlighted to differentiate it from the other sides of the Magic Tile. The Connecting Side is where a new polygon attaches. The magic of the tile is derived from its transformational movement. This movement occurs when a new polygon is attached to the connecting side of the polygon currently in the Pattern Area and the current polygon *magically* disappears. Clicking on one of the five polygonal buttons in the Action Panel causes the Magic Tile in the Pattern Area to transform to the new polygon. Clicking on the *Turn* button will change the Magic Tile's Connecting Side one step at a time in the clockwise direction. A central location in the Pattern Area represents the *Home* position for starting a pattern[1]. At the start of a session, when the user clicks on a polygonal button, the Magic Tile appears at the Home position.

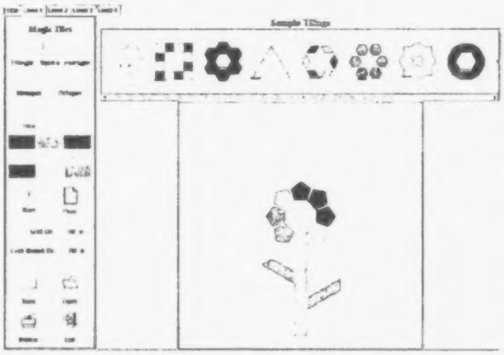
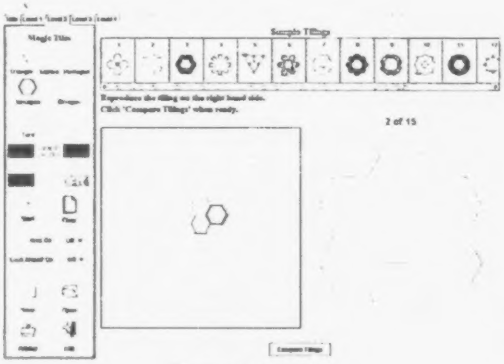


Figure 1: Level 1



Reproduce the tiling on the right hand side.
Click 'Compare Tilings' when ready.

2 of 15

Figure 2: Level 2

The Magic Tile can be filled with a color or left blank. For instance, if the user clicks on the red button, the Magic Tile's polygonal frame will be filled with the color red—creating a red *footprint*. The user can thus construct a pattern by leaving colorful footprints as the Magic Tile 'walks around' the Pattern Area. If the Magic Tile is filled with color while it overlaps existing footprints, the underlying footprints disappear and are replaced by the new footprint. This behavior ensures that the resulting pattern is solely comprised of non-overlapping regular polygons.

The magical movement of the tile and understanding how footprints appear and disappear constitute all the basic rules of the environment which children need to know in order to work with TileLand. Once children know how to operate the mouse, this conceptual simplicity of TileLand is intended to make it easy for them to interact with the environment.

In addition to the above basic rules, there are a few other features to enhance the environment. An *UNDO* feature allows children to undo their previous actions. They can thus explore and backtrack different visualization paths. A *Clear* feature allows children to clear the screen. A homing feature (*Home* button) allows children to reset the location of the Magic Tile and return to the center of the Pattern Area. Children can also turn a background grid *on* or *off*. A *Look Ahead* feature allows children to see the next position of a Magic Tile if they were to click on it. Children can also save or print a tiling pattern that they have constructed and open an existing one.

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[1] Our formative usability evaluations suggested that it is easier for very young children to be given a starting position so they do not have to worry about where to begin.

TileLand is an open-ended environment intended to allow children to progress through it at their own pace, gradually developing more sophisticated 2-dimensional visualization abilities. Currently, TileLand has four levels. Different levels have different learning features and can be regarded as different types of learning environments.

Level 1: Open-Ended Construction Tool

Level 1 provides children with a construction tool that has a specific focus—that of creating mathematically-based patterns and tilings. Therefore it is based on the constructionist approach to learning [Papert, 1980; Harel and Papert, 1991]. This level is purely exploratory. Children are free to pursue their interests and create any type of pattern they desire. Although these patterns may have little mathematical properties, they help children develop an understanding of the metaphoric language of interaction used in the environment. Additionally, Level 1 provides a motivating environment in which children can construct colorful designs. Figure 1 shows a sample design created by a seven-year-old child. Although this module is referred to as a level, it is a self-contained environment—that is, children need not progress to or explore any other levels.

Level 2: Logic-Based, Problem-Solving Game

Level 2 is a typical sequential game-based, problem-solving activity [Alessi and Trollip, 2001]. It is a goal-driven version of Level 1. At this level, children need to solve a variety of geometrical pattern problems using the basic rules of TileLand which they learn in Level 1. Children are given explicit, pre-created patterns to reproduce. Whereas Level 1 is more experiential, Level 2 is more about making decisions, comparing the merits of different sequences and polygons, and reflecting on their relationships to determine how an existing pattern can be created [Norman, 1993; Sedig, 1998]. For instance, Figure 2 shows a simple pattern that children can reproduce. They can produce the pattern in several ways. One strategy is to produce the pattern in a radial manner—i.e., start from the center, move out, return to the center, turn, move out again, return to the center, and so on. Another strategy is to produce the pattern by walking around the central hexagon—i.e., start from the center, move out, turn, walk around, placing other hexagons around the central one (see Figure 5).

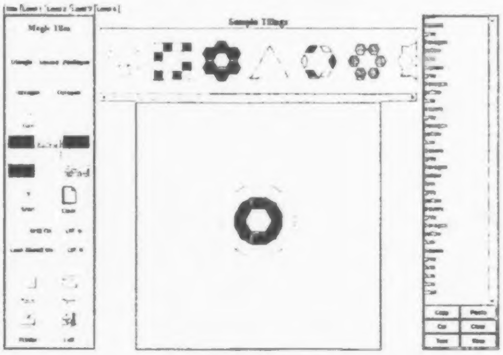
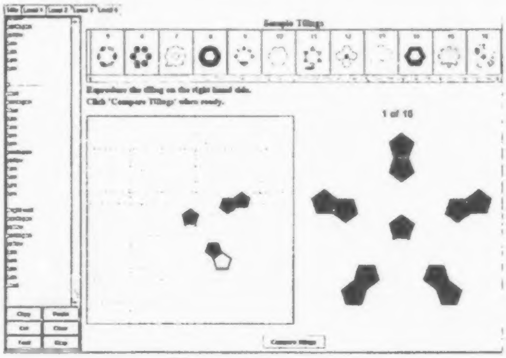


Figure 3: Level 3



Reproduce the tiling on the right hand side.
Click 'Compare Tilings' when ready.

Figure 4: Level 4

Level 3: Open-Ended Programming Microworld

Sedig et al. [2001] suggest that interfaces that gradually move learners from a visual thinking strategy to a linguistic (algebraic or command-based) one can be effective in engaging learners in reflective thought and deeper processing of educational concepts. In Level 3, children's interactions with the Magic Tile are simultaneously translated into linguistic commands appearing in a *Programming Panel* on the right-hand side of the screen (see Figure 3). For instance, clicking on the square button produces the command 'square', and other buttons produce commands such as 'pentagon', 'red', and 'turn'. There are sixteen commands in total which can be categorized into two main conceptual groups—five polygon commands and nine color commands—plus Turn, Home, and Clear. The sequence of commands in the panel corresponds to all the actions the user has performed. This sequence serves at least three goals: 1) it can act as a bridge between the visual and linguistic description of a pattern, 2) it can act as a mapping between the spatial and temporal representations of a pattern, and 3) it can act as an external representation that can be examined and modified.

Visual-to-Linguistic Description: All visual mathematical concepts have a corresponding linguistic description [Devlin, 2000]. Additionally, an important feature of educational environments is to provide multiple representations of content [Tabachneck-Schijf and Simon, 1996; Lajoie, 2000]. In Level 3 children learn that visual patterns can be described linguistically. One of the benefits of this multiplicity of representations is that visual representations are processed differently from linguistic representations. The former are processed in parallel, whereas the latter are processed sequentially, requiring more cognitive processing and investment of mental effort [Sternberg, 1999]. As such the two forms of representation complement each other (see Figure 5).

Temporal-to-Spatial Mapping of Interaction: When children interact with the buttons in TileLand, their interactions produce a spatial image. This image implicitly contains the history of the steps that led to its creation. However, the only way that children can access this history is to examine their own memory which may contain cognitive residues of their interaction with the system. Instead of relying on children's short-term memory, TileLand maps their temporal interactions into a spatial representation—i.e., a linearized history of their actions in the Programming Panel.

Externalization as an Object of Reflection and Interaction: The externalization of the visual description and interaction—that is, its conversion to 'code'—affords children to both reflect upon the code as well as interact with it. Children can use the programming panel to modify and augment the sequence of actions (i.e, the code) by copying, cutting, pasting, and typing code. By copying and pasting blocks of code, children are performing rudimentary procedural routines[2]. Children can bypass the use of buttons entirely and use the Programming Panel as an editor as well as a dynamic interpreter to write code from scratch to produce their patterns. Code written in the programming panel can be 'run', and a visual simulation of its corresponding pattern is generated step by step. This provides children with a very simple programming microworld—a self-contained software environment which embodies a reduced set of principles and concepts from a domain of knowledge [Ginsburg & Zelman, 1988]. Children can augment the history of their actions by inserting comments in the code. This feature helps the reflective practice of coding allowing children to chunk blocks of code into meaningful units.

```
Home
Hexagon
Orange
Hexagon
Pink
Turn
Turn
Hexagon
Pink
Turn
Hexagon
Pink
Turn
Hexagon
Pink
Turn
Hexagon
Pink
Turn
Hexagon
Pink
Turn
Home
```

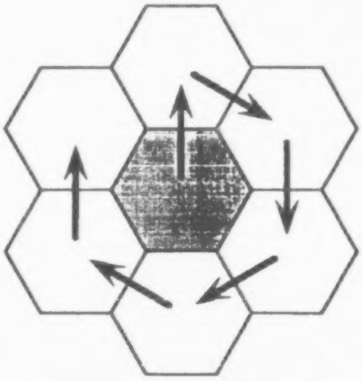


Figure 5: A simple pattern, a possible program for its creation, and its corresponding strategy

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[2] Indeed using cutting and pasting, the user may find it easier to produce more elaborate patterns (see Figure 4).

Level 4: Programming Game

Level 4 is a problem-solving game, similar to Level 2. However, the Action Panel is no longer present (see Figure 4). It is replaced by the Programming Panel. In order to advance through the game, children need to produce a purely linguistic description of the given patterns. Children do this in a coding-testing-reflecting-modifying cycle. They can write a few lines of code or an entire program, test it, reflect on the resulting pattern and its code (i.e., discover why it did or did not work), and modify the code as needed. Unlike Level 2 where children can see the immediate result of every action while clicking on action buttons trying to re-produce a pattern, in Level 4 there is a temporal disconnect between devising a solution and testing it. This disconnect implies that children may need to mentally 'walk through' the visualization before they produce and test the code and observe its externalization. This mental simulation is one of the most important skills in visualization that a learner can acquire [NCTM, 1989].

Usability Evaluation

TileLand has gone through a series of formative evaluations. These evaluations have greatly influenced its design. Formative evaluations were conducted with half a dozen children, ages ranging from five to eight. In the early stages of its design, TileLand contained such actions as Forward, Back, TurnLeft, TurnRight, and Mark. However, we discovered that children had a difficult time constructing a proper conceptual model of the environment. For instance, the Current Tile had a Current Color while it moved. Children had to click on a Mark button for the tile to leave a footprint. They found it difficult to understand why a tile that had a current color would not leave a footprint while moving and that they needed to click on a 'mark' button for the footprint to be created. Additionally, they could not understand the difference between a tile attaching to a current one and moving a tile forward and backward.

After an iterative process of testing and modifying the environment, we minimized the number of conceptual actions and introduced the notion of the Magic Tile. In our latest usability evaluations, several children, as young as five years old, used the system with ease and found it engaging. They produced many printouts and were proud of their designs.

Summary and Future Work

This paper has presented TileLand, a multi-faceted microworld. TileLand allows children to construct colorful tiling patterns using regular polygons, engaging them in creative, mathematical art. TileLand is also a logic-based, problem-solving game which encourages children to explore the underlying geometric principles involved in constructing tiling patterns. TileLand can also be considered a programming microworld. It allows children to use simple descriptive language to express how a tiling pattern should be created while dynamically testing their description.

TileLand integrates several types of pedagogical interaction styles. It involves open-ended exploration as well as goal-directed play; it can be considered an experiential, fun tool as well as a reflective, challenging one; and it requires visual as well as linguistic information processing skills.

Future work involves conducting formal empirical evaluations of TileLand to assess its educational effectiveness. Additionally, the order of the presentation of the tiling puzzles in the game levels need to be examined, as each tiling pattern embodies different mathematical concepts [Peterson, 2001; Kinsey and Moore, 2002]. This organization can affect the way in which children conceptualize and understand the patterns and their underlying principles.

Acknowledgments

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References

Alessi, S. M., & Trollip, S. R. (2001). *Multimedia for Learning*. Needham Heights, MA: Allyn & Bacon.

Devlin (2000). *Mathematics: The Science of Patterns*. New York, NY: Freeman and Company.

Druin, A. (ed., 1999). *The Design of Children's Technology*. San Francisco, CA: Morgan Kaufmann Publishers, Inc.

Forman, G., & Pufall, P. B. (1988). *Constructivism in the computer age*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Ginsburg, H. P., & Zelman, S. (1988). Understanding individual differences in the computer age. In G. Forman & P. B.

Pufall (Eds.), *Constructivism in the computer age*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Harel, I., & Papert, S. (eds., 1991). *Constructionism*. Norwood, NJ: Ablex Publishing Corporation.

Kinsey, L. C., & Moore, T. E. (2002). *Symmetry, Shape, and Space*. Emeryville, CA: Key College Publishing.

Lajoie, S. (ed., 2000). *Computers as Cognitive Tools*. Hillsdale, NJ: Lawrence Erlbaum Assoc.

MECC. (1995). *Tesselmania*. [Computer Software]. Minneapolis: Author.

NCTM (1989). *Curriculum and Evaluation Standards for School Mathematics*. Reston, VG: The National Council of Teachers of Mathematics, Inc.

Norman, D. A. (1993). *Things that make us smart: Defining human attributes in the age of the machine*. New York, NY: Addison-Wesley Publishing Company.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York, NY: Basic Books.

Peterson, I. (2001). *Fragments of Infinity: A Kaleidoscope of Math and Art*. New York, NY: John Wiley & Sons, Inc.

Sedig, K. [or Sedighian, K.] (1998). *Interface style, flow, and reflective cognition: Issues in designing interactive multimedia mathematics learning environments for children*. Unpublished Ph.D. dissertation. Department of Computer Science, The University of British Columbia, Vancouver, Canada.

Sedig, K., Klawe, M., Westrom, M. (2001). Role of Interface Manipulation Style and Scaffolding on Cognition and Concept Learning in Learnware. *ACM Transactions on Computer-Human Interaction*, 1(8), 34-59.

Sternberg, R. J. (1999). *Cognitive Psychology*. Orlando, FL: Harcourt Brace & Co.

Tabachneck-Schijf, H. J. M., & Simon, H. A. (1996). Alternative Representations of Instructional Material. In D. Peterson (ed.), *Forms of Representation*. Exeter, UK: Intellect Books.

New Roles for Teaching and Learning: A Collaborative University Project for the Government

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Abstract

This presentation describes a project to educate a team of college students in designing and developing an online course for the National Security Agency (NSA) utilizing constructivist methods of learning.

Constructivist Approaches To Learning And Research

This project involved converting a face-to-face NSA course to a multimedia web-based course. The conversion included a team of undergraduate and graduate students from Instructional Technology, Art Education, Computer Science, Special Education, and Graphic Design. Representation of various cultures was taken into consideration when selecting the students. In addition, two students were already teachers in the public schools and had experience in curriculum development. Two professors directed the project and were part of the team – one from Instructional Technology and the other from Art Education. The team's focus was on collaborative group work and a constructivist approach to learning. Constructivist approaches served as the basic foundation for organizing and developing the project "...where students develop their knowledge through team collaboration, discuss different interpretations of a problem, and negotiate and synthesize ideas drawing from various disciplines" (Boyer & Semrau, 1995, 14). The constructivist goal was for the students to collaborate and the faculty to facilitate. Technology allowed the students to have more control over their own learning and become more independent in their search for knowledge. Jonassen noted that significant knowledge construction could be facilitated by:

1. Learning environments, which include working with authentic tasks,
2. Providing real world learning environments,
3. Fostering reflective practices,
4. And, supporting collaborative construction of knowledge through social negotiation rather than competition among learners for recognition.

The students were trained in new skills and how to research and work collaboratively with both faculty members and each other. Training was provided on html, Photoshop, Premiere, MediaCleaner, Pagemill and the designing of web pages. WebCT was used for managing the website, communication and collaboration, and uploading pages.

A major course goal was to keep the web course interactive emphasizing learner control. Useful tools for designing constructivist approaches to learning are hypertext and hypermedia because they allow for a branched instructional design rather than a linear top-down approach. It was also important in the distance education course that there be a balance between the text and the use of graphics, diagrams, video and audio to reinforce the learning.

For a foundation in working collaboratively in building a website, the students first designed a demonstration site on streaming media with RealAudio and RealVideo examples. The demonstration site was developed for sharing our research and for communication among the students and project faculty. Emphasis was placed on demonstrating educational uses of streaming video and audio in education as well as being a source of research data and instruction for creating streaming video and audio for web-based training. Roberts et al state, "...students need to be able to find and use relevant information, share and discuss data and ideas, and collaborate on problem solving" (1990, 116).

In this presentation five stages are described, which are involved in creating a distance education course. Specific strategies are detailed and actual solutions are illustrated for each of the following 5 stages:

1. Planning and Development of the Content
2. Layout and Design of the Website
3. Implementation
4. Editing the Content
5. Assessing Learning and Evaluation

Conclusion

The new web-based version of this course will make the content accessible to more NSA employees located in various places throughout the world. Plus, the online version will include interactive pop quizzes with immediate scoring and feedback as well as streaming media lectures to complement the course content, which is presented as text on the web pages.

In addition as Boettcher and Cartwright (1997) emphasized, web course designers must realize that the "individual learner must be viewed as the key design element." We need to design instruction so that each individual learner can effectively build on what he or she knows and have the resources and assistance to learn (p. 2).

Through this project the students became constructively involved in their own learning and acquired in-depth experiences in collaborative learning and team approaches. New roles were created for both the teachers and the students. The students became empowered to be creators of their own curricular materials and web pages instead of being passive viewers of others'. In this project all of Bloom's higher-level taxonomies were implemented:

- Students analyzed websites,
- Synthesized criteria that they researched,
- Applied their book readings,
- Compared and contrasted their criteria,
- Designed and produced their own web pages focused on sound educational practices.

The faculty worked side-by-side with the students, setting new goals together, and evaluating and problem-solving as a team. As Gibson (1998) noted "...we, as distance educators, need to be learner-centered reflective practitioners" (p. 143).

References

Boettcher, J. & Cartwright, G. P. (Sept/Oct 1997). Designing and supporting courses on the web. [On-line]. Available: http://www.kentinfoworks.com/change/articles/sepoct97.html

Boyer, B. A. & Semrau, P. (January/February, 1995). A constructivist approach to social studies integrating technology, *Social studies & the young learner*, 7(3), 14-16.

Gibson, C. C. (1998). In retrospect, *Distance learners in higher education: Institutional responses for quality outcomes*. Chere Campbell Gibson, editor. Madison, WI: Atwood Publishing.

Gibson, J. W. & Herrera, J. M. (January 1999). How to go from classroom based to online delivery in eighteen months or less: A case study in online, *T.H.E. Journal*. [On-line]. Available: http://www.thejournal.com/magazine/vault/a2080.cfm

Jonassen, D. H. (Undated). Thinking technology: Toward a constructivist design model. [On-line].

Polichar, V. E. & Bagwell, C. (May 2000). Pedagogical principles of learning in the online environment, *Syllabus*, 13(9), 52-56.

Roberts, N., Blakeslee, G., Brown, M., & Lenk, C. (1990). *Integrating telecommunications into education*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

When You Only Have One Chance: Online Library Instruction

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Abstract: DePaul University has developed the Instruction Builder, an application for creating, delivering and administering online tutorials. This paper discusses how online library instruction differs from online instruction for a semester or quarter long course. It also examines the roles of peer-to-peer, student/instructor, and ongoing communication in an online learning environment.

Courses with a strong research component will often turn to the library to teach a 'one-shot' session on effective library research. The librarian's goal is to foster information literacy: to teach the students the skills necessary to find the information they need. The quantity and complexity of research sources has grown tremendously in recent years, and it can be a challenge to cover anything beyond the basics in these workshops. There is also little chance for the librarian to follow up with individual students, and some students may see the session as busy work if it there is not a visible degree of collaboration between the librarian and the instructor.

Faced with higher enrollments, shrinking resources, more content to teach, and a growing population of distance ed. students, librarians have turned to the web to teach information literacy skills. One of the major challenges librarians face is that while they now teach their skills online, the integration of these skills into the course itself has not changed. Most web-based research tutorials are still a one-shot session, an assignment that students must complete on their own time. Librarians are creating online workshops as opposed to online courses.

The distinction between online workshop and online course is a crucial one in selecting the right tools. Most Learning Management Systems (LMS), such as Blackboard or WebCT are built with the assumption that online instruction will 'mimic' a traditional quarter or semester long course. In his ED-MEDIA 2001 keynote address, David Jonassen argued that these assumptions reinforce some of the worst aspects of traditional in-class education.[1] For librarians, they simply don't work. These systems provide an array of features that cannot be used in a one-shot session and don't provide the tools needed to effectively teach the skills in question.

The DePaul Libraries began offering online library instruction in the Winter of 1998 with the Library Research Workshop. This workshop teaches up to 40 sections of freshman English students per quarter how to search online databases to find journal articles. The library's first version of the workshop used WebCT to create the class navigation. The problem? We were unable integrate teaching materials, demonstrations, quizzes and assignments on the student's own topic. The first version of the workshop forced students to wade through a great deal of material before reaching anything directly relevant to their own interests. In the fall of 2000, the Library needed to bring a more extensive research program for adult learners online. We saw that WebCT and the other LMS systems would not meet our needs, so we began work on the Instruction Builder, an in-house Learning Content Management System (LCMS).

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[1] David Jonassen. (June, 2001). E-Learning to Solve Problems. *Keynote Address: ED-MEDIA World Conference on Educational Multimedia, Hypermedia & Telecommunications.* Tampere, Finland

The distinction between the LMS and the LCMS is derived from an IDC white paper.[2] LCMS software is more focused on teaching skills than on managing classrooms. Consequently, rather than offering discussion boards, course syllabi, automatic grading and other common LMS features, it focuses on helping teachers break down their content into small sections, and teaching that content in more interesting ways. It allows both the teaching material and the students' responses to be stored in a database, to better track which skills are taught well and which skills students are frequently missing.

The Instruction Builder organizes content into skill-based modules. Each module ends with an assignment that applies the skill taught to the student's own interests using open-ended questions. Because the system is divided into segments, authors are deterred from creating long pages that attempt to teach too many skills at once. Students are tested on skills based on their own interests as they learn them, rather than having to plow through a long workshop, then take a long test. The student's answers are reviewed by a librarian, who then responds to the student.

When librarians taught these workshops in person, a great deal of emphasis was placed on peer-to-peer communication. Librarians had students work in groups to construct search strategies for one another's topics. This taught the creative process of word choice in database searching. Some students were likely to come up with terms that wouldn't have occurred to others, and it was clear that talking about the topic helped them search it more effectively. There was, however, very little one to one or ongoing communication between the librarian and any individual student. When students were in the lab working on the assignment, there was one librarian attempting to help over 20 students at once!

The move to an online environment has eliminated peer-to-peer communication, but has greatly enhanced one on one and ongoing communication between the librarian and student. As of December 2001, approximately 1,700 students have taken workshops created with Instruction Builder. Each student's assignment is individually reviewed, and the librarian is able to recommend strategies and alternatives when appropriate. In terms of communication with a librarian, the library research portion of these courses is now more fully integrated into the course itself.

Both the loss of peer-to-peer communication and the enhancement of student/librarian communication are crucial. Authors such as Curtis Bonk increasingly point to communication and interaction as the key to successful online learning. In "A Dozen Recommendations for Placing the Student at the Center of Web-Based Instruction", six of the recommendations pertain to peer-to-peer or ongoing communication.[3]

The Library has already outgrown the system developed in-house. While there are a number of promising LCMS systems appearing on the scene, including Avaltus and Knowledge Mechanics, these systems don't provide the tools for fostering ongoing communication between student and instructor which we see as the core of our workshops' value. DePaul's Instructional Technology Department has begun work on a more robust Instruction Builder system, to be implemented throughout the University.

The fact that the one-shot research workshop model has been carried over from the traditional setting to the online environment has more to do with the assumptions & habits of librarians and instructors than the limitations of technology. This can (and should) be changed by breaking up the one-long-workshop model into smaller segments, which are taken during selected weeks of the quarter. It was assumed, for instance that since we had an hour and a half in class, that we would also have an hour and half online. But an hour and a half sitting at the computer taking an online course is a very different experience, and can be fairly numbing. Breaking the workshop up would integrate it more completely into the course content, foster more exchange between the student and librarian, and would ease the fatigue of online instruction.

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[2] Brennan, Michael, et al. (May, 2001). The Learning Content Management System: A New E-Learning Market Segment Emerges. http://www.internettime.com/itimegroup/lcms/IDCLCMSWhitePaper.pdf

[3] Bonk, C. J., & Cummings, J. A. (1998). A dozen recommendations for placing the student at the center of Web-based instruction. *Educational Media International*, 35(2), 82-89.

Rejuvenating the Social Foundations of Education Course Using Digital Technology and the Case Method

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Abstract: This conceptual essay examines theoretical and methodological problems associated with teaching the Social Foundations of Education course and provides a framework on how to overcome these difficulties. Foundations of Education courses are notable for both their volume and the ambivalence with which students and instructors regard their role in preparation for teaching. The ambivalence is held because foundations courses generally suffer from instructors unknowingly devising incompatible goals for the course while the multidisciplinary nature of the course frequently leads to intellectual incoherence. One way to overcome these deficiencies is to have students acquire an "ironic" understanding using the case method. Case studies that use digital technology make this approach even more powerful because digital technology provides students with a cognitive tool that encourages the profound knowledge necessary to attain ironic understanding.

This conceptual essay examines theoretical and methodological problems associated with teaching the Social Foundations of Education course and provides a framework on how to overcome these difficulties. A staple of teacher education since the 1930's (Cohen 1999; Lagemann 2000), Foundations of Education courses are notable for both their volume and the ambivalence with which students and instructors regard their role in preparation for teaching. The ambivalence is rightfully held by both because foundations courses, from their inception, have suffered two significant shortcomings. First, instructors unknowingly have devised incompatible goals for the course. Second, the multidisciplinary nature of the course frequently leads to intellectual incoherence for all concerned.

As a teacher of Foundations courses, I have struggled with overcoming these embedded course deficiencies. Over time, I came to a realization that the course needed a new goal. I borrowed from Kieran Egan (1997) the idea of having students acquire an "ironic" understanding. Due to the multidimensional representation possible with cases, attaining ironic understanding is enhanced when case methods are employed (Merseth, 1996). Most recently, I have begun to supplement paper copies of case studies with digital technology and believe that the enriched learning experience provided by such an approach makes the case study method even more powerful. Digital technology provides students with a cognitive tool that encourages the profound knowledge necessary to attain ironic understanding.

Many instructors of foundations of education courses have grappled with ways to overcome the incompatible goals and the intellectual muddle of the course. An effective way to resolve the paradox is to create a course that seeks a new goal using new intellectual tools. Vygotsky (1978) argued that people make sense of the world using mediating intellectual tools. Intellectual development, then, is dependent not only on psychological stages, like those described by Piaget, or on the knowledge we accumulate, but also relies on the intellectual tools that society makes available. While Vygotsky focused on oral language, or sign systems, in his formulation, other intellectual tools are available. Using these tools in innovative ways can refashion the social foundations of education course.

For me, the way out of the teaching dilemma presented with a course that has at its core incompatible goals is to radically change the student outcome desired. Guided by the insights of Kieran Egan (1997) on the larger purposes of schooling, I seek to assist students in acquiring an ironic understanding of schools and teaching. Briefly, irony, as we know it today, is tied to a belief that the truth long sought in the western intellectual tradition is illusionary. In place of certainty, irony provides for the centrality of reflexiveness in thinking. Ironic understanding, then, leads to the removal of a commitment to simple truth of general schemes. The sophisticated ironist, instead, enjoys extensive ways of understanding and recognizes the value of a varied spectrum of perspectives.

Fostering multiple perspectives is at the heart of the articulate ironist. Gliding from perspective to perspective is valued and becomes second nature in such a person. The ironist applies the varying perspectives to make sense of their experiences. A teacher might ironically note, for example, that a new school policy designed to improve math performance in fact creates a wider gap between high math achievers and low achieving math students. A better identification of the problem and a clearer solution is then possible. One must take care, ironically enough, to make sure that the disciplinary incoherence of the social foundations course is not replaced with incoherence arising from seeing events with different perspectives. The value of a case study approach to teacher education is that while cases offer multiple perspectives, they are at the same time grounded in a specific narrative context. General theoretical principles flow from an array of possibilities that build on one another. Out of what seems to be chaos comes not only insight but also orderliness.

Emerging digital technology is allowing the case study method to develop into an even more powerful tool by permitting cases to become more contextually grounded. More specifically, an interactive course web site that supplements the text of a case with multimedia presentations and links to other data sources allows great flexibility in student construction of knowledge. To illustrate this, I shall borrow a metaphor from the world of art museums. Elizabeth Valance (1995) refers to a "public curriculum" inherent in the orderly images found in art museums. This public curriculum consists of the images displayed; the order in which the images are placed; the information provided for visitors; the tours, lectures and workshops and other programs offered to the public; and the publications produced. The curriculum is randomly accessed by visitors and is readily available to anyone who comes to the museum. All visitors, however, study" the curriculum on their own and make sense of the images in endless varieties of ways. While visitors may understand the curriculum in a variety of ways, the curriculum is deliberate. Images are arranged in some order (usually by culture chronology but such need not be case) with or without helpful labels. Some images are quite accessible to all but others are difficult, and visitors may even view an image with hostility. Visitors will frequently confront a museum worker with some sort of refrain along the lines of, "Is that really art?"

Similarly, a well-designed course website will be accessible and challenging. Depending on how images, text, video and audio are arranged, one can create different learning environments and attempt to frame relevant issues in key ways. Arranging course materials using digital technology into generative topics allows for students to respond to the realities of classroom practice and educational policy-making in multiple ways. What cannot be controlled, of course, is what students learn. The goal, instead, is to provide as many avenues as possible to allow students to make their own connections and to form their own categories. Like a well run art museum that helps novice visitors find accessible entry points into the world of art, an interactive website can assist the novice teacher into gaining access to the profession of teaching.

References

Cohen, S. (1999). *Challenging orthodoxies: Toward a new cultural history of education*. New York: Peter Lang.

Egan, K. (1997). *The educated mind: How cognitive tools shape our understanding*. Chicago: University of Chicago Press.

Lagemann, E. C. (2000). *An elusive science: The troubling history of education research*. Chicago: University of Chicago Press.

Merseth, K. K. (1996). Cases and case methods in teacher education. In J. Sikula (Sr. Ed.), and T. Buttery and E. Guyton (Eds.), *Handbook of research on teacher education: A project of the Association of Teacher Educators, 2nd edition*. New York: Macmillan Library Reference USA, Simon & Schuster Macmillan.

Vallance, E. (1995). The public curriculum of orderly images. *Educational Researcher*. (24), 4-13.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. M. Cole, V. John-Steiner, S. Scribner, and E. Souberman (Eds.). Cambridge: Harvard University Press.

The Evolution of Critical Thinking and Use of Scaffolding in a Technology-Mediated Environment

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Abstract Recently, attention has focused on developing methods for facilitating critical thinking in students. Scaffolding is a method that has been successfully used in many settings to support different learning goals. This study focused on the influence of scaffolding on critical thinking skills in a technology-mediated environment. The main research questions explored changes in participant use of scaffolding and influences on the evolution of critical thinking. A qualitative design guided data collection and analysis. Five graduate participants were purposefully selected from an online instructional design class and interviewed repeatedly over one semester. Major findings indicated that participant use of scaffolding moved from externally directed to internally relevant assimilation. Influences on the evolution of critical thinking included prior knowledge, reflection, feedback, project context, and perception of self as learner. Implications for research and practice are outlined.

Introduction

This paper describes a study conducted to explore the influence of scaffolding on critical thinking skills in a technology-mediated environment. With the recent increase in online education and Internet-based content, the development of critical thinking skills becomes more important, along with the development of methods for supporting critical thinking. Much attention has been focused on identifying and developing methods for supporting and facilitating learning in non-traditional environments. Scaffolding is one method that has been used in a variety of settings, ranging from one-on-one tutoring to traditional classrooms for supporting very different learning goals (Bliss, Askew, & Macrae, 1996; Graves & et al., 1996; Hogan & Pressley, 1997; Lepper, Drake, & O'Donnell-Johnson, 1997; Palincsar, 1986; Saxe, Gearhart, & Guberman, 1984; Wood, Bruner, & Ross, 1976).

Scaffolding was first defined as a process by which an expert supports a learner in the accomplishment of a task beyond the learner's individual capabilities, and then gradually fades that support as the learner becomes more competent in task accomplishment (Wood et al., 1976). Scaffolding has been used effectively in classroom environments for supporting the learning of reading (Palincsar, 1986), language (Roehler & Cantlon, 1997), mathematics (Schoenfeld, 1991), and scientific inquiry (Hogan & Pressley, 1997). In these environments, teachers interact with groups of students, providing them with appropriate support through modeling, questioning, or cued reflection and externalization of metacognition. Studies have shown that through such support and scaffolding, students gradually internalize cognitive processes and assume responsibility for and control of their own learning (Roehler & Cantlon, 1997).

Researchers have tried to broaden the availability and application of scaffolding by developing technology-mediated and technology-based scaffolding. Despite the limitations of computer-based intelligent systems in emulating the sensitivity and responsiveness of the human expert, computers were able to mediate and emulate certain facets of the scaffolding process (Chee, 1995; Guzdial, 1994; Kao & et al., 1996; Soloway et al., 1993). In most cases, these applications functioned as on-demand help systems and provided the learner with procedural and directive instructions for task completion.

Recently, a few technology-based scaffolding applications have been developed that address the internalization of cognitive strategies and higher order thinking skills. *Reading Partner* (Salomon, Globerson, & Guterman, 1989) focused on supporting the internalization of metacognitive strategies by providing intellectual and pedagogical scaffolding for seventh graders' reading skills. Despite the lack of fading, the continuous introduction of metacognitive questions and hints resulted in students' internalization of strategies and improvements in a near transfer task—writing.

The *Web-based Inquiry Science Environment* (WISE) (University of California at Berkeley, 1999), another prominent application, focused on scaffolding students' scientific inquiry and higher order thinking skills on the Internet. With the help of the software tools and scaffolding in the form of questions, students evaluated web sites and asked critical questions aimed at evaluating the utility of the site's content for a specific project. Empirical evidence indicated that scaffolding tools positively influenced students' critiques and their ability to ask critical questions (Slotta & Linn, 2000).

Research indicates that scaffolding of higher order thinking skills is best achieved through metacognitive hints and questions—directive guidance seems to engender an over-dependence on scaffolding and reduces the capability of the learner to function independently (see for example, Kao & Lehman, 1997). Additionally, scaffolding must be overtly faded to encourage and identify the transfer of metacognitive strategies to related future tasks. Apart from techniques and implementations of scaffolding, internalization of cognitive strategies is also affected by context and task structure. Research indicates that students' ability to assimilate technology-based scaffolding is increased by providing goals and orientation (Oliver & Hannafin, 2000; Slotta & Linn, 2000).

Students' epistemological readiness and interests mediate both the use of scaffolding (Oliver & Hannafin, 2000; Sherman, 1994) and the ability to think reflectively and critically (King & Kitchener, 1994; Kuhn, 1999). For younger students, directive and instructive scaffolding may prove more effective because of students' naïve epistemologies and willingness to accept authoritative knowledge (Kuhn, 1999). For slightly older students, however, scaffolding in the form of Socratic and open-ended questions might prove more effective due to students' epistemological readiness to question and seek knowledge.

Research Questions and Design

Based on reviewed literature and studies and the purpose of the current study, three major research questions were addressed:

- How does student perception and use of scaffolding evolve?
- What processes and sources influence the development of critical thinking skills?

A qualitative research design was used to meet the purpose of the study and to address the research questions. The study was conducted in the context of a primarily online Instructional Design (ID) offered in the spring semester 2001 in a large Southeastern university. Within this online environment, scaffolding supported the performance of critical thinking tasks in ID. Data were mainly gathered by interviewing five purposefully selected graduate students within the course. Participants were selected through administration of the Cornell Critical Thinking Test (CCTT) Level Z test (Fisher & Scriven, 1997) and their willingness and ability to articulate their thinking and learning. Participant generated documents were used to cue recall during the interviews. Interview data were analyzed using the constant comparison method (Glaser & Strauss, 1967).

During the course, the students used a textbook as a primary source of content and instruction. In addition, systematic, deliberate, and static scaffolding was provided via course materials at five discrete intervals to coincide with the completion of specific class-based tasks. The scaffolding, designed collaboratively by the researcher and course instructor, was designed to facilitate deeper reflection, metacognition, and critical thinking for the execution of six class-related documents. Decisions about level and type of scaffolding were negotiated throughout the course, and scaffolding was gradually faded.

Students accessed the static scaffolding directly through the web page that described the assignment. Thus, the task was presented concurrently with the appropriate mode of scaffolding—Socratic questioning, modeling, or externalization of metacognition and reflection. The scaffolding provided for critical thinking in relation to Instructional Design was based on relevant literature in ID (Briggs, 1977; Dick & Carey, 1985; Smith & Ragan, 1993), critical thinking (Beyer, 1997; Ennis, 1987; Paul, 1990), and scaffolding (Hogan & Pressley, 1997; Rogoff & Wertsch, 1984; Vygotsky, 1978; Wertsch, 1984; Wood & Wood, 1996).

Data were gathered through two main sources: interviews and participant document artifacts, which included six assignments that were directly related to participants' individual instructional projects, and four concept maps generated at various stages by each participant. Participants were interviewed five times during the semester, at an interval of 2-3 weeks and during interviews, the concept maps and document assignments were used as visual triggers for participants to reflect on their meaning making process. Some participants also generated bi-weekly journals that detailed their thinking and experiences in ID. Also, participants posted their reflections about changes in their individual views of ID on the class bulletin board at the middle and end of the semester. Transcripts of the reflective bulletin board activities were used as additional document data, in conjunction with the reflective journals generated by some participants. The multiple sources of data also provided a source of triangulation and validity.

Major Findings

Use of Scaffolding

Initially, some participants perceived the scaffolding as directive and used the questions and examples as directions for task completion. For example, one participant said, "… it kinda coached me through the activity … and I thought about what it was she [the instructor] really wanted you to put in there." A similar attitude was adopted by another participant who tried to "parrot the examples" in the beginning of the semester. Towards the middle of the semester, as participants became more involved in their instructional project, most began to perceive scaffolding as a guide to help them achieve their own special needs. Participants began to speak about the advantages of having a "framework … to help you pinpoint where you need to focus on" and "prompts that [thinking] and that definitely helps." In most cases, the change in participants' perception and use of scaffolding was an acknowledgement of the their individual needs and contexts. One participant admitted that she began to view the scaffolding in terms of its applicability to her project, and by extension, her life: "I'm beginning to say you know, how would this fit into my real life and what should I be concerned about getting from it and whatever."

Use and interpretation of scaffolding moved through three distinct phases—in the first, scaffolding was considered as directive instructions. In the second phase, scaffolding was used as a guide within participants' individual context. Scaffolding in the third phase was marked by interpretation and selection to suit individual needs. In the externally dictated mode, participants chose to implement the provided scaffolding literally and "answer the questions" or react in accordance to their perceptions of what the "instructor wanted." However, as participants became increasingly conscious of their individual contexts and goals, they began to perceive the scaffolding as a guide that allowed them to direct their thinking along appropriate and personally meaningful direction. Some participants used scaffolding in a customized manner from the very beginning and indicated that the customization was guided by relevance to their project goal. The other participants also indicated that they eventually changed their perception and use of scaffolding based on their individual project goals and needs. The findings of the study indicate that it is important to identify methods for alerting students to the function of scaffolding—that is, to assist them in realizing their individual goals. In the current study, goal realization was an individual process occurring at different times. The importance of continuously defining and refining the learning goal during the scaffolding interaction is a key component of Wertsch's (1984) explication of scaffolding processes. Goal clarification has been identified as a keystone for success in the assimilation and use of scaffolding by students of different ages and in a variety of settings (see for example, Rogoff & Wertsch, 1984; Saxe et al., 1984; Slotta & Linn, 2000).

Influences on Critical Thinking

Five elements seemed to influence the evolution of critical thinking: reflection, feedback, problem context, perception of self as learner, and prior knowledge. Reflection emerged as a very important influence in the development of critical thinking. One participant often mentioned the value of reflection in changing her thinking, specifically with regard to the assignments and the necessity of looking beyond "predefined notions of how to do" things. Other participants acknowledged the novel role and the value of reflection in their activities as exemplified in the quote by this participant: "Basically I would say that reflecting is a new element that's coming into play and looking at details is not something I've had to consciously do …and it's not something that comes naturally to me." Authors such as Kuhn (1999) emphasize that fostering metacognitive and reflective skills is of utmost importance in promoting critical thinking. Brookfield (1986) identifies reflection as one of the most "useful" tasks in helping people think critically. Consequently, those participants who engaged in reflection often and who valued reflection as a tool to promote their thinking were most likely to engage in critical thinking.

Seeking and reacting to feedback was another influence on shaping participants' critical thinking in ID. Participants often mentioned their higher regard for seeking feedback, or as one participant said: "…maybe I'm just more comfortable hearing the feedback." Feedback was rated highly by participants as a means to gather different viewpoints and as a way of becoming more "open to just different ideas or different approaches." McPeck (McPeck, 1990)cites feedback or "rational disagreement" (p. 52) as one of the primary methods for stimulating the examination of ideas. McPeck also recommends that teachers who attempt to facilitate critical thinking in their students must learn to move their teaching from more "didactic" to "discursive" modes of presentation. This approach is consistent with the findings of the study, which indicate that feedback served to refine participants' understanding.

For many participants, the exigencies of their individual project context appeared to influence the development and evolution of critical thinking. The more authentic and unstructured the problem context, the more likely that individuals engaged in critical thinking. The two participants who addressed authentic, ill-structured problems for their instructional project acknowledged the importance of the integral nature of the project in their lives, and thereby the additional meaning and reflection gained from the experience. Research and theory offers two perspectives on these differences. King, Wood and Mines' (1990) research suggests that reflective, critical thinking is most often triggered by ill-structured problems rather than "well-structured problems" (Churchman, 1971). Two other participants who engaged in relatively well-structured projects that involved very little ambiguity indicated fewer instances of critical thinking.

Participants' perceptions of themselves as learners, as well as their perceptions of their role as learners significantly influenced changes in their thinking. For example, one of the older participants indicated that she preferred to "mimic" the processes being presented and she consistently referred to her novice status as a hindrance for critical thinking. Another participant who characterized herself as a "creative" and "alternative" thinker, said that the analytical nature of thinking required within the course was not to her liking or style. These self-imposed conceptions of self as learner hindered critical thinking in the instance of these two participants. Brookfield (1986) suggests that adults' understanding of their learning styles, selves as learners, and patterns of learning is an important prerequisite for critical thinking. Learning styles are defined as "the characteristic and preferred way in which an adult engages in learning activities" (Knox, 1986, p. 20). Reflecting consciously on and understanding one's learning has two implications for critical thinking. First, an awareness of one's learning style allows an individual to select appropriate strategies for effective learning (Brookfield, 1986). In addition, such understanding can promote appropriate adaptation of learning styles to suit changed circumstances. For example, some of the other participants, while acknowledging distinct learning styles, mentioned that they tried to integrate their styles with the class requirements, and indicated higher levels of critical thinking.

The role of prior knowledge in shaping participants' critical thinking in ID was apparent in a number of instances. In the case of three participants, prior knowledge served as a basis from which to compare their current learning and experiences in the class. These three participants incorporated their prior knowledge and experiences into their understanding of ID almost from the very beginning. For one participant, prior knowledge served as a source of data for guiding and refining his thinking; for another, prior knowledge stimulated an acknowledgement of existing biases and the need to make a "conscious effort to displace yourself." In these instances, prior knowledge helped to activate a comparison of prior and current experiences and to stimulate additional thinking and reflection when an inconsistency was encountered. This finding is consistent with research on the role of prior knowledge in triggering additional reflection and the search for additional information (see for example, Baker, 1979; Pitts, 1994). In other instances, especially in the case of the youngest participant, prior knowledge conferred an authority to her thinking that impeded critical thinking and she said in explanation: "I know every aspect of it…." This attitude is consistent with research indicating that prior knowledge can give rise to counterproductive strategies such as assuming the validity of default knowledge (Phillips, 1992) or preserving information that supports one's beliefs (Klayman & Ha, 1987)

Relevance and Significance

This study has implications for different groups. First, practitioners and educators interested in developing critical thinking skills in their students might benefit from the results of this study in being able to identify how and why students choose to assimilate and use critical thinking skills when adequately supported by scaffolding. Second, using the strategies recommended in this study as a launching point, designers and developers of online or technology-mediated instruction might adapt and introduce more effective strategies for implementing scaffolding for critical thinking in such environments. Specifically, this study provides a starting point for those interested in designing and implementing scaffolding for critical thinking related to Instructional Design, and encouraging further research and design based on the results of this study.

Apart from practical implications, this study contributes some interesting theoretical perspectives on scaffolding and critical thinking. In literature on scaffolding, attention has been focused in two main areas: (1) identifying characteristics of an expert "scaffold" (see for example, Lepper et al., 1997; Saxe et al., 1984; Wood et al., 1976), and (2) identifying outcomes of the scaffolding interaction between expert and novice (see for example, Hogan & Pressley, 1997; Kao & Lehman, 1997; Salomon et al., 1989; Slotta & Linn, 2000). This study contributes to a missing perspective—the role of student characteristics in assimilating and using scaffolding. By identifying a few of the cognitive characteristics and beliefs that affect student use of scaffolding, this study offers a starting point for other researchers who are interested in further exploring the interaction of student characteristics and scaffolding.

A second area of theoretical contribution is offered in this study's description of the influences on development of critical thinking. Although students may be eminently capable of thinking critically, a variety of influences preclude the development and demonstration of critical thinking skills. The documentation and description offered in this study also offer a starting point for exploring and deriving theoretical frameworks that define the impact of student and context characteristics on the development of critical thinking.

References

Baker, L. (1979). Comprehension monitoring: Identifying and coping with text confusions. Journal of Reading Behavior, 11(4), 365-374.

Beyer, B. K. (1997). Improving student thinking: A comprehensive approach. Needham Heights, MA: Allyn & Bacon.

Bliss, J., Askew, M., & Macrae, S. (1996). Effective teaching and learning: Scaffolding revisited. Oxford Review of Education, 22(1), 37-61.

Briggs, L. J. (Ed.). (1977). Instructional design: Principles and applications. Englewood Cliffs, NJ: Educational Technology Publications.

Brookfield, S. D. (1986). Developing critical thinkers: Challenging adults to explore alternative ways of thinking and acting. San Francisco: Jossey-Bass.

Chee, Y. S. (1995). Cognitive apprenticeship and its application to the teaching of Smalltalk in a multimedia interactive learning environment. Instructional Science, 23, 133-161.

Churchman, C. W. (1971). The design of inquiring systems: Basic concepts of systems and organizations. New York: Basic Books.

Dick, W., & Carey, L. (1985). The systematic design of instruction. Glenview, IL: Scott, Foresman.

Ennis, R. H. (1987). A taxonomy of critical thinking dispositions and abilities. In J. B. Baron & R. J. Sternberg (Eds.), Teaching thinking skills: Theory and practice (pp. 9-26). New York: W.H. Freeman & Co.

Fisher, A., & Scriven, M. (1997). Critical thinking: Its definition and assessment. Point Reyes, CA: Edgepress.

Glaser, B., & Strauss, A. (1967). The discovery of grounded theory. Chicago: Aldine.

Graves, M. F., & et al. (1996). Scaffolded reading experiences for inclusive classes. Educational Leadership, 53(5), 14-16.

Guzdial, M. (1994). Software-realized scaffolding to facilitate programming for science learning. Interactive Learning Environments, 4(1), 1-44.

Hogan, K., & Pressley, M. (1997). Scaffolding scientific competencies within classroom communities of inquiry. In K. Hogan & M. Pressley (Eds.), Scaffolding student learning: Instructional Approaches and Issues (pp. 74-107). Cambridge, MA: Brookline Books.

Kao, M. T., & et al. (1996). Scaffolding in hypermedia assisted instruction: An example of integration. Paper presented at the National Convention of the Association for Educational Communications and Technology, Indianapolis, IN.

Kao, M. T., & Lehman, J. D. (1997). Scaffolding in a computer-based constructivist environment for teaching statistics to college learners. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

King, P. M., & Kitchener, K. S. (1994). Developing reflective judment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults. San Francisco: Jossey-Bass.

King, P. M., Wood, P. K., & Mines, R. A. (1990). Critical thinking among college and graduate students. Review of Higher Education, 13(3), 167-186.

Klayman, J., & Ha, Y. W. (1987). Confirmation, disconfirmation, and information in hypothesis testing. Psychological Review, 94(2), 211-228.

Knox, A. B. (1986). Helping adults learn: A guide to planning, implementing, and conducting programs. San Francisco: Jossey-Bass.

Kuhn, D. (1999). A developmental model of critical thinking. Educational Researcher, 28(2), 16-26.

Lepper, M. R., Drake, M. F., & O'Donnell-Johnson, T. (1997). Scaffolding techniques of expert human tutors. In K. Hogan & M. Pressley (Eds.), Scaffolding student learning: Instructional Approaches and Issues (pp. 108-144). Cambridge, MA: Brookline Books.

McPeck, J. (1990). Teaching critical thinking: Dialogue and dialectic. New York: Routledge.

Oliver, K., & Hannafin, M. J. (2000). Student management of web-based hypermedia resources during open-ended problem solving. Journal of Educational Research, 94(2), 75-92.

Palincsar, A. S. (1986). The role of dialogue in providing scaffolded instruction. Educational Psychologist, 21(1-2), 73-98.

Paul, R. (1990). Critical thinking: What every person needs to survive in a rapidly changing world. Rohnert Park, CA: Center for Critical Thinking and Moral Critique, Sonoma State University.

Phillips, L. M. (1992). The generalizability of self-regulatory thinking strategies. In S. P. Norris (Ed.), The generalizability of critical thinking: Multiple perspectives on an educational ideal (pp. 138-156). New York: Teachers College Press.

Pitts, J. M. (1994). Personal understandings and mental models of information: A qualitative study of factors associated with information-seeking and use of adolescents. Unpublished doctoral dissertation, Florida State University, Tallahassee.

Roehler, L. R., & Cantlon, D. J. (1997). Scaffolding: A powerful tool in social constructivist classrooms. In K. Hogan & M. Pressley (Eds.), Scaffolding student learning: Instructional approaches & Issues (pp. 6-42). Cambridge, MA: Brookline Books.

Rogoff, B., & Wertsch, J. V. (1984). Children's learning in the "Zone of Proximal Development". San Francisco: Jossey-Bass.

Salomon, G., Globerson, T., & Guterman, E. (1989). The computer as a zone of proximal development: Internalizing reading-related metacognitions from a reading partner. Journal of educational psychology, 8(4), 620-627.

Saxe, G. B., Gearhart, M., & Guberman, S. R. (1984). The social organization of early number development. In B. Rogoff & J. V. Wertsch (Eds.), Children's learning in the "Zone of Proximal Development" (Vol. 23, pp. 19-30). San Francisco: Jossey-Bass.

Schoenfeld, A. H. (1991). On mathematics as sense-making: An informal attack on the unfortunate divorce of formal and informal mathematics. In J. F. Voss & D. N. Perkins & J. W. Segal (Eds.), Informal reasoning and education (pp. 311-344). Hillsdale, NJ: L. Erlbaum Associates.

Sherman, G. P. (1994). The effects of cued interaction and ability grouping during cooperative computer-based science instruction. Unpublished doctoral dissertation, Arizona State University.

Slotta, J. D., & Linn, M. C. (2000). The Knowledge Integration Environment: Helping students use the internet effectively. In M. J. Jacobson & R. B. Kozma (Eds.), Innovations in science and mathematics education: advanced designs for technologies of learning (pp. 193-226). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Smith, P., & Ragan, T. (1993). Instructional design. New York: Macmillan Publishing Company.

Soloway, E., Guzdial, M., Brade, K., Hohmann, L., Tabak, I., Weingrad, P., & Blumenfeld, P. (1993). Technological support for the learning and doing of design. In M. Jones & P. H. Winne (Eds.), Adaptive learning environments (pp. 173-200). New York: Springer-Verlag.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Wertsch, J. V. (1984). The zone of proximal development: Some conceptual issues. In B. Rogoff & J. V. Wertsch (Eds.), Children's learning in the "Zone of Proximal Development" (Vol. 23, pp. 7-18). San Francisco: Jossey-Bass.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. Journal of Child Psychology & Psychiatry & Allied Disciplines, 17(2), 89-100.

Wood, D., & Wood, H. (1996). Vygotsky, tutoring and learning. Oxford Review of Education, 22(1), 5-16.

Turning ICE into Icicle

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Abstract: This work in progress, called Icicle, is a computing environment for children that is easy to learn and use. It is based on two principles: use interaction and feedback to elicit program descriptions from the users and maintain a close mapping between user actions, program commands and program representations. Children construct performers for the Icicle world and then train the performers to behave in particular ways. The training takes the form of a dialogue between the children and the system and uses direct-manipulation and programming-by-demonstration techniques to encode programs as animations.

The Icicle system came about following work on a programming-by-demonstration (Cypher 1993) turtle-graphics environment called ICE (Sheehan 1999). ICE was a successful experiment in that it was easy to produce programs within the environment that generated pictures, many of them with sophisticated effects. However children want to make games (Sheehan 2001), not just fancy pictures, and there were some things missing from ICE if it was going to be used to produce games and other forms of interactive behaviour.

Programming by Interaction

The ability to cope with interactions was missing from ICE. The only object to control was the turtle. In Icicle, interactions are at the heart of the system; this includes interactions between a child developer and the system, between different objects in an Icicle program and between a child player and an Icicle program.

The first thing children have to do when presented with a blank world in Icicle is to make a *performer*. Performers are the object actors in the Icicle world. They have shapes, behaviours and state information. Programs in Icicle are represented by the rules associated with performers.

When designing a performer's appearance children can initially choose from three differently coloured simple shapes: an octagon, a square or a triangle. Rather than relying on professional clip-art, children must construct their own shapes using a simple drawing environment by modifying these initial shapes. Each performer can have as many different shapes as the children want. As Icicle programs run, performers can morph from one shape to another. This provides a remarkably flexible system for smoothly animating behaviour.

Once a performer has an appearance it can be placed in the Icicle world. A drag and drop of a shape from a performer window places a new instance of that performer in the world. The system immediately checks to see if there is a default behaviour for this new performer and if there isn't it asks the child, "What should this performer normally do?".

The most common behaviours for performers can be demonstrated using direct-manipulation. In particular the user can drag the performer around the screen. This results in *turn* and *move* behaviours being learnt. Similarly a different shape can be dragged onto the performer in the world – this action is interpreted as requesting a *morph* from the present shape to the new one. Handles on a performer can also be dragged indicating a *zoom* instruction.

When constructing a rule the user can undo any mistakes and demonstrate new instructions. As well as removing instructions from the rule, the undo command restores the performer to the state it was in before it was moved or morphed. When the user is satisfied with a sequence of commands he or she closes the dialog box. Turning the world on makes the performer repeatedly execute its default behaviour. If the user drags more copies of the performer on to the world they will automatically begin executing this default behaviour.

When a new interaction, such as a collision between performers occurs, and there is no existing rule corresponding to this situation the system once again asks the child to demonstrate the required behaviour. The user is asked to provide instructions for each performer involved in the interaction.

Users can be the source of interactions as well. If a key is pressed when the world is running the system checks to see if any performers have a rule corresponding to the key press. If so the appropriate instructions are executed, if not the user is asked to choose a performer and define a rule for the key press. Thus users can influence the behaviour of performers as the world runs, obviously necessary when implementing games.

Representation of the Rules

One of the problems in programming-by-demonstration systems is providing a listing of the generated program that is useful to the user (Myers & McDaniel 2001). Supplying the listing of a conventional textual program is not acceptable for novice users, in this case children. The connection between a textual program listing and the actions of objects on the screen is not clear enough. There is a gap in the novice user's understanding between the textual representation and the effect produced.

The Icicle system minimizes this gap by using animations of the action's results as the program listing. In terms of the cognitive dimensions (Green & Petre 1996) there is a true closeness of mapping between the program code and the desired behaviour - they are virtually identical. The conditions which cause the rules to activate are also animated, e.g. two performers colliding. Even for children unable to read the descriptions beneath each animation, it is clear what is being represented here.

In order to increase the perceived connection between the program code and the results of that code, changes to the code are reflected immediately in all the performers active in the world. Similarly changes to the shapes and colours of the performers in the drawing editor are shown simultaneously. The world can keep running while new performers are created and added to it or while old performers are modified. This produces a sense of liveliness that hopefully makes the performers appear more like active agents in the world (Travers 1996).

The fact that performers can only change their shapes by morphing is also an attempt to convey a sense of concreteness about each performer. A performer's shape is part of what the performer is and even though it can change shape it does it gradually in a way that preserves its continuity. When a child single steps the world forwards or backwards, it is easy to see the gradual change from one shape to another.

Parallel Processing

All performers execute their rules in parallel. When an interaction occurs the performers involved in the interaction change to run the interaction code. After the interaction is dealt with the performers return to their default behaviours. This parallel processing is not the only parallelism the system provides.

When a rule is made that comprises several instructions, such as a move, a turn and a morph, it is possible to make two or more of the instructions occur in parallel. This is useful if the user wants the performer to move along a curved path or to change shape as it moves.

Changing from sequential to parallel is simple; the user drags one instruction on top of another. The rule animations merge to show the result of the parallel instruction e.g. moving and changing shape simultaneously. Preliminary testing shows that this is easy for children to use, how much they comprehend is as yet unknown.

Similar Work

Different aspects of Icicle can be seen in a variety of children's programming environments or programming-by-demonstration systems. *Klik & Play* was a commercial product which turned into *The Games Factory* and uses interactions to ask for rules. Stagecast Creator (Smith & Cypher 1999) and Agentsheets (Repenning 1993) maintain rules which are fired when preconditions are met.

References

Cypher, A. (Ed.) (1993). *Watch what I do: Programming by demonstration*, Cambridge, MA: MIT Press.

Green, T.R.G. & Petre, M. (1996). Usability Analysis of Visual Programming Environments: A 'Cognitive Dimensions' Framework. *Journal of Visual Languages and Computing*, 7, 131-174.

Myers, B.A., & McDaniel, R. (2001). Demonstrational Interfaces: Sometimes You Need a Little Intelligence, Sometimes You Need a Lot. In H. Lieberman (Ed.), *Your Wish Is My Command: Programming by Example*, San Francisco: Morgan Kaufmann. 45-60.

Repenning, A. (1993). Agentsheets: A tool for building domain-oriented visual programming environments. *INTERCHI'93: Conference on Human Factors in Computing Systems*, ACM, Amsterdam, The Netherlands, 142-143.

Sheehan, R. (1999). Incremental Control of a Children's Computing Environment. *Human-Computer Interaction INTERACT '99*, IFIP TC.13, Edinburgh, UK. 504-509.

Sheehan, R. (2001). *Children's Perception of Computer Programming and Computer Programmers*, submitted for publication.

Smith, D.C. & Cypher, A. (1999). Making Programming Easier for Children. In A. Druin (Ed.), *The Design of Children's Technology*, San Francisco: Morgan Kaufmann. 201-221.

Travers, M.D. (1996). *Programming with Agents: New metaphors for thinking about computation*, PhD Thesis MIT.

On-Line Tutorials to Move Students from PC/Windows to Unix

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Abstract: The majority of today's college students enter their first computer science course with a working knowledge of computers, primarily PC/Windows based. Their experience with PC systems as their "native language" is then reinforced in the many universities that require laptop PCs or distribute them to incoming freshmen. Teaching students the Unix environment thus has become more difficult as students cling to the operating system that they have grown comfortable with. This paper describes a tutorial program intended to move students from PC/Windows to Unix. The self-paced tutorial lessons are written in Macromedia Director and can be accessed from the students' personal computers on the Web. The lessons begin with basic Unix commands executed through a simulated terminal window, provide remote access to an actual Unix terminal window for "real" feedback, direct students to a Unix lab at our university, proceed through more advanced Unix utilities, and offer feedback through graded quizzes.[1]

The Problem

The growing number of laptop-equipped students in today's universities is a mixed blessing for the computer science discipline. Students entering our courses believe themselves to be quite computer-savvy, but most have been brought up on PCs/Windows and have a natural reluctance to move out of the environment that has grown so familiar to them. Their portable computers also spoil them on working in their dorms and apartments, and Unix labs that used to bustle with student activity are now mostly quiet. Most academic computer scientists, however, continue to see the value in teaching students the Unix operating system, and for many good reasons – its robustness; its groundbreaking position as a system for multitasking, networked, and heterogeneous computing environments; and the source-code transparency that lends itself to learning operating system concepts and implementation. A second problem in introducing students to the Unix environment is that user-level skills don't seem worthy of classroom time, yet we want our students to come out of our courses with a certain level of proficiency in using the operating system. We need a way to ensure minimum competency in Unix lab skills without sacrificing classroom instruction time to recite simple Unix commands that students could learn on their own. Thus, the purpose of our tutorial system is to wean PC-devoted students to the Unix environment by letting them get their first glimpse of it through their own personal computers, and to do this in a self-paced tutorial system with student accountability via quizzes and a database that records student activity.

The Tutorial

Our tutorial system is accessible from the Web at http://www.cs.wfu.edu/~burg/UnixTutorials/Tutorial.htm. We have so far implemented and tested six tutorial lessons: Lesson 1. Unix and the Unix Lab; Lesson 2. Getting Started; Lesson 3. Basic Unix Commands ; Lesson 4. Creating Text Files; Lesson 5. Using Unix from Your PC; and Lesson 6. Compiling and Running C++ Programs

To clarify the difference between working directly on Unix-based computers and remotely from PCs, the first tutorial gives the students a visual tour of the Unix lab at their university. (This is the only lesson

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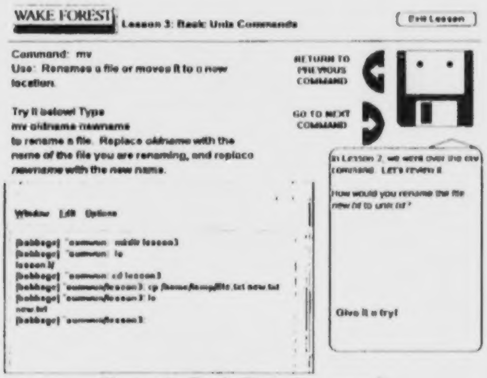
[1] This work was supported by a Charles E. Culpeper Grant, the Summer Program for Technology Adoption, at Wake Forest University, Summer 2001.

specific to our university and its labs.) Students learn where the lab is located, how to get access, and how to get an account on our system. This lesson also touches on what an operating system is and how Unix relates to Windows in the computing world, along with a quick explanation of the hardware and software that we have for them to use.



Command: mv
Use: Renames a file or moves it to a new location.

Try it below! Type
mv oldname newname
to rename a file. Replace *oldname* with the name of the file you are renaming, and replace *newname* with the new name.

```
[babbage] ~common: mkdir lesson3
[babbage] ~common: ls
lesson3/
[babbage] ~common: cd lesson3
[babbage] ~common/lesson3: cp /home/temp/file.txt new.txt
[babbage] ~common/lesson3: ls
new.txt
[babbage] ~common/lesson3:
```

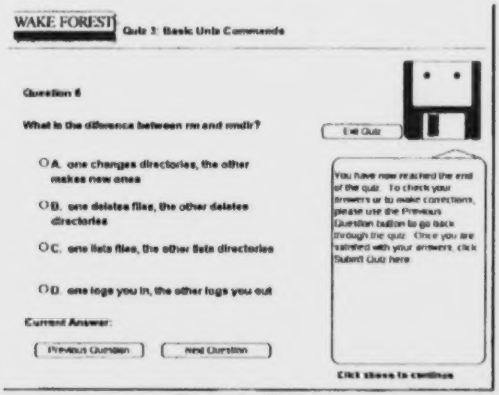
In Lesson 2, we went over the mv command. Let's review it.

How would you rename the file new.txt to unix.txt?

Give it a try!

Figure 1. Basic Unix Commands

The second and third lessons, covering basic Unix commands, are presented by means of a simulated Unix terminal window. The students are given practice with simple Unix commands in a controlled environment where errors can be checked and feedback can direct their learning. A character called "Floppy" (reminiscent of "Clippy©" from Microsoft Office) guides the students through the lessons. Lesson 4 discusses the use of text editors in a Unix terminal window. We chose to use the *vi* text editor. While this may not be the easiest to learn, it has the advantage of not requiring X-Windows. The students are guided step-by-step throughout the process of using the editor. In Lesson 5, we begin to wean the students from their PCs by showing them how to get remote access to an actual Unix terminal window. They are given directions on downloading and installing a remote login program, which then opens a terminal window alongside the tutorial. At the end of Lesson 5, students are given a series of exercises to try in the Unix terminal window, some of which will have them investigate new commands, command options, and error conditions more closely. For example, they are asked to remove a directory that still contains files, or they are asked to find an option for the *ls* command that lists even "hidden files." Lesson 6 introduces the use of compilers. C/C++ is chosen as their introductory language since it is the language most closely related to the Unix operating system.



Question 6

What is the difference between rm and rmdir?

○ A. one changes directories, the other makes new ones

○ B. one deletes files, the other deletes directories

○ C. one lists files, the other lists directories

○ D. one logs you in, the other logs you out

Current Answer:

You have now reached the end of the quiz. To check your answers or to make corrections, please use the Previous Question button to go back through the quiz. Once you are satisfied with your answers, click Submit Quiz here.

Figure 2. Quiz 3

Each lesson ends in a 10-item quiz. At the end of the quiz, the students can, if they choose, step through the items they got wrong and see the correct answers. The quiz scores are written back to a database for the professor's reference.

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Project TALENT: Creating Change in Teaching Activities

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Abstract: TALENT (Teaching And leading for Educational Needs with Technology) is a 2000 PT3 Implementation grant. Besides faculty and K-12 teacher training through focused workshops and weeklong institutes, TALENT has taken an innovative approach in creating 'triads' consisting of a preservice teacher, a K-12 master teacher, and a university supervisor, who function as a learning community. This learning community spans two parallel activity systems: the university and the school in which the preservice teacher is placed. The project is discussed using the framework of Activity Theory, which can clarify activities and add predictive validity to TALENT's grant efforts.

Background

TALENT (Teaching And Leading for Educational Needs with Technology) is a 2000 Preparing Tomorrow's Teachers to Use Technology (PT3) Implementation grant funded by the U.S. Department of Education. Co-directed by Bohlin, Chiero, and Harris, TALENT's purpose is to infuse instructional technology into the teacher preparation program at California State University, Fresno (CSUF). The project's overarching aim is for teacher-candidates to complete their credential programs with the knowledge and understanding to deal with the digital needs of diverse, limited English-speaking, high poverty, and rural students in the K-12 schools in which they intend to teach.

In order to empower all educators in the teacher preparation program – including university faculty both in Education and in other departments where teacher candidates take their undergraduate and subject area courses, K-12 master teachers, and university supervisors of student teachers – TALENT designed, developed, and delivered weeklong institutes and full day workshops. Topics were tailored to the participants' particular knowledge, skill, and interest level, and to their expressed needs. Typical tools taught ranged from PowerPoint, Web research, and Inspiration to digital video and virtual reality. K-12 teachers were trained along with university faculty in the institutes, and with university supervisors in the workshops. Thus, there was cross-fertilization of ideas among these three populations in the training programs (Fig. 1).

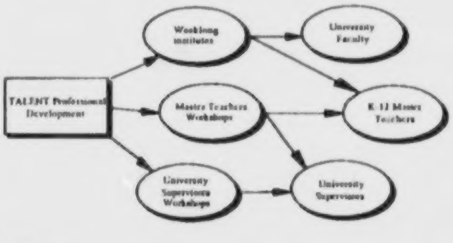
Weeklong Institutes
University Faculty
TALENT Professional Development
Master Teachers Workshops
K-12 Master Teachers
University Supervisors Workshops
University Supervisors

Figure 1: Project TALENT Training Activities

In the next phase of its activities, TALENT began to forge links between the university supervisors, the K-12 master teachers, and the teacher candidates using a "triad" learning community model, in which each participant could share strategies and ideas about teaching with technology with the other participants. The triad structure already existed, but the concept of using the structure as the basis of a learning community focused on technology infusion was unique to TALENT. In the TALENT model, a learning community could also consist of a larger team of master teachers, supervisors, and teacher candidates at a K-12 school. The purpose of these learning communities would be to increase comfort, confidence, and competence in technology infusion among all members and to begin to develop technology leadership abilities among the newly credentialed teachers.

TALENT as an Activity System

In both of these sets of professional development activities, the project directors envision learning as social construction of knowledge within a community of practice. Learning is situated in authentic activities, and there is plenty of time for group

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discussion and reflection to apply newly acquired knowledge and skills to both the university and the K-12 classroom. Moreover, the presenters explicitly model student-centered learning and student creation of projects.

There is a rich base of social learning theory, beginning with Vygotsky (1978) in the Soviet Union. For example, Lave (1991) envisioned knowing, learning, and cognition as social constructions, expressed in actions of people interacting within communities of practice. Koschmann (1996) coined the term "computer-supported collaborative learning" to describe learning communities that engaged in authentic, knowledge-building tasks supported by electronic interactions. Tavalin and Gibson (Sherry, Billig, Tavalin, & Gibson, 2000a, 2000b; Sherry & Tavalin, 2000) facilitated the use of online sharing of digital art and music files within a community of experts, had students post their products to a public audience, and then had the students selectively filter the ensuing feedback for the purpose of revising and refining their work. Carroll (2001) extended this notion to the entire PT3 grant initiative, in which electronic interactions among teachers and learners help to foster online communities of learners. He considered schools – including schools of education as well as K-12 schools – as connected learning communities of teachers and students, in which some participants were expert learners and others were novice learners, sharing information, supporting one another's learning processes, and constructing a common base of understanding and shared skills.

Engestrom (1996, 1998) pushed the limits of these viewpoints by envisioning communities of practice as *Activity Systems* in which individuals intentionally used tools (or technologies) to create or transform objects or concepts in order to bring about a desired outcome. In an Activity System, any given individual's actions take place within a sociocultural framework that includes the community of which the individual is a part, together with the norms and conventions of use of those tools, and the social roles or division of labor that characterize individual actions within local collective activities. The basic difference between traditional social learning theory as characterized by Lave and Wenger (1991) and Engestrom is Activity Theory's emphasis on the transformational nature of collaborative endeavors. "Activity theory suggests that collective developments occur when, through their actions, people reinterpret their environment, rebuild their activities, and reconceive of themselves (Blackler, Crump, & McDonald, 2000, p. 296)."

It is interesting to note the striking parallel between Engestrom's depiction of an Activity System and the process that may be occurring in the TALENT project regarding the adoption and use of instructional technologies to support teaching and learning. Moreover, the current work of Engestrom (2001) and his colleagues is now focusing on parallel Activity Systems, such as HMOs and hospitals, that share a common goal: to preserve and improve the health of individual patients. In TALENT, the university teacher preparation faculty and the teachers in the cooperating K-12 schools can be considered as a pair of parallel Activity Systems with a common goal: to foster good educational practice so that all children can learn. The learning community model links these two Activity Systems through the university supervisors and teacher candidates, (Fig, 2).

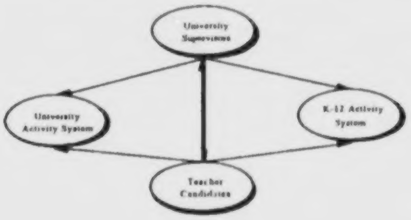

Figure 2: Parallel Activity Systems

As typically takes place within an Activity System, TALENT introduces new tools to the university faculty and to the K-12 master teachers to accomplish two planned outcomes: restructured, technology-infused courses within the university, and technology-infused lessons within the K-12 schools. For the faculty member or teacher who becomes interested enough in the new tools to acquire more knowledge about their potential uses to enhance instruction, to develop a positive attitude toward incorporating them into their own practices, and to actually make the decision to implement technology in the classroom, this is only the beginning. Each trainee must go through a learning/adoption trajectory (Sherry, 1998) to gain the necessary comfort, confidence, and competence to do so. This is the purpose of the institutes and workshops and of the continuing technical and collegial support provided by the TALENT leadership, staff, and teaching community.

Besides gaining the expertise and knowledge to use new tools to enhance instruction, there is a second order effect that TALENT hopes to bring about – increased modeling of promising practices for teaching with technology, by both university faculty and K-12 master teachers, for their respective teacher candidates. For TALENT to succeed, the project directors may wish to consider fostering the coaching and modeling process among its trainees, just as student-centered learning is explicitly modeled within the institutes. However, since the master teachers are not paid for their efforts, and since the Office of Field Placement does not wish to discourage an otherwise qualified person from being a master teacher, this is a mediating factor that could serve as an inhibitor for K-12 teacher modeling. It may be fruitful to contemplate discussing this issue with master teachers because modeling could

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help to empower teacher candidates. Moreover, the extent of modeling the use of technology for teacher candidates at field placement sites represents one of the research areas in the national evaluation of the PT3 grant initiative. Since these activities take place within a sociocultural context, the outcomes– technology -infused instruction– generate a "ripple effect" within each Activity System (Fig. 3 & 4).

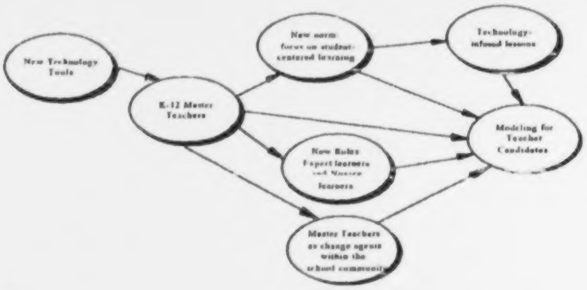
New Technology Tools
K-12 Master Teachers
New norm: focus on student-centered learning
Technology-infused lessons
New Roles Expert learners and Novice learners
Modeling for Teacher Candidates
Master Teachers as change agents within the school community

Figure 3. K-12 Activity System

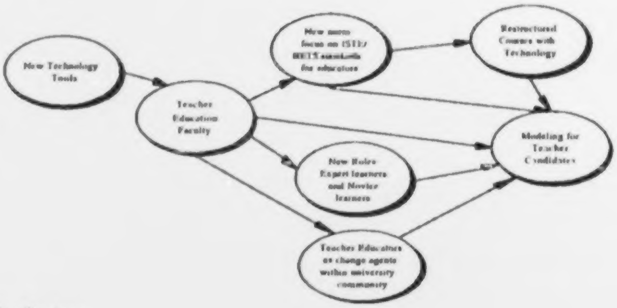
New Technology Tools
Teacher Education Faculty
New norm: focus on ISTE/ NETS standards for educators
Restructured Courses with Technology
New Roles Expert learners and Novice learners
Modeling for Teacher Candidates
Teacher Educators as change agents within university community

Figure 4: University Activity System

Changing Norms

Rules, norms, and beliefs define the culture of an Activity System. Let us focus on the cultural norms within the university and the K-12 environment. Wilson and Myers (2000) state, "Using a tool in a certain manner implies adoption of a cultural belief system about how the tool is to be used." For example, if the norm in a specific academic department at the university is to use closed-answer tests that can be scored using scantrons, and if this continues to make a professor's day to day tasks relatively easy, then new tools and assessment strategies that make his/her job harder will not be used. They have no relative advantage over the status quo. Moreover, they require extra learning and extra work that could be better devoted to teaching and research. On the other hand, if the norm within that department, say, anthropology, is to collect data from primary sources via observations and interviews, then the use of digital video could make his/her work more fruitful. Additionally, video case studies could be shared and discussed with university students, and could become part of a living archive of the community's culture. In that case, chances are that the professor would continue to explore the use of digital video because it adds value to his/her instruction. Moreover, if other educators within the department can observe the improvement in the professor's instruction, and its effect upon the university students, then the use of digital video could very well become the norm within the department.

Besides observability, Rogers (1995) lists compatibility with potential adopters' needs and values, relative simplicity, the ability to experiment with an innovation on a limited, risk-free basis, and relative advantage over the status quo as facilitators for innovative concepts, processes, and products. In a discussion following a training session in the January 2001 institute, three faculty members engaged in the following conversation, discussing the relative advantage of using digital photography for university students' products:

> *I'm thinking about maybe teaching some of my history students about how to make a little film.*
>
> *I think that's a good thing there. You're mentioning how you would attempt to use it. How would any of the people in the room here intend to use it, even what you have learned within the last three days here?*

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> *Well, this just adds a whole other dimension to [student projects]. There are all kinds of cultural events going on all over Fresno. Send people out with a camera and equipment, and a video camera might be a little easier. Go to the events and put together...a total essay on PowerPoint using the digital images, or a short introductory, maybe 5 to 10 minute short film on cultural events. That would be a no brainer!*

The same holds true in the K-12 school situation. National surveys (CEO Forum on Education and Technology, 1999; NCES 1999a, 199b) indicate that students are more adept at using interactive technologies than their teachers. Technology is becoming the norm for school children. As the use of Internet searching and PowerPoint presentations by children increase, there is a chance that that those tools will become part of "the way we do things around here" within the school setting. Technology-savvy children will tend to drive learning in their teachers as well. This is especially true if greater depth of research and more sophisticated, interactive presentations will result in greater achievement for the children. RMC Research Corporation's evaluation of several PT3 and Technology Innovation Challenge grants provides evidence from observations, interviews, and focus groups with faculty, K-12 teachers, and students, which have shown that both of these outcomes are common.

In the case of TALENT, activities are focused on changing two sets of norms. At the university, the new norm would be to focus instruction on the new California state standards for teacher credentialing, which are echoed in the ISTE/NETS standards for educators. At the K-12 schools, the new norm would be a greater focus on technology-infused, student-centered learning. However, this is moderated by the schools' focus on measuring student achievement by their performance on the Stanford 9 test – an external factor over which TALENT has no control.

Changing Roles

Its division of labor – the generally accepted roles of its members – defines the social structure of an Activity System. Generally, teachers are considered experts while students are considered learners. However, this role structure is called into question when students have greater comfort, confidence, and competence with technology than their teachers do, and are able to use tools such as word processing, concept mapping, database searching, graphing calculators, interactive mathematics applets, Web search engines, graphic art, and digital video effectively to increase their academic performance.

Consider the self-perceived role of the teacher. If that role is to transmit information, then word processing and PowerPoint will suffice, and other tools are considered unnecessary. Moreover, if a teacher is concerned about the validity of information on the Web sites that his/her students are citing in research papers, and considers that open-ended searching could jeopardize his/her role as the expert in the classroom, then there is no reason for a teacher to support such online activities. But if the role of the teacher focuses on creating a rich environment for active learning in the classroom (Grabinger, 1996), then he/she would encourage the students to use the full range of current technologies. Such activities, in turn, transform the role of the teacher to a co-learner and co-explorer. This is indeed the case in an elementary school where one of TALENT's K-12 master teachers has his second through fourth grade classes use digital video to capture learning experiences and present them to other teachers, parents, and the entire school community.

A sudden reversal of traditional roles can cause discomfort and a disturbance in an Activity System. Brown and Palincsar (1989) considered cognitive dissonance and its ensuing discomfort to be the driver of learning. If the disturbance caused by a role reversal creates learning and makes life better, then it will be sustained; else the system will reject it and return to stasis. For example, at a high school in Vermont that participated in The WEB Project, one student became the school's acknowledged expert in digital editing. His portfolio gained for him a four-year, all-expense paid, scholarship to a leading university. Subsequently, more students became interested in digital editing, and similar activities still continue at the school. As a counter-example, consider a tenured professor who considers him/herself as a "stand-up lecturer", as mentioned by one of the TALENT trainees during a discussion in one of the training institutes. This individual was interested in using PowerPoint to enrich lectures with slides that illustrated historical and artistic trends. True, this is using technology, but it does not create a student-centered environment, nor will it change the role of the professor. As a result, our fear is that his/her students will leave the university teaching as they have been taught – as transmitters of information, rather than as creators of technology-rich environments for active student learning.

In the case of TALENT, there was a wide range of potential changes in roles, with several professors writing mini-grant proposals to restructure their courses to include more university student use of technology. As a whole, the university supervisors perceived technology as useful tools for their preservice teachers more often than did the technology-savvy K-12 master teachers, who primarily saw technology as a teacher-centered tool. However, the master teachers who co-taught several of the TALENT training sessions countered this trend, often presenting and discussing products that their K-12 students had created.

The use of technology-focused learning communities would also result in some role changes. In a learning community, each of the individuals would be a co-learner and a co-contributor, constructing knowledge as a coherent team, and serving as an interface between the university and the K-12 environment. A potential outcome of the community might be a few lessons that were relevant and appropriate for the teacher candidate's classroom, together with the necessary resources and documentation that constitute part of a teaching unit. Another possibility would be a videotape of the teacher candidate demonstrating a promising practice for teaching with technology in the K-12 classroom. These videotapes could then be used to spark discussions within the triad. They could also be archived and used as exemplars within the teacher education program.

Changing the Community

Besides norms, rules, and roles, every Activity System has structures and boundaries that self-identify it as a system. At the university, an important structure is the criterion used for review, tenure and promotion. If a university's structure supports technology innovation with incentives like release time, extra pay, or some other form of recognition for a faculty member's effort, then the chances that more tools will be used increase.

At CSUF, there is a Center for the Enhancement of Teaching and Learning (CETL). This organization provides mini grants for faculty members who restructure curriculum in some innovative way that enhances instruction or assessment. At the end of the January 2001 TALENT institute from faculty and teachers in the social sciences, five professors wrote mini-grant proposals for restructured syllabi; all five proposals were funded. Based on this record of success, six faculty members in the June 2001 institute for faculty and teachers in the arts, music, and humanities also expressed an interest in doing likewise. Likewise, faculty members wrote two mini-grant proposals following the mathematics and science institute in July 2001.

Another distinctive feature of CSUF is its tenure and promotion process, which rewards innovative teaching practices as an element of professional scholarship. Moreover, the Provost has an annual award related to outstanding teaching with technology, which recognizes and supports the work of TALENT. If such efforts continue to be supported by the university, then the vision of the PT3 project at CSUF may well be realized.

Driving Change in Activity Systems

Two interesting research questions emerge from studying TALENT: By what process does change in an Activity System take place? And how does this differ for connected, parallel Activity Systems? Engestrom's reply would be something like this: "Disturbances within and between Activity Systems are the driving force for growth and change." When these questions were posed at the 2001 AERA conference, one of Engestrom's peers (Barab) replied, "The direction of change depends on who holds the power." Thus, further investigation into these two questions revolves around empowering the agents within each Activity System to drive change, and empowering those who reside at the intersection of two parallel Activity Systems to moderate change between the two connected systems. Shifting the balance of power created disturbances, and "As disturbances become evident within and between Activity Systems, participants may begin to address underlying issues and to create new learning." (Blackler, Crump, & McDonald, 2000, p. 281)

In conducting case studies of PT3 grantees across the U.S., we have found that there is no a priori direction for bringing about change in either a university's teacher preparation program or the field experiences of its teacher candidates at associated K-12 schools. For example, in teacher preparation programs where strong leadership resides within the school, college, or department of education (SCDE), it is the SCDE that drives change within the university and at the partner K-12 schools. In SCDEs with a Professional Development School (PDS) structure, or with schools that have some of the characteristics of a PDS, it is the K-12 teachers who often drive the change – whether inservice or preservice.

In the case of TALENT, it is the project directors, technical support people, and K-12 master teachers who drive change, while the university system is the recipient of the change, as intended by the project directors. This quotation from a veteran professor illustrates this trend:

> *Quite frankly, the issue is, are we doing anything for [the students in the teacher preparation program]? I'm a traditional lecturer, and we look at what they're doing in the high school. Sometimes I have to wonder, is what I'm doing – even though I'm good at it – is it really pertinent to what they're teaching? I'm wondering what their students think, who are doing some of these really creative things such as PowerPoint...what do they think of what they learned in our classes? How useful that is? I've given them all sorts of information...maybe the younger people know how to do things that are innovative, people doing things out there in the high school...I mean, I feel like I'm in the dark ages!*

However, the direction of change could easily be reversed, once the university faculty members begin teaching their restructured courses throughout the teacher preparation program, and the teacher candidates begin to carry their newfound expertise and skills into their student teaching experiences. Moreover, learning communities that link the university Activity System with the K-12 Activity System could change this whole dynamic by sharing information between the K-12 schools and the SCDE. This is a fruitful area for further investigation that could both clarify and add predictive validity to TALENT's grant efforts.

Project TALENT learning communities are currently engaged in joint activities that will be completed by the end of the current academic term. Preliminary findings will be presented at Ed-Media.

References

Blackler, F., Crump, N., & McDonald, S. (2000). Organizing processes in complex activity networks. *Organization*, 7 (2), 277-300. Thousand Oaks, CA: SAGE.

Brown, A.L., & Palincsar, A.S. (1989). Guided, cooperative learning and individual knowledge acquisition. In L.B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser*, pp. 393-451. Hillsdale, New Jersey: Erlbaum.

Carroll, T.G. (2001). *Preparing Tomorrow's Teachers to Use Technology: SITE 2001 PowerPoint presentation* [On-line]. Available: http://pt3.org/pt3_info/pt3_archives.php3

CEO Forum on Education and Technology. (1999). *Professional development: A link to better learning*. Washington, DC: Author.

Engestrom, Y. (1996). Interobjectivity, ideality, and dialectics. *Mind, culture, and activity*, 3 (4), 259-265.

Engestrom, Y. (1998). *Cultural-Historical Activity Theory [On-line]*. Available: http://www.edu.helsinki.fi/activity/6a0.htm

Engestrom, Y. (2001). *The horizontal dimension of expansive learning: Weaving a texture of cognitive trails in the terrain of health care in Helsinki*. Paper presented at the international symposium, "New challenges to research on learning", March 21-23, University of Helsinki, Finland. Paper also presented at the annual conference of the American Educational Research Association (AERA), April 10-14, Seattle.

Grabinger, R.S. (1996). Rich environments for active learning. In D. Jonassen (Ed.), *Handbook of research for educational communications and technology*, pp. 665-692. New York: Simon & Schuster Macmillan.

Koschmann, T. (1996). *CSCL: Theory and practice of an emerging paradigm*. Mahwah, New Jersey: Erlbaum.

Lave, J. (1991). Situated learning in communities of practice. In L.B. Resnick. J.M. Levine, & S.D. Teasley (Eds.). *Perspectives on socially shared cognition* (pp. 63-82). Washington, DC: American Psychological Association.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

National Center for Education Statistics. (1999a). *Status of education reform in public elementary and secondary schools: Teachers' perspectives*. Washington, DC: Author, U.S. Department of Education.

National Center for Education Statistics. (1999b). *Teacher quality: A report on the preparation and qualifications of public school teachers*. Washington, DC: Author, U.S. Department of Education.

Sherry, L. (1998). An Integrated Technology Adoption and Diffusion Model. *International Journal of Educational Telecommunications*, 4 (2/3), 113-145.

Sherry, L., Billig, S., Tavalin, F., & Gibson, D. (2000a). New insights on technology adoption in schools. *T.H.E. Journal*, 27 (7), 43-46.

Sherry, L., Billig, S.H., Tavalin, F., & Gibson, D. (2000b, February). New insights on technology adoption in communities of learners. Paper Presentation: In *Proceedings of the AACE/SITE 2000 Conference*, San Diego CA. Available: http://www.cudenver.edu/~lsherry/pubs

Sherry, L., & Tavalin, F. (2000, April). *Good online conversation: Building on research to inform WEB Project practice*. Roundtable presented at AERA 2000, New Orleans. Available: http://www.cudenver.edu/~lsherry/pubs

Vygotsky, L.S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, Massachusetts: Harvard University Press.

Wilson, B. G., & Myers, K. M. (2000). Situated cognition in theoretical and practical context. In D. H. Jonassen & S. M. Land (Eds.), *Theoretical foundations of learning environments* (pp. 57-88). Mahwah, New Jersey: Erlbaum. Available Online: http://ceo.cudenver.edu/~brent_wilson/SitCog.html

An Exploratory Study on the Effects of Learner-Controlled Sequencing and Advance Organizers in a Web-Based Environment

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Abstract: This exploratory study investigates the effects of advance organizers and learner-controlled sequencing in a Web-based learning environment. This study used a 2x2 factorial, posttest only design. The two independent variables were learner-controlled sequencing and advance organizers. The two dependent variables were students' ability as measured by scores on the posttest and time spent completing (a) the instructional materials and (b) the performance test. The treatments were four Web-based tutorials designed to teach students how to produce simple Web pages using Hypertext Markup Language (HTML). The analyses showed that neither learner-controlled sequencing nor advance organizers affected student test scores. However, the results revealed an unexpected effect on the time students spent learning and applying new material. The study revealed that those who consistently took the least amount of time were students using program-controlled sequencing with advance organizers.

The Study

This study investigates the effects of advance organizers and learner-controlled sequencing in a Web-based learning environment. An *advance organizer* is defined by Ausubel (1963, pp. 81-82) as "appropriately relevant and inclusive materials" introduced in advance of learning which functions to provide "ideational scaffolding" for the stable incorporation and retention of the more detailed and differentiated material to be learned. For this study, the advance organizers are in the form of short paragraphs serving as metaphors that liken the components of a web page to that of a written paper or report.

This study used a 2 x 2 factorial, posttest only design. The two independent variables were learner-controlled sequencing and advance organizers. The two dependent variables were students' ability as measured by scores on the posttest and time spent completing (a) the instructional materials and (b) the performance test. The treatments were four Web-based tutorials designed to teach students how to produce simple Web pages using Hypertext Markup Language (HTML).

The topic of instruction was chosen on the basis of its unfamiliarity to the sample population. Only one out of 63 students in the same class surveyed in a previous semester had ever created a Web page. Since one of the independent variables of the study was the use of advance organizers, unfamiliarity of the material was an essential criterion. According to Ausubel (1960, p. 268), advance organizers are designed to "facilitate retention in areas of knowledge new to learners." Using an unfamiliar topic helped ensure that all students started from approximately the same baseline in learning the material.

The subjects for this study were 74 pre-service elementary and secondary teachers, 71 of whom were female between the ages of 19 and 23. All 74 students were enrolled in a technology course at a large university in the intermountain west. The study was introduced and described to students during regular classroom meeting time. Students were asked to volunteer to participate, and all those who consented were directed to go to the computer lab where they were randomly assigned to one of the four experimental groups approximately equal in size.

The posttest was a performance-based activity where the students were required to produce a Web page according to a set of criteria. A lab assistant recorded a rating for each student based on the specified criteria. This rating was used to determine student performance. In addition, each student completed a time log that indicated the time spent working on each assignment and the posttest. The time log was designed to determine if there was a significant difference in the amount of time spent between groups. Two-way ANOVAs were conducted for each dependent variable to analyze the data.

The Findings

The analyses showed that neither learner-controlled sequencing nor advance organizers affected student test scores. Whether analyzed separately or together, learner-controlled sequencing and advance organizers failed to produce significant improvements in posttest scores. Average mean scores were nearly identical for the four experimental groups. However, students who were given program-controlled sequencing took significantly less time (13 percent less) to complete the instructional materials than students who were given learner-controlled sequencing. These results suggest that program-controlled sequencing significantly reduces the time students spend learning new instructional material. In addition, students using advance organizers completed the performance test in 15 percent less time than students not using advance organizers. These results suggest that although performance scores are not affected, advance organizers have a positive effect in reducing the time students spend applying newly gained knowledge.

Conclusions

Although learner-controlled sequencing and advance organizers failed to produce more effective learning (i.e., higher test scores), these variables yielded an unexpected effect by producing more efficient learning. Program control produced more efficient learning by reducing the time students spent learning new material. Advance organizers produced more efficient learning by reducing the time students spent applying the newly learned material in a performance test. Students who consistently took the least amount of time were those using program-controlled sequencing with advance organizers. When compared to the group taking the most time, this group was 20 percent faster learning the instructional materials and 25 percent faster completing the performance test.

What are the implications of these results in educational practices? The author postulates that the combined use of program control and advance organizers can lead to significantly reduced instructional and testing time in a Web-based learning environment. The combined effect of program-controlled sequencing with advance organizers produced the same performance test results as any other combination in the 2 x 2 factorial design used in this study. The benefit is in the time it takes to obtain those results, which in this study was significantly less. When considering the proliferation of Web-based instruction and training costs increasing in the future, the implications are significant in educational and business settings or anywhere that time is a highly valued resource.

References

Ausubel, D. P. (1960). The use of advance organizers in learning and retention of meaningful material. *Journal of Educational Psychology. 51*, 267 272.

Ausubel, D. P. (1963). *The Psychology of Meaningful Verbal Learning*. New York: Grune and Stratton.

Burbules, N. C., & Callister, T. A. (1996). Knowledge at the crossroads: Some alternative futures of hypertext learning environments. *Educational Theory, 46*, 23-48.

Clark, R. (1994). Media will never influence learning. *Educational Technology Research and Development, 42*, 21-29.

Dede, C. (1988). The role of hypertext in transforming information into knowledge. Paper presented at the annual meeting of the National Educational Computing Conference, Dallas, Texas, June 1988.

Gall, J. E., & Hannafin, M. J. (1994). A framework for the study of hypertext. *Instructional Science, 22*, 207-232.

Jonassen, D. H. (1988). Designing structured hypertext and structuring access to hypertext. *Educational Technology, 28* (11), 13-16.

Lawless, K. A., & Brown, S. W. (1997). Multimedia learning environments: Issues of learner control and navigation. *Instructional Science, 25*, 117-131.

Tripp, S. D., & Roby, W. (1990). Orientation and disorientation in a hypertext lexicon. *Journal of Computer-Based Instruction, 17*, 120-124.

Are the Promises of Online Assessment Being Proved in Practice?
A case study into what conditions should be met in order to use online assessment successfully

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Abstract: This paper describes the way teachers at Delft University of Technology make use of the new online assessment tool, called Etude. In order to judge the extent to which the benefits of online assessment will be achieved, a checklist was developed. Results show that lecturers as well as students appreciate the possibilities of online assessment, but an educational guidance program will be necessary in order to benefit optimally from the educational opportunities of online assessment.

1. Introduction

Delft University of Technology (DUT) started the development of a new online assessment system, named Etude, in 1996. The system became available to the teaching staff in September 2000. The objective for developing the Etude system was to offer teachers one system that is supported and maintained centrally. Etude is an item-banking program that provides for item entry and storage, test creation, online testing, scoring, reporting and analysis of tests. In earlier papers we described the completion and functionality of Etude (Van de Ven, *et al*, 1999), and reported about the use of the system in two pilot projects (Dopper and Van de Ven, 2001). At the moment of writing this paper, Etude is used at 17 different courses at DUT.

This paper offers an outline for evaluating the use of online assessment. We will identify the potential benefits of online assessment with Etude and describe the conditions for achieving these. This will result in a checklist used to determine whether teachers will realize the benefits of an online assessment system or not. We analyzed the way the present users at DUT have implemented Etude in their (online) course, based on interviews. One of these cases will be described in more detail and the results of the appreciation of students of two of the identified benefits will be presented. Finally, we will answer the research question: is the way in which Etude is used by the present users appropriate to realize the benefits of the system?

2. Potential benefits of Etude and conditions to reach them

We have divided the potential benefits in three sections, i.e. storage of items (2.1), item entry (2.2) and taking a test online (2.3). This division is based on two main functions of online assessment systems: building and maintaining an item bank, and students taking a test online.

2.1 Storage of items

An item bank is a collection of test items that may be easily accessed for use in preparing examinations. Good item bank management enables efficient and effective generation of tests and efficient re-use of items. To achieve these benefits, it is important that items are not stored in the item bank in an arbitrary order. In order to retrieve items as necessary to make revisions or to create a test, items have to be coded (Ward and Murray-Ward, 1994). In Etude the following codes can be used: key word, subject matter, difficulty level, literature, and objectives. Content codes are preferably based on objectives. Once a coding scheme is set up, there should be no modification in the coding scheme unless the entire bank is recoded (Ward and Murray-Ward 1994).

2.2 Item entry

Most of the online assessment systems on the market have a great variety of possibilities to design items, so does Etude. Five important options are described in this section.

Type of questions

The Etude system provides for four types of questions: multiple-choice questions (1 out of m and n out of m), open numerical questions with the use of variables, short answer questions and hotspot questions. Care should be taken that items stored in the bank are of high quality. An important condition for this is that the chosen question type fits the learning objectives to be tested. For example an open numerical question is more appropriate than a multiple-choice question when students have to calculate. This implies that teachers have to rethink their old questions: Is this the best way to present the question online in order to achieve this learning objective?

Multi-media elements

Etude enables adding several multimedia-elements to items, such as pictures, sound, animations and video. The use of multimedia elements makes it possible to assess other learning objectives, for example asking students to identify the cavitation type by showing a video of a rotating propeller. An important condition for the use of multi-media in a test is that they are functional, i.e. that students need them to answer the question correctly.

Feedback

Etude offers different feedback options in order to provide students with immediate feedback. Feedback assists the learner in constructing his or her understanding. Ultimately, in the absence of feedback, learners will feel isolated, motivation to learn will drop, and ultimately learning will suffer (Rovai, 2001). It seems that students not only want to know if their answer was right or wrong, but also why it was right or wrong. So the feedback requires containing explanatory remarks. A simple "sorry, this answer is wrong, try again", is not sufficient.

Hints

Hints can be added to a question, with or without score discount. The difference with feedback is that a hint appears before the question has been answered and that the student can decide whether opening the hint or not. Hints have great potentials, but also high risks. Hints can help students to get on the right track, when they don't know the protocol to solve the problem. But when a student uses a hint and the hint turns out to be useless, motivation to learn will drop, especially when it means a score discount. Consequently, a hint should contain useful information for the student, for example the line of reasoning to solve the problem or a reference to resources where the answer can be found. After reading a hint students should have the feeling that it was worth using it.

Main and sub question mechanism

The main and sub question mechanism offers students a difficult main question, which give students the chance to earn the total score for the item. If the main-question is answered correctly, the student can go to the next main-question, if it is answered incorrectly, the student is offered a few sub-questions, which can still result in a part of the total score for the item. Main- and sub-questions can be used to distinguish between excellent students and average students. Excellent students are able to generate the protocol to solve the problem, whereas average students need help to solve the problem in little steps. A condition for a functional use of the main and sub question mechanism is that teachers know exactly what difficulties students have when solving certain problems.

2.3 Taking a test online

Just in time testing

Students can take an online test whenever and whereever they want. Especially when the aim of the test is to practice and not to grade students, this can have great benefits. When the aim of the test is to practice, online testing can have the benefit of just in time learning. In a constructivist-learning environment students have to plan their own learning activities. A lecturer can make the test available for some weeks during the course, and students can decide themselves when the online test fits best in their learning process. This can differ from student to student. Also the place where students take the online test is flexible. They can take the test on any computer with an Internet Connection. An important condition for just in time testing is that students know the best moment for taking the test.

Immediate feedback on scores

When students take a test online, it is possible to give them information about their score on a question immediately after answering the question. This is a benefit of online testing compared to written tests. Moreover, after finishing the test, students immediately know their total score for the test.

Adaptive testing

A test is called adaptive if it is able to select an item on the basis of the student's performance on earlier items (Essenius, 1995). The advantage of adaptive testing is that students receive a set of questions appropriate to their abilities, so the test remains challenging for each individual student. Adaptive tests can be used in training situations as well as in examinations. In a training situation the aim is to improve the performance of the students. An adaptive exam aims to assess the student's performance-level. The Etude system offers two adaptive test methods, one is adaptive for the difficulty level, the other is pre-planned by the teacher. Using the first method students get one question with a certain difficulty level, and depending on the correctness of their answer, they will get a more or less difficult question. Using the second method the test also starts with one item, and depending on the answer, the student will go into another pre-defined path of items. A necessary condition for the first method is a large item bank and calibrated items. For the second method one needs fewer items in the item bank, but the teacher has to think ahead carefully about the paths to define.

	Conditions for reaching the benefits:	Do teachers reach the benefits? Yes/no
A. Storage of items	• Is a coding scheme available? • Is the coding scheme based on objectives?	
B. Item entry B1. Type of questions	• Does the chosen question type fit the learning objective?	
B2. Multimedia elements	• Are the multimedia elements functional? • Are the multimedia elements appropriate to the objectives?	
B3. Feedback	• Does the feedback contain explanatory remarks?	
B4. Hints	• Does the hint contain useful information for the student?	
B5. Main and sub questions	• Does the main question discriminate between excellent and average students? • Do the sub questions lead to an answer to the main question?	
C. Taking a test online C1. Just in time testing	• Do the students know the best moment for taking the test?	
C2. Immediate feedback about scores	• Is the effect of knowing the score on the behavior of the student beneficial for the objective of the test?	
C3. Adaptive testing	• Are a large item bank and calibrated items available (difficulty levels)? • If students can do the difficult paths, does that mean that they can do the easy paths as well? (pre-defined paths)?	

Figure 1: Checklist to determine whether the benefits of an online assessment tool will be achieved

3. How is Etude used?

We interviewed eleven of the present users of Etude at DUT. We developed an interview scheme based on the identified benefits, in order to find out what functionality they used and what reasons they had to use it or not. The results are presented in this section.

3.1 Storage of items

In order to achieve the benefit of re-using items, a coding scheme is necessary (see figure 1). However, none of the respondents use codes to classify their items. They organize their items in folders, using chapters of the book as the organizing principle. Teachers explained that the reason for not having a coding scheme is lack of time. Furthermore, they were not convinced that having a coding scheme is necessary, because of the so far relatively small number of items in the item bank (varying from 10 to 250). However, retrieving items in order to make revisions or to create a test, turned out to be harder when item banks expand. Consequently, benefits like efficient re-use of items will probably not be reached. Moreover, ordering items according to the chapters of a book has the risk that when the book is replaced, the item bank becomes useless.

3.2 Item entry

Type of questions

Teachers do not tend to rethink their old questions and think about what question type fits the learning objectives best. They start to fill the item bank with items they already have. The existing questions are mostly multiple-choice or open numerical. The interviews showed that only two respondents use hotspot questions and one respondent uses short-answer questions.

Multi-media elements

The only multi-media elements used by (half of) the present Etude users are pictures. Pictures are applied by the teachers in a functionally way. Reasons for not using sound, animations and video are "too busy with other things", "no material available", or technical reasons like "no sound card or headphones available in the computer room" or "slow connections in student houses". None of the respondents related the use of multi-media to other learning objectives.

Feedback

Eight of the interviewed teachers make use of feedback. Most of the teachers use feedback for both correct and incorrect answers. Some of them also add specific feedback to different possible answers. They understand the importance of feedback, especially when the aim of the test is to practice. Those who don't use feedback yet, plan to do it in the near future. However, not all of the teachers use explanatory remarks.

Hints

Only three respondents add hints to their questions. This is because constructing hints is labour-intensive. Also, not all teachers recognize the added value of hints. It appears that the use of feedback is more natural than using hints.

Main and sub question mechanism

Only one of the interviewed teachers uses the main and sub question mechanism. It seems that the present users of Etude were not acquainted with this mechanism. Once it was explained, most of them were interested.

3.3 Taking a test online

Just in time testing

Nearly half of the teachers use Etude for both exams and practice tests. Two teachers use Etude just for exams and four use Etude only for practice purposes. In the case of exams, all tests are taken in a controlled assessment setting. The practice tests were available for students for some weeks, and they could decide themselves when the test fitted best in their learning process.

Immediate feedback about scores

Opinions differ on whether students should be shown their scores immediately. In practice test situations all teachers, except one, gave immediate feedback about the scores. They assumed that the scores could stimulate students to learn the subject matter again, or that the scores stimulated students to do the test more seriously. In case of an exam, half of the teachers offer students their scores immediately. A reason they gave for this was: "a benefit of online assessment is that students know their test result right after finishing the exam". Reasons for not showing the scores were: "fear that students would quit the exam once they know they will pass", "fear for failures in the calculating system of the scores", and "fear for a psychological effect, when students know during the test that they are doing poorly".

Adaptive testing

None of the present users make use of adaptive testing. They are simply not familiar with the possibility, or did not find the time yet to think about it. Half of the teachers is interested in applying adaptive testing for practice purposes in the future. Most of them consider the main and sub question mechanism to be more attainable.

4. How do students appreciate two of the promises of online assessment?

In the previous section, we predicted to what extent the teachers will reach the benefits of the online assessment tool Etude. In this section, we will address and evaluate the implications of using such a tool for a course on collaborative report writing. The course on collaborative report writing is part of the first-year module *Systematic Problem Solving* at the faculty of Technology, Policy and Management at DUT. Since 2000, students and tutors no longer meet face to face. Instead, all instructions, course material, exercises, etc. are provided through an electronic learning environment, called *Blackboard CourseInfo* (http://www.blackboard.com/). This platform has been chosen as part of a faculty wide project on ICT in education (Brakels et al. 2002). Our experience with using this platform for electronic peer review in collaborative writing has been presented in Sjoer and Brakels (2001). In 2001 the online assessment tool Etude was added to the ICT learning environment. The introduction of online assessment was meant to stimulate the students to study writing techniques.

4.1 Evaluating the use of Etude: research questions and design

The application of the online assessment tool Etude was evaluated during the autumn course of 2001. As part of the course, a three-week project has to be carried out. Part of this project consisted of writing a report. During the three-week period, at a self-chosen moment, each student had to do an online assessment on report writing. The main goal of this assessment is that students can apply their knowledge on report writing to cases similar to those they have to write themselves. The assessment was set up in such a way that the students could do the assessment at the time when case-based exercises are useful to them. Moreover, the tutors have taken the effort to develop specific computerized feedback for every possible answer.

To evaluate the application of Etude, we formulated and investigated the following research questions.

- At what moment in the educational process do the students carry out the assessment and are they satisfied afterwards with the moment they selected?
- Did the students appreciate the immediate feedback, and did they find it useful?

To answer these questions, a questionnaire was developed. The questionnaire was split into four sections and consisted of closed questions. With respect to the research questions we asked the student the point in the writing process where they did the assessment and their appreciation of the feedback provided. 138 students performed the assessment. 84 students completed the questionnaire, which implies a response of 61%. The questionnaire was answered anonymously, directly after the course was completed.

4.2 Learning 'Just-in-time'

In the assessment instruction, the students had been advised to take the test after they had read certain parts of the manual about report writing, but before they actually started composing, and revising texts of their own. Only 11 students followed the assessment instructions to the letter. 82% of the students indicated that they studied the course book and 54% of the students studied the course book before doing the assessment (figure 2). If we look at which moment in the educational process the student carried out the assessment, we see that more than half of them did the assessment during the writing process (as shown in figure 3). Yet, nearly a third of them would have preferred to do it earlier. Moreover, although 20% of the students indicate that they did the assessment after finishing the report, more than half of them concluded that this was a mistake i.e. they should have performed the assessment earlier on. To conclude, nearly half of the students either followed the assessment instructions (relative to writing) or indicated that they should have followed them.

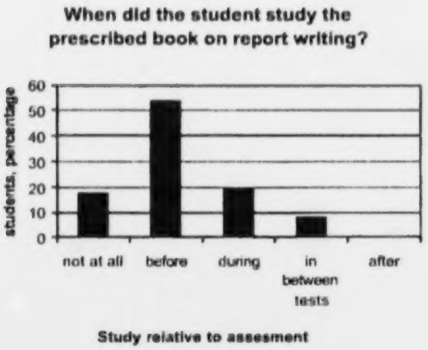

Figure 2: Moment selected for studying book

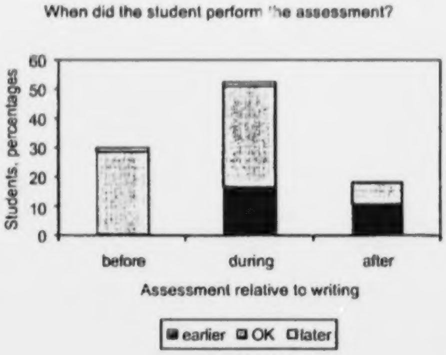

Figure 3: Moment selected for performing test

4.3 Computerized Feedback

The students reacted positively to questions that are related to the computerized feedback. 82% of the students indicate that they appreciate getting feedback on every answer, which probably accounts for the fact that nearly 85% took the effort to read most or all of the provided feedback. The students had a higher appreciation for feedback on wrong answers than for correct answers, scoring 70% for wrong answers and 64% for correct answers on 'useful' or 'very useful'. Despite the high appreciation for the feedback, 42 % indicated that they had learned 'pretty much' from the feedback, while 36% indicated that they learned only a little. This suggests that giving feedback is very positive, but that even more effort should be spent on the content of the feedback. Especially when half of the students do not always find the feedback clear enough.

To sum up, students should be stimulated more to start the assessment before they actually start writing the report. The feedback option was appreciated greatly. It shows great promise for distance education, provided that enough effort is spent on the content and readability of the feedback.

5. Conclusions and recommendations

In this section we answer the research question: is the way Etude is used by the present users suitable to realize the benefits of the system? In general we can conclude that offering an assessment tool like Etude doesn't mean automatically that the users will achieve the potential benefits of the tool. It appears that when a new ICT tool is applied, people tend to start with the substitution of what they were used to doing. In other words, they don't adapt their method to the tool. This conclusion is supported by our interview results in several ways, as shown in the following sections.

5.1 Storage of items

Teachers use chapters of the book to organize their items, because this classification is common to them and immediately available. We recommend to support teachers to think of a coding scheme which is based on the learning objectives, because this will improve the chance that they will fully profit from the benefit of efficient re-use of items and effective generation of tests.

5.2 Item entry

Teachers start filling their item bank with existing items, instead of considering what type of question fits best to the learning objectives. This also applies the use of multi-media, especially sound, video and animations. It seems to take a lot of effort and educational insight to create items that assess the learning objectives most favorably. Part of the potential of the system is not used at all, because teachers are not familiar with it. Students as well as teachers are positive about computerized feedback. Teachers understand the added value of feedback for the learning process of the students. Students appreciate feedback on wrong answers as well as correct answers. The case on report writing shows that feedback has to be clear in order to reach the benefits. Educational assistance should focus on the quality of the feedback. Teachers don't recognize the possible benefits of hints. Consequently, they don't know how to apply a hint functionally. Educational assistance is necessary in order to make clear in what way hints can support the students' learning process. Teachers are not acquainted with the main- and sub question mechanism in Etude. The same counts for the adaptive test methods. Teachers should be informed about these possibilities.

5.3 Taking a test online

Teachers should consider how to guide students in their learning process. In the case on report writing the appropriate time to take the test was included in the test instructions. This was not sufficient for all the students to take the test at the right moment. As a result of this case study an educational guidance program is being developed in order to integrate the new assessment tool successfully. It includes support on different organizational levels in order to set up well-founded code schemes, to fill item banks with high-quality items, and to implement the tool in the educational process.

6. References

Brakels et.al (2002). Implementing ICT in education faculty-wide, *European Journal of Engineering Education* vol. 27, no 1, 36-76

Essenius, R.P. (1995). *Adaptive Computer-based Training in Engineering Education.* Dissertation, Delft University of Technology.

Dopper, S.M. & Ven, M.J.J.M. van de (2001). ETUDE, educational online assessment system. *Sefi-proceedings "The impact of ICT on the curriculum"* May 2-4.

Rovai, A.P. (2001). Online and traditional assessments: what is the difference? *Internet and Higher Education, 3(3),* 141-151.

Sjoer, E. & Brakels, J.K. (2001). Changing writing processes using ICT: electronic peer review in collaborative writing. *Sefi-proceeding "The impact of ICT on the curriculum"* May 2-4.

Ven, M.J.J.M. van de, Staal, R.H.A. & Stehouwer, A.M.A. (1999). The ETUDE automatic assessment system. *Sefi Document No. 23, seminar proceedings.*

Ward, A.W. & Murray-Ward, M. (1994). Guidelines for the development of item banks. *Educational Measurement: Issues and Practices, 13(1),* 34-39.

Relevant URL's http://www.lrdc.pitt.edu/hplc/HPLC_publications.html; http://act.psy.cmu.edu/ACT/awpt/awpt-home.html; http://www.questionmark.com/us/casestudies/index.htm; http://ericae.net/parc/articles.htm

Beyond Technology Training: PT3 Grantee Fills the Technical Support Void, Enabling Schools to Make the Most of Their Available Technology-related Resources, Helping to Bring Technology to Life in the Classroom

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Abstract:

Project ImPACT (Implementing Partnerships Across the Curriculum with Technology) is a first-year PT3 implementation grant awarded to the University of Tennessee in 2001. A primary goal of the project is to work in partnership with preservice teachers, mentoring teachers, local area schools and school systems to effectively infuse technology into the curriculum to enhance student learning. At the local school level, Project ImPACT provides training to mentoring teachers, interns, the university faculty supervisor, and the school technology coordinator on computer applications and techniques as well as methods of integrating technology into the curriculum. Early in the initial training phase of the project, local schools in one participating school district received wireless mobile computer labs accompanied by limited or no technical support for setup and integration. This paper will focus on the tremendous change that occurred in the overall dynamics of one specific university-school partnership as Project ImPACT stepped in to fill the technical support void and worked together with the participants, the school and the school system to bring this newly purchased technology out of the carton and into the classroom, and will share the tremendous explosion in technology-enhanced learning that occurred as a result.

Project ImPACT (Implementing Partnerships Across the Curriculum with Technology) is a first-year PT3 implementation grant awarded to the University of Tennessee in 2001. A primary goal of the project is to work in partnership with preservice teachers, mentoring teachers, local area schools and school systems to effectively infuse technology into the curriculum to enhance student learning. At the local school level, Project ImPACT provides training to mentoring teachers, preservice teachers, university faculty supervisors, and school technology coordinators on computer applications and techniques as well as methods of integrating technology into the curriculum.

Prior to the beginning of project training, teachers at one participating middle school expressed tremendous frustration with the very limited technological resources available to them. Most classrooms had only one current computer system, which primarily served as a teacher station to record grades and perform basic word-processing tasks. The library, which was to serve as the training center for the project, was equipped with several computers, but of varying ages and capabilities. As a group, teachers at this school agreed that there was simply no way to integrate technology into the curriculum with their limited and often unreliable hardware. The frustration was so great, and their outlook so grim, one group member stated that none of them would even be participating in the project were it not for the stipend they could look forward to receiving upon completion of project activities.

Before training was to begin, however, each school in this particular school district learned that they were to receive wireless mobile computer labs as a result of a long-term district initiative to create a world-class school system. After learning of the impending arrival of the new equipment, the group became somewhat energized, but still expressed doubt as to the practicality and logistics of using the labs in their classrooms. While the purchase and distribution of the computer hardware represented the achievement of an extremely admirable goal, the school district provided limited or no technical support for its setup and integration.

When ImPACT staff arrived to begin the training phase of the project, participating teachers expressed great frustration that this wonderful new resource remained packed in boxes and stacked in the hallway.

Immediately upon becoming aware of the situation, Project ImPACT trainers met with the administration of the school to offer their help and time to prepare the equipment for use at the school. Working together with school personnel and PTSA volunteers, Project ImPACT staff quickly set up the first of the mobile computer labs. Once operational, ImPACT trainers began to integrate the wireless lab into project training sessions.

Initial reticence soon gave way to growing enthusiasm as project participants became familiar with the new equipment and the myriad possibilities that it made available. Once the first mobile computer lab was set up and put into use, the other labs were quickly assembled as well. Project ImPACT mentoring and preservice teachers soon "adopted" the labs, taking ownership and pride in their new equipment.

Project staff and participants weathered the storm together as they worked through the initial bugs and difficulties that so often accompany the deployment of new equipment. Mentoring teachers and interns learned quickly to take things in stride when the new hardware did not always work as planned, even for instructional technology professionals. Working through the idiosyncrasies of the hardware and software together with the ImPACT staff, school personnel became far more comfortable with the equipment than they might have been if exposed in a more controlled laboratory setting.

The partnership among school personnel, volunteers, and Project Staff blossomed as the local PTSA unit hosted a reception for the superintendent of the school district, featuring a project training session using the wireless mobile computer labs so recently purchased by the district. Guests at the reception included School Board Members, the mayor of the town, members of the local Chamber of Commerce, as well as many volunteers and community activists. This presented the perfect opportunity for the project and the school to showcase their growing and mutually beneficial partnership. Delighted with the chance to see his initiative in action, the superintendent spent a great deal of time with grant participants, discussing potential use of the new equipment and the possibilities for use in the classroom. The community was once again treated to a demonstration of the newly purchased equipment as the PTSA subsequently invited Project ImPACT to participate in their annual Founder's Day celebration by demonstrating the use of the wireless labs and explaining project training.

Stressing teamwork, partnership, and collaboration throughout the training process, Project ImPACT staff continued to work with participants as they began to plan for the integration of technology into the curriculum. Project ImPACT staff facilitated regular team meetings, at which teachers and interns began to share their technology integration plans. As one eighth grade math teacher discussed some of her ideas to incorporate technology into her classroom lessons, a seventh grade math teacher realized that she, too, was working on activities involving the very same curriculum content for her advanced class. Inspiration finally struck, and these two teachers, who had never considered working together before, began to share ideas and lesson plans. Collaboration grew from there as other teachers who were accustomed to working in the isolation of their pods and grade levels began to collaborate as well. As Project activities continued, Project ImPACT participants began to be sought out by their colleagues as a valuable resource on how to best use the new labs. Today the labs are in high demand all over the school. Technology-enhanced lessons, once thought to be impractical at best, have started to become the norm, rather than the exception.

Acting as school technology coordinator for Project ImPACT activities, the long-time school librarian recently wrote, "Thanks for all your hard work on Project Impact. It was a lot more fun than I had thought it would be and I feel like I developed some close relationships with our faculty that I hadn't had before. That's an aspect of the program I think gets overlooked--the relationship part." What a far cry from the disgruntled comments made by a begrudging participant just a few months earlier.

Using Video- tape Language Samples and Hyper-Studio Applications to develop literacy (reading) skills in young children Ages 4 – 8 identified as developmentally delayed in oral language and literacy skills

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Children who are at risk for developmental delays in the area of oral language are also at risk for developmental delays in reading. Oral language skills provide an essential foundation for the emergence of literacy competence. As school-based language intervention emerged, combined with an emphasis on a more naturalistic approach to literacy instruction, the importance of strategies such as language samples have increased in importance and utility in identifying areas of concern and devising daily lessons for improving oral language skills.

Advances in video technology have improved the accuracy of language samples. In addition, a video provides additional information such as body language and attentiveness, not available in the more traditional approach of audio-tape language samples. Technological advances in software applications such as Hyper-Studio have the capacity to utilize pictures, sound, voice, animation, and text in a combination of lessons to build oral language skills and literacy skills.

The children who participated in this study were enrolled in a cross-categorical non-graded program at a local regular education elementary school. Their age range was four to eight years. All the children were ambulatory and age appropriate in the area of self-help and gross/fine motor skills. Cognitive and language skills were at least six months to one year delayed as measured by Brigance Early Screening Inventory of Basic Skills.

University students enrolled in an upper division (junior/senior level) special education course addressing communication challenges in young children (pre-school through third grade) were the primary investigators. The course instructor and media specialist at the local elementary provided guidance in the area of analysis of language samples and development of instructional sequence of curricular lessons on Hyper-studio.

This investigation provides information in the following areas:

1) information relevant to normal and atypical development of oral language and literacy skills
2) strategies to analyze language samples
2) examples of young children's language sample videos and Hyper-studio lessons and provide rationale for their content
3) feedback from university students regarding the relevance of the assignment and its practical application to their future employment as special education teachers.

Java WEB-based K12 Experimental Research: Formative evaluation of Research Tools

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Abstract: This paper discusses the formative evaluation of computer-based research tools and methodology used in a study investigating how different levels of interaction in a computer game-like situations affect the learning of spatial visualization skills. The current study, as yet not complete, uses Java Applets to implement interactive puzzles which write data back to a server.

There are three research questions in the current study: How does interaction with a computer versus observation affect: 1) mental rotation, 2) path memory and 3) mental imagery? For each research question, we constructed an online experiment.

The experiments make use of Java applets running over the internet that send data back to a server machine on the Stony Brook campus. We set up this infrastructure to achieve the goals of conducting experiments remotely with minimal loss of data and to provide a quick turn-around time for developing new experiments. All programming has been done by undergraduate computer science students for credit. In the treatments, participants were randomly assigned to either 1) an interactive or 2) an observational condition. the posttests, all participants performed the same task regardless of previous treatment condition.

Experiment 1 was designed to investigate the effect of interaction on mental rotation. The scenario experiment one is similar to the classic mental rotation experiments of Shepard & Cooper (1982). Two polygons are shown. The polygon on the right is either a rotated version of the one on the left, or it is reflected as well as rotated. The participant is asked to specify (by pressing a button) whether the polygon on the right is 1) just rotated or 2) reflected as well as rotated. The polygons are randomly generated shapes. In the treatment condition, the interactive participant is allowed to interactively rotate (with mouse) the polygons so that they are the same orientation and it is easier to verify whether the polygons are reflected. In the observational condition, the polygon on the right rotates by itself (animation) until both polygons align. In both conditions participants must specify whether the polygon on the right is a rotation only or reflected. The posttest is essentially identical to the classic mental rotations of Shepard & Cooper (1982). There is no movement or animation. The polygons are static. The participant has to perform mental rotation in his/her head and specify whether the polygons are rotated only or reflections of each other. The program automatically records elapsed time and whether they got the correct answer. For each trial, the same random polygon shape is used in both treatment and posttest. However in both treatment and posttest, it was random whether the polygon on the right was a reflected version of the polygon on the left, or just rotated. Each participant did ten trials. In both treatment and posttest, participants received feedback on their success.

Experiment 2 was designed to investigate the effect of interaction on path memory, remembering a path through a maze. The experiment had a computer game type fantasy of finding your way through a maze in the darkened interior of a pyramid. It had a treatment posttest design. In the treatment, participants are shown in top view a maze in the dark, i.e., they can see only their starting point. There were two treatment groups, an interactive group and an observational group. The interactive group used the arrow keys to maneuver a Pacman-like character through the darkened maze. When they tried to go in a wrong direction into a wall, they were alerted by a beeping noise. When they go in the correct direction, the square they move to is lit up, gradually revealing the maze. The observational group views an animation of a Pacman-like character traveling through the darkened maze, squares lit up as the character enters them. Both treatment groups received the same posttest. They are asked to remember the maze. Then they are shown a darkened square the same dimensions as the maze and asked to recall, by clicking in the squares, the path through the previous maze. They receive feedback on whether and to what degree they remember it correctly.

Experiment 3 was designed to investigate the effect of an interactively rotating a shape on a mental imagery task. During the treatment, both treatment groups (interactive and non-interactive) were asked to memorize a random polygon, with the additional hint of "What does it look like?". The interactive group were allowed to interactively rotate the shape to help them remember it. The presumption was that they would rotate it find an orientation that looked like something they recognized. The non-interactive group were shown the polygon, and asked to remember it, without being able to rotate it. The posttest mental imagery task was to specify whether a "hole in the ground", seen in profile, could accommodate the memorized polygon, either a) a rotation of the memorized polygon, b) a reflection of the memorized polygon, or c) not at all, i.e., the "hole in the ground" was the shape of a completely different polygon.

We have been conducting a series of formative evaluations of the research infrastructure with approximate 80 third through fifth graders (average age 8.5 years) from public elementary schools on Long Island, New York. The formative evaluations have taken place in computer labs of participating elementary schools on Long Island, New York, and also in computer laboratories on the Stony Brook Campus.

Younger children (such as third graders) had difficulty understanding terms like "polygons", "rotated", and "reflected". We therefore changed the terms to "shapes", "turned" and "flipped".

One of the problems we encountered early on was that it was difficult for the younger students, such as third graders, to read the instructions and understand the task. We therefore decided to add voice-over instructions. Scripts were developed for the voice-over instructions, and recorded with a non-threatening female voice to wave file formats and then incorporated into the Java applets. The voice-over instructions clearly improved participant comprehension of the tasks. Some participants had particular trouble understanding what was required for the path-memory experiment. We added a fantasy story line with voice over, "you are lost inside a dark pyramid.", and visuals of the inside of a pyramid. The fantasy story line help users understand the task and added to their engagement.

Participants expressed dissatisfaction at not knowing how or why their answers were correct or incorrect. We changed the programs to include audio, written, and animations of shapes to provide feedback as to why answers were correct or incorrect.

The largest problems so far have been with downloading and uploading data to K12 computer labs. We programmed the communication between client machines and server using Remote Method Invocation (RMI). RMI allows the Java applet operating on the client machine (the computer of the user) to invoke methods (programs) on the server machine. This implies a "higher level" more abstract level of communication than the "http" communication used by most web pages. Unfortunately, after running a number of tests at different school districts, we discovered that the "firewalls", proxy servers, and other filtering software in place in almost all K12 computer lab settings simply do not allow RMI communication between their computers and a remote server. We converted all our code over to a "http" communication, the method of communication between client machine and servers that the majority of web pages use. From the point of view of computers in K12 computer labs (and their firewalls, filtering programs and proxy servers), it appears that our programs are just calling for and downloading ordinary web pages, however we are downloading java programs and uploading data from experiments. During a number of "dry-run" tests from K12 computer labs, data was able to get through.

Next during the first major period of experiments in school computer labs, over the course of a week, approximately 100 fifth grade students attempted the puzzles. There were major technical difficulties. With groups of 20-25 students on the running the java applets simultaneously, the download of the applets (containing a significant amount of multimedia content) was agonizingly slow.

With 20 to 25 students running the Applets at once, the programs froze part-way through in the vast majority of cases. We only able to run the programs with maximum of three students simultaneously. And even then, very few were able to proceed in through to the third experiment. The result was that we were able to gather a significant amount of data on the first experiment only, Mental Rotation. And that data was suspect because of the high attrition rate. One cause of the problem, we later discovered was the limited capacity of the database program, Access, we are using on our server.

We have not yet achieved our goal of setting up a web-based infrastructure for developing and conducting experiments. Various technical issues at K12 computer labs present difficulties. These include firewalls, proxy servers, filtering programs as well as the lower quality of computer hardware at schools, compared to universities. There are other problems associated with undergraduates computer science students developing the code, such as continuity between semesters and incomplete knowledge of some of the technical requirements. We have been now working on the infrastructure for a year. We project that we will be able to set up our experiment infrastructure within a few months.

Math and Distance Learning threaded discussions

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Abstract: Distance learning web-environments do not provide the most basic communication tools for discussion of math problem solving vital to math courses. A needs assessment indicates that online instructors and students need to be able to view, edit, and post diagrams and formulas directly in online postings, without going through laborious intermediary stages. MathThread, an nsf funded project, is dedicated to providing these tools to online instructors and students, supporting instructors in adapting their classes to use these tools and researching the effects of more natural math-oriented threaded discussion tools on mathematics learning. After reviewing the existing possible tools, we have formed a partnership with NetTutor who makes the Whiteboard math discussion tools. We have conducted a pilot study evaluating undergraduate students' ease of using the Whiteboard for calculus discussion. We found that most participants had little trouble understanding and using the tools.

Need

Current distance learning web-environments emphasize the written word and threaded discussions, but do not provide the most basic communication tools for discussion of math problem solving vital to math courses. In face-to-face math classes, instructors work problems, write formulas and draw diagrams on the chalkboard while students ask questions, providing a feedback communication loop. When students hand in homework, instructors and TA's can cross things out and write other formulas. This ability to demonstrate problem solving, represent problems through diagrams, and provide a communication feedback loop are fundamental to math learning, yet are awkward in web-based distance learning environments. Currently math notation, as well as diagrams, can not be directly included in online distance ed. documents. Because math notation and diagrams are NOT integral with the online distance education environments, instructors laboriously go through several steps to attach an image file with formulas and diagrams. Since students can not respond by writing math notation, this disrupts the communication loop. In a Sept. 2000 needs assessment of web-based math instructors in N.Y. State using a dominant web-based environment, instructors declared, *"It has been extremely frustrating teaching math online...",* and *"Your project sounds very timely and useful ."* Instructors consistently wished they could put equations, math notation, conceptual diagrams and graphs directly into online postings (i.e., a math notation editor, a drawing tool for creating conceptual sketches, and a graphing calculator).

Literature search

Current web-based distance learning environments do not directly support formulas and diagrams, in their postings. Logically this can have at least three possible effects on math students and instructors. Firstly, it can force instructors and students to work through a number of intervening digital representations in order to communicate with formulas and diagrams. Online instructors must do this extra work if they are to deliver mathematical content. Secondly, students and instructors may avoid this extra work and force ordinary written prose to carry the extra burden of mathematical meaning, without the support of formulas and diagrams.

Thirdly, students may drop or shy away from web-based distance mathematics courses. Instructors may avoid teaching them.

It seems intuitive that these issues interfere with student mathematical learning outcomes and with mathematics instructor teaching effectiveness. Since a plethora of intuitions that turn out to be scientifically and empirically incorrect, here are some social science concepts which lend support.

The saying "a diagram is sometime worth ten thousand words" is supported by information processing theory, cognitive psychology and cognitive neuroscience. A diagram "preserves explicitly the information about the topological and geometric relations among the components of the problem" in a way that supports parallel processing by human beings. Purely verbal and symbolic descriptions force humans to sequentially parse the relationships between elements of a problem. So while verbal descriptions of math problems may be informationally equivalent to diagrams (all relations in one representation are inferable in the other and vice versa), there are many cases where diagrams are computationally more efficient than verbal descriptions (Larkin & Simon, 1995). The eye, retina, visual perceptual system and visual short term memory are object-oriented, i.e., designed to efficiently, and in parallel, process the relations between different parts of objects. At a neurological level, human visual processing has two well developed "streams" which process "what" (object discrimination) and "where" (spatial relationships between objects and features of objects) (Ungerleider & Haxby, 1998). Both streams are likely used in parsing diagrams. Similarly, while the capacity of Visual Short Term Memory (VSTM) is commonly held to be four items, if items are features of an object, instead of separate objects, capacity jumps to at least 16 (Jiang, Olson, and Chun, 2000; Olson & Gettner, 1998) i.e., if elements of a problem are presented diagrammatically as features of an object, significant learning benefits may accrue.

In current web environments, students (and instructors) may be able introduce formulas/diagrams in the their postings by going through several intermediary steps, such as using MathType within word, saving the file as a image file (GIF), and then uploading or attaching the image file to a posting. But such extra steps in the communication process cannot help but distract student's limited attentional resources away from the vital elements of new schema's they are learning and impose an extraneous "cognitive load" on the students' short-term memory (Sweller, 1994).

Previous work

There are a number of companies, consortiums and organizations working on supporting online math threaded discussion. WebEQ provides an extremely well-designed interface for creating mathematical formulas that go into documents which can be posted to the web. WebEQ is an interface that has grown out of MathType, which provides an add-on to Microsoft Word, to enable the inclusion of formulas. It is notable that WebEQ is in being picked up by some distance education providers, such as Blackboard. Although WebEQ is a well designed interface, it does not provide for the inclusion of diagrams or the graphing of equations.

Another approach is the Imath Communicator (www.imath.org), a math-enabled browser, which displays, creates and edits math notation and some diagrams, by using Mathematical Markup Language (MML) an XML extension to HTML that provides for math notation. Imath has modified the open source code of Amaya (of the WorldWide Web Consortium (W3C)) to create Imath Communicator. Imath has been used somewhat successfully as a web component in distance beginning algebra courses. The advantages of Imath/Amaya approach are: 1) it is based on an extension to html, so all browsers may support this solution in the future, and 2) it is open source, allowing a diversity of programmers from around the world to potentially improve its source code. The disadvantage of the Imath approach is that it does not perform quickly with large html pages.

LiveMath (www.livemath.com), is a wonderful way to display interactive three dimensional graphs of mathematical equations over the internet. Distance educators can download and purchase the LiveMath Maker, a program that allows them to input mathematical equations and create a variety of two and three dimensional graphs of the equations. These graphs can be posted to web pages, where users can view them after downloading a free plug-in. The user can interactively rotate and view these graphs. However LiveMath does not provide a means of putting formulas, diagrams and graphs directly into online threaded discussion postings. The user must create the files with LiveMath Maker, upload the file created, and then link to the file from within a threaded discussion environment. The interface of LiveMath Maker is complicated and would likely be difficult for remotely connected undergraduates to learn. It is perhaps best used as a valuable supplementary resource.

Probably the best and most complete solution is the Whiteboard by NetTutor (www.nettutor.com). Whiteboard, designed as a chat system for math and predominantly used for round-the-clock chat-based math

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tutoring, it can also be used in asynchronous mode for math oriented threaded discussions. So far Whiteboard is the only working tool that allows users to put *directly* into asynchronous threaded discussions the most vital elements of math communicatio: formulas, graphs, and diagrams. There are no intermediary stages, just an interface that allows users to view, edit and post discussions with these elements. The NetTutor/Whiteboard could use some improvements on its interface. The company that owns it, Link Systems, is relatively small and seems amenable to making improvements. Since Whiteboard is the only reasonably complete and working product supplying the needs of math asynchronous threaded discussion, we have chosen Whiteboard as the tool we will use and they have agreed to a partnership with us.

Work is beginning and on-going

The Math Thread project has recently been funded by the National Science Foundation, through the program Course, Curriculum, and Laboratory Improvement - Adaptation and Implementation (NSF CCLI A&I). The funding starts officially January 2002 and runs for three years.

Major goals and approach

1) Provide distance ed. math instructors with basic math communication tools to fluently teach math, including direct inclusion of math notation, conceptual drawings and graphs into distance ed. postings by both instructors and students. Instructors will directly put math symbols into distance ed. documents, without converting documents into unmodifiable formats (such as image files, gif's, LaTex etc.) and adding them as attachments. Our goal is to have modifiable math notation in distance ed. documents, so instructors can easily copy, modify and annotate students' work and thereby achieve fluent of two-way math communication. *Achieve by:* Unite an existing distance ed. Environment with a math-friendly interface, NetTutor's Whiteboard, which creates, views and edits math notation and diagrams. 2) Adapt existing web-based and face-to-face college math courses to include these basic communication tools for math. *Achieve by:* Through the SUNY Learning Network, a non-profit infrastructure for distance ed. at the State Universities of New York, redesign/deliver two Intro. Calculus and two Pre-Calculus courses using the math friendly communications tools. 3) Provide faculty development/support for instructors to re-design their math courses. *Achieve by:* During redesign of adapted courses, instructors meet with the project personnel and receive feedback on designing online math classes from other instructors at SLN, through online threaded discussion. 4) Research the impact of more natural math and diagrammatic communication on math learning. *Achieve by:* Once adapted courses are running in the SLN environment, research students' use of different modalities (e.g., diagrams, graphs, formulas) in their learning, for example, the correlation between diagrams use and comprehension/achievement, particularly for developmental students. 5) Facilitate the quick spread of basic math distance ed. communication tools to other math instructors a) in the Dept. of Applied Math & Statistics at STONY BROOK, b) within SLN through-out the state of New York and c) nationally. *Achieve by:* During redesign of adapted math courses, approach other math instructors at SLN for suggestions. Offer on-campus workshops through the Center for Excellence in Learning and Teaching (CELT) at STONY BROOK. Provide other math instructors with a simulation of a distance ed. math course using easy creation/viewing/editing of math notation, diagrams and graphs within assignments and discussions. During teaching of adapted courses, allow other math instructors to unobtrusively observe. Suggest that other math instructors use MathThread in one experimental unit. Present at the yearly SUNY Conference on Instructional Technology (CIT). Approach other distance ed. providers about using the basic math communication tools. Write papers for peer-reviewed journals and present workshops and papers at national conferences.

Validation

In a needs-assessment of 40 web-based distance education math and math-related instructors across the nation, the instructors declared, *"It has been an extremely frustrating experience teaching math online..."*, and *"This aspect of my internet course is the most discouraging. I find myself spending an exorbitant amount of time responding to students mathematically* [because the infrastructure does not support it] *and not enough time* *teaching. If this doesn't change, it will eventually be the reason why I give up teaching mathematics on the internet."*

In response to our mentioning our plans to address the problems, the following comments were made: *"Your project sounds very timely and useful "*, and *" Yes! I am so glad that you are working on this project."*

The instructors consistently asked for a common set of tools, i.e., the ability to put equations and mathematical notation directly into online postings and threaded discussions, a drawing tool for creating conceptual sketches and a graphing calculator.

Math Thread Pilot Study of NetTutor

Prior to introducing the Net Tutor software into experimental classroom settings it is important to identify human and other factors (such interface design and technical usability) that might influence how well the software would function as part of a course. Early identification of such factors provides opportunities to modify or eliminate them prior to actual implementation, or to control for the identified factors in the experimental setting and account for them in subsequent project assessment.

A series of six pilot sessions were completed. Students who had taken or were currently taking pre-calculus or calculus were recruited to participate in single sessions to evaluate the use of the Net Tutor software in a naturalistic setting. Sessions were held in a computer lab, and students received course credit for their participation.

In order to decrease any anxiety resulting from stereotype threat (Spencer, Steele, & Quinn, 1999; Steele, 1997) and/or from concerns about self-presentation or mathematical ability, students were repeatedly assured that the session goal was to evaluate the software and not their math or computer knowledge and expertise. The two-hour pilot sessions had four parts. First, participants were provided with a facilitated software tutorial, during which they could practice using the tools and ask questions. Second, participants were each assigned to a small group, provided with a set of calculus-related problems/tasks, and directed to work through the tasks using the Net Tutor tools and online threaded discussion with the other members of their assigned group. Third, participants were asked to complete a brief open-ended questionnaire regarding their experience using the software. Last, participants took part in a group interview regarding the use of the Net Tutor software and the pilot session experience.

Results of the Pilot Sessions

In general, responses to Net Tutor were relatively positive. Most, though not all, participants had little or no difficulty understanding how to use the tools ("It wasn't hard at all."), found most of them easy to work with, felt they had the right tools to do what they wanted to do, and felt there were enough tools provided. Several participants especially liked the graphing feature, although several would have liked a built-in graphing calculator. There also appeared to be a consensus that there was a certain awkwardness and tediousness to using Net Tutor, and participants suggested that they would feel more positive about the software if it functioned in simpler and more familiar ways (i.e., more like the MS Windows applications to which they are accustomed: "I think I would also like key commands."). Most participants indicated that they believed they could become comfortable and proficient with the tools as part of a class in a fairly short time.

Participants' responses to questionnaires and during interviews indicated a number of moderating factors clustered into several common themes. First, participants' perceptions of the ease of use of Net Tutor were clearly moderated by their level of computer expertise and experience with online environments. Those who indicated a higher level of technical expertise, especially in the use of graphics software, reported less difficulty in learning to use the Net Tutor tools and in navigating the software. Also, prior experience with online threaded class discussions (e.g., Blackboard) appeared to moderate participants' comfort and satisfaction with the group problem-solving tasks, although some dissatisfaction with the basic attributes of this function (e.g., read messages do not change color and there is not an automatic refresh) appeared to moderate even the responses of computer-savvy participants. We suspect that variability in students' computer expertise will continue to be a major issue in computer-based classroom approaches for some time to come. Instructors implementing such approaches will need to build in adequate time for training and tutorials, especially for less technically able students.

Second, participants who perceived themselves to have less math expertise expressed some dissatisfaction with the amount of information provided on how to use the tools. They suggested that pop-up windows that provided some definition and description of the tools and how to use them would be helpful, as well as a glossary of relevant mathematical terms.

A third group of factors clustered around personal communication preferences. There was a fair amount of variation in whether or not participants thought they would like using Net Tutor for group projects or to communicate with professors and teaching assistants. Some expressed a strong desire to ask questions face-to-face and to use pencil and paper to draw diagrams. Others felt Net Tutor would be a useful means to communicate questions to professors and teaching assistants outside of office hours. Instructors implementing Net Tutor in classes would be advised to provide adequate opportunities for face-to-face meetings with students, in order to accommodate a variety of communication preferences.

In addition, observations by the project staff suggest some concerns to be addressed in training sessions with instructors for the experimental classrooms. Despite repeated reassurances, some participants still suffered from self-presentation concerns which might be expected to negatively affect their experiences with Net Tutor and their performance. Instructors need to be aware of this and find some means of monitoring students' participation and interactions to mediate the impact of self-presentation issues on performance. Another observation involves the recognition of a learning curve for instructors as well as students. As the skills of the pilot sessions instructor/facilitator improved, she noted that it appeared she was able to accelerate participants' learning because her increasing knowledge meant she could more readily answer questions. Instructors should be aware of their own learning curve, and strive to be well ahead of students prior to implementing Net Tutor into classes.

Although the asynchronous component of the NetTutor Whiteboard seemed fairly usable, there were certain technical shortcomings and some features that students suggested would make the WhiteBoard more usable. In using NetTutor for a ascynchronous threaded discussion, it could be more robust. It often happened that students opened up two windows with the interface, causing the browser to freeze. Additionally students called for a number of additional features, some of which are present in common distance learning environments and/or in Windows-based applications. The people at NetTutor have agreed to address these issues immediately. We feel that when these problems are fixed, NetTutor's Whiteboard will be a very serviceable tool for mathematics-oriented asynchronous threaded discussion.

These pilot sessions yielded useful information for the next phase of Math Thread, identifying and training instructors for the experimental classrooms.

Upcoming work

The next phase in our project is to train and support several online mathematics instructors to incorporate the Whiteboard tools into their existing courses. We have made a partnership with a community college in up-state New York to convert a pre-calculus and a calculus class to take full advantage of the Whiteboard tools. We will conduct seminars over the summer of 2002 to assist them with incorporating Whiteboard into the fabric of their courses. The adapted courses will be offered Fall of 2002.

References

Jiang, Y., Olson, I.R., and Chun, M.M. (2000). Organization of visual short-term memory, Journal of experimental psychology: learning, memory and cognition, Vol. 26, No. 3, 683-702

Larkin, Jill H. & Simon, Herbert A. (1995). In Narayanan, N. H. & Chandrasekaran, B. (Eds.) Diagrammatic Reasonaing: Cognitive and Computational Perspecitives, Boston, MA: MIT Press and Menlo Park, CA: AAAI Press, 1995

Olson, C.R. and Gettner, S.N. (1998). Brain representation in object-centered space, in L.R. Squire and S.A. Kosslyn (Eds.) Findings and current opinion in cognitive neuroscience.

Ungerleider L.G. and Haxby, J.V. (1998). 'What' and 'where' in the human brain, in L.R. Squire and S.A. Kosslyn (Eds.) Findings and current opinion in cognitive neuroscience.

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*, 35, 4-28.

Steele, C. M. (1997). A threat in the air: How stereotypes shape the intellectual identities and performance of women and African-Americans. American Psychologist, 52, 613-629.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. Learning and Instruction, 4(5), 295-312.

Technology Innovation through Collaboration in a Teacher Education Program

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ABSTRACT

Teacher preparation has emerged as a critical factor in the effective use of new technologies in education. Information technology investments may not pay off unless future teachers are given the opportunity to become technology-proficient educators. This study presents a theoretical framework for implementing technology innovation through a cohort model. Results from interviews of the first year's participants, and the lessons learned from their efforts are reported. Findings clearly indicate that structure and ownership are essential ingredients to producing a viable and collaborative cohort model and that the power of technology integration can be realized through collaboration.

Introduction

Rapid and widespread technological growth over the past decade has had a significant effect on our society; technology is changing the way we live. Changes are most noticeable in the way we do business and the way we communicate. Many teacher education institutions are studying the way in which technological innovations can significantly influence the way we teach and learn. Today, more than at any other time in recent history, teacher preparation has emerged as a critical factor in determining the effective use of innovative technologies in education. Federal, state, and local agencies are investing billions of dollars to equip schools with current technologies and telecommunications networks. However, these information technology investments may not pay off unless future teachers are given the opportunity to become technology-proficient educators who know how to take advantage of these new learning tools to enhance and improve the education of all students.

In recognition of the urgent need for technology-proficient educators, the U.S. Department of Education, with the support of Congress, has begun a new initiative to prepare tomorrow's teachers to use technology for improved teaching and learning. In its first year, the Preparing Tomorrow's Teachers to Use Technology (PT3) program awarded $75 million to 225 grantees in every region of the country. One of the PT3 project grantees, the Learning Generation (LearnGen) Project at the University of Kansas, focuses on the abilities of teacher education students to assist faculty in generating technological innovations and to transfer this expertise to their teaching experiences.

The LearnGen Project has sought to accomplish this goal through the creation of Technology Innovation Cohorts (TIC). The role of each TIC is to design, implement, and assess a "technology innovation" that is intended to integrate technology into teacher education. This paper presents the theoretical framework for the project's efforts to implement a TIC model and the lessons learned from the first year's efforts.

Literature Review

Over the past decade, reports have indicated that the importance of technology in teacher education is not central to the teacher preparation experience in most colleges of education in the United States today (Office of Technology Assessment (OTA), 1995; American Council on Education Report, 1999). Typically, teacher educators are not prepared to model appropriate uses of information technology or to incorporate the use of technology across the curriculum. Instead, the extent of their ability to use technology centers on accessible applications (e.g., drill and practice, word processing, use of the Internet). Teacher educators tend to lack more sophisticated skills that enable them to integrate realistic problem-solving activities into teacher training programs (Abdal-Haqq, 1995; Office of Technology Assessment (OTA), 1995). If technology is to be successfully integrated across teacher education programs, preservice training that is focused on technology integration must become a priority, especially if preservice teachers are to become comfortable and competent with the use of technology in their teaching (Hasselbring, 1989; Langone, Malone, Stecker, & Greene, 1998; Office of Technology Assessment (OTA), 1995; Sheingold & Hadley, 1993; Wetzel, 1993).

When technology is introduced during the preservice years, the focus is generally on "how to" components and skill acquisition of technology rather than on effective strategies for using technology to enhance learning. Preservice teacher education students need to experience technology as modeled by their instructor(s) rather than simply being informed of its "potential benefits" (Barker, Helm, & Taylor, 1995; Bryant, Erin, Lock, Allan, & Resta, 1998; Good, 1996; National Council for Accreditation of Teacher Education (NCATE), 1997; Smith, Houston, & Robin, 1995).

There is acknowledgement among researchers that mentoring relationships are paramount to successfully assisting beginning teachers in adjusting to teaching requirements. Through supportive national, state and local efforts seeking to support mentoring relationships between experienced teachers and preservice teachers, entry-level teachers have a chance to become better prepared at facing the day-to-day challenges of the classroom. The trained mentor/observer is able to observe and analyze teaching and provide the preservice teacher with substantive and specific feedback as part of the mentoring process. The mentoring relationship is generally organized around such supportive activities as: (a) observation (visiting each other's classroom); (b) demonstration (coaching); (c) conferencing (feedback); and, (d) joint preparation (Alderman & Milne, 1998; Gratch, 1998; Hawkley, 1998). Reports indicate that effective mentoring is based upon interpersonal communication. Through communication, mentors and mentees can develop along the three phases of the mentor/mentee relationship: (a) establishing the relationship; (b) getting to work; and (c) evaluation and follow-up (Alderman & Milne, 1998; Gratch ,1998; Hawkley, 1998; Hiemstra & Brockett, 1998).

Method

Semi-structured interviews were used to collect data about: (a) the training program, (b) the mentoring experience and (c) the technology integration efforts from TIC participants. Audio taped interviews were conducted individually for all participants and were approximately 30 minutes in duration. The twenty interview questions were broadly grouped into three categories that included: (a) TIC collaboration; (b) TIC support and interaction; and (c) attitudes, comfort, and ability to use technology. For this study, the data gathered included only the personal experiences and opinions of the TIC participants. Using the process of constant comparison, responses were coded and sorted according to themes that developed. All interviews were audio taped and transcribed for content analysis. To check the reliability of the interpretations, an independent evaluator reviewed all the recordings of interviews to confirm quotes and organization of patterns of participant responses. A second evaluator checked and coded the transcribed responses to ensure reliability. A further comparison was made of the two reviewers' codings and organizations. Member checking was also performed to ensure the credibility and trustworthiness of the data. Participants unanimously perceived the presented results as accurate reflections of the TIC experience and concerns specific to integration. The interview responses were examined and partitioned into data units by the reviewers. These data units were organized into categories established from specific themes that developed out of the interviews. These categories were grouped directly from the themes to organize the findings.

Each TIC was responsible for producing products or resources that exemplify their innovations. These might include detailed descriptions of teaching strategies, lessons, media, technology competency tutorials, or student portfolios for example. TIC developed products provided evidence of the TICs application of instructional technology. Throughout their involvement in LearnGen, progress reports were submitted by participating teacher education students. These reports reflected the progress and growth of each TIC as they developed their innovations. In addition, each TIC provided relevant information about their cohort for their cohort website as well as submitting one or more examples of their innovation(s) to be disseminated.

The LearnGen project's purpose was to integrate instructional technology into a teacher education program through a collaborative model. Therefore, the work produced by the TICs was reviewed for evidence of the following attributes: collaboration; use of technology; the integration of instructional technology; and, emphasis on teacher education.

Discussion

Emerging from the analysis of the TIC products and interview results were several informative themes from which we were able to identify lessons to apply to future TICs. Generally, the use of technology within TICs occurred in one of two ways. The first was to use technology as a means to facilitate the work of the TIC. In this example, technology was secondary to the mission of the TIC and would be used to record or produce their final product(s). A second way in which technology was used was as a component of what the TIC was developing. In this way, technology was a primary focus of the TIC and the work of the TIC was centered around its integration into educational settings. This delineation of roles was also seen in the way in which each TIC viewed the integration of technology. Some TICs viewed technology integration as a key component to laying the foundation for further technology integration. Other TICs viewed technology integration as an opportunity to provide a direct integration of technology. These TICs approached their innovation as a way to learn new technology and integrate this technology directly into the educational setting.

Individual progress reports indicated that the TICs typically consisted of a teacher education faculty member, two teacher education students and one or more K-12 educators. Findings from the TIC final reports (reflecting their efforts and providing a description of their innovations) suggest that no two cohorts functioned in exactly the same manner. In fact, their individual accomplishments were attributable to their unique relationships brought about through collaboration. However, simply considering what the TICs' "produced" or reported did not prove sufficient. Those involved and the type of interactions that occurred varied greatly from group to group.

TICs approached the integration of instructional technology in one of two ways. First, on a curricular level, several TICs explored how to integrate instructional technology into specific courses, such as what technology skills were needed by prospective teachers or what special educators expected of teachers that were to use technology to aid with adaptive instruction. Second, on a technology level, several TICs sought to develop technology-based products suitable for use in a course or a K-12 classroom, such as the legislative tracking assignment or the review and application of educational software within three professional development schools. Since the TICs work typically represented a snapshot of the K-12 or teacher education course or program, it was difficult to determine the reach or quality of the integration. With the review of the software, for example, while this was requested by the K-12 educators, there is no record if teachers in the three schools took advantage of the information.

The original expectation for TIC members was to gather and decide amongst themselves what the direction of the TIC would be and how they would accomplish it. This presented a challenge for some TICs. A teacher education faculty member observed, "I don't think that we had enough information about the expectations of a faculty member or what a TIC should accomplish. Contrary to our original expectations, we discovered that some clear definition was essential for the process to emerge. TICs that were formed around an idea generated by the teacher education faculty member proved more successful than those that sought to use the entire TIC to generate the idea. In addition, TICs that based their work on the initiative of the teacher education faculty member were up and running much quicker than other TICs. This is not to suggest that the other TIC members were peripheral to the process, but rather that the innovation was directed both toward the teacher education faculty member and a portion of their responsibility in the teacher education program.

Unanimously supported by TIC members interviewed was the need for an informal, yet systematic process of forming TICs. As a result, several changes were made to the cohort development process for the second round of cohorts. In order to accommodate faculty needs and offer faculty an opportunity to explore their interests, one of the co-principal investigators of LearnGen took on the role of faculty liaison. As faculty liaison, he is able to offer additional opportunities for open-ended discussions and exploration of faculty ideas, needs, and interests as they relate to technology integration. The results have been promising to date.

An intended outcome of the LearnGen project was to develop and encourage future collaborative efforts among faculty, students, and the K-12 community. The strongest evidence to support this was seen in the work and activities of the teacher education students following their involvement in the TIC. While unfortunate for the education profession, two of the TIC student members have since chosen technology-related occupations in the business world. Other students have taken on additional responsibilities related to technology either through their involvement within the school of education, or as members of technology-based projects throughout the school of education. Some students have reassessed their careers and have chosen to pursue terminal degrees. These students are considering careers in the field of higher education and technology leadership (i.e., district, administrative, or site-based technology integration specialists, technology support, and technology training).

Faculty mentoring was evident throughout the study, however, reverse mentoring was much more common. As one teacher education faculty member put it, "It was nice to be working with someone who had a technical expertise to be able to help me figure out how to take ideas that I had and…make th[em] a reality. I think if I'd had the same level of technical expertise as them [the student], I'd question whether or not our TIC would have been as successful as it was because basically I'd talked about doing the programming and setting this thing up and I was lost." Preservice teachers found themselves in "enviable" positions. They soon found validation among their peers and among faculty for the technical expertise they possessed. "In some way I actually became a mentor as far as instruction was concerned." The role of the student in the TIC process was unique. This is seen as a strong indicator of the success of the TICs in general. As one student discovered, "I didn't understand it until [faculty TIC member] led a conference in Dallas. He had mentioned while giving a presentation for the first time that I was "his" mentor.

He totally took me off guard. I hadn't really thought about it that way. I realized that I kind of was because I was the one that was teaching technology and trying to integrate it."

The impact of the incentives for student participation was significant. Incentives took the form of laptop computers that were assigned to each student to use as needed throughout their involvement in the project; a small hourly wage for their time commitment; and exposure to a wide variety of technologies and opportunities.

Lessons Learned

1. Faculty ownership is critical. Given the experiences of the first year, those cohorts that were formed around an idea generated by the teacher education faculty member were more successful than those that sought to use the entire cohort to generate the idea.
2. An informal, systematic process of forming and reviewing cohorts is needed. Cohorts now are required to complete a seven-stage process.
3. Mentoring plays a key roll. TIC members adopted a mentoring approach to contributing to the "supportive environment" of the TIC.
4. Technology integration increased. Participants reported an enhanced understanding of instructional technology, an improved capability to integrate technology into higher education and K-12 classroom instruction, and general understanding of how to use technology as an instructional tool to meet all learners' needs.

Conclusion

Throughout the study, participants reported an enhanced understanding of instructional technology, an improved capability to integrate technology into higher education and K-12 classroom instruction, and general understanding of how to use technology as an instructional tool to meet the needs of all learners. Clearly, this is evidence that technology integration across preservice course work is on the increase, and the potential for widespread integration is a possibility.

While the long-term success remains undetermined, those involved have come to understand that the power of technology integration is best realized through collaborative efforts. The strength of this project's efforts rests in the inclusive and collaborative nature of the TICs, the support system provided to them, the level of faculty ownership and the design, testing, and reporting of their technology innovation efforts.

MERLOT: Reaping the On-line Vineyard

Karen Smith-Gratto, David Wicks, and Carl Berger

"Once upon a time there was a faculty member in a school of education who wanted to involve students in activities incorporating the World Wide Web. This faculty member wandered the on-line vineyards and found K-12 vines that produced lesson plans and even content-related activities for use with elementary and high school students. The faculty member wandered for days and finally found a few vines that contained information appropriate for use in an undergraduate teacher education class and a few vines appropriate for use in graduate classes in education. Only a few of these vines were useful for what the faculty member was planning to teach. The yield from the harvest was small for the time spent in the search. The faculty member was discouraged and wondered whether the incorporation of web-based activities was such a good idea. If only the faculty member had know about MERLOT, the search would have been quicker because the types of vines are identified and would have often been reviewed by peers."

MERLOT (Multimedia Educational Resource for Learning and On-line Teaching) is a database that can assist university faculty to quickly locate sites that would contribute to the instructional process. The MERLOT database is a collection of links to web sites that present content specific information within a variety of content areas. The objective of the database is to provide a collection of materials that are peer reviewed for the educational efficacy within specific fields. In this paper, we will specifically address the Teacher Education portion of the database.

The database serves two functions. The first function is the collection of sites useful for teaching at the university level. As anyone who has searched the web for materials can attest, the time spent searching the web can be daunting. By collecting sites submitted by the developers or by professors who have used the sites with classes, the database provides a timesaver for professors engaged in instructional planning in which the incorporation of the web is desired. This is extremely important in teacher education because professors must model those behaviors and skills that teacher education students must learn and later exhibit in their classrooms. As with any group of professors, teacher education professors teach classes, attend committees, engage in service, and produce scholarly works and time is at a premium. Time spent surfing the web for appropriate sites to integrate into classes can take time away from these other activities.

The database provides not just the name and a link to the site but a brief description of the site. Sites that have a Peer Review are identified with a rating of up to five stars. A compilation of the reviews is developed and can be accessed by users to see not just specific details about how the site fared but also information about learning goals that can be addressed by the site; the intended audience and other possible audiences for the site; the prerequisite knowledge and skills needed to get the most out of the site; the type of material, and a note about special technical requirements. The inclusion of this information can help the professor quickly eliminate sites and cut down the number of sites he or she needs to directly preview for use. The database also provides the opportunity for users to make comments and to describe activities they have developed to use in conjunction with the sites.

The second function is to provide professors who have developed materials to use in their own teaching may get those materials reviewed, in a manner similar to how journal articles are reviewed.

The review process for the Teacher Education portion of the MERLOT database begins with submission. The MERLOT database is an open database in which both users and developers of sites may submit sites for inclusion. Teams of reviewers analyze the site for it quality in three areas: Quality of the Content; Ease of Use; and Effectiveness as a Teaching Tool. The quality of content includes not just accuracy but the clarity of presentation and relevance. Ease of use covers such characteristics as how easy the interface design is to negotiate for both faculty and students, how engaging the presentation is, and how interactive the site is. The last aspect that is analyzed is the effectiveness of the site for use in an instructional setting. The site is examined for the presence of objectives, potential for integration into teacher education classes, and instructional flexibility. The usefulness of the database would be limited if the organization only viewed the collected sites through "Teacher Education" without breaking the major category down into areas within the field.

The Teacher Education portion of the database is divided into subcategories that were hammered out and agreed upon by educators from around the United States and Canada. The subcategories are: Educational Foundations; Educational Psychology; Classroom Management; Diversity and Multicultural Education; Educational Research; Instructional Technology; Special Education; Student Assessment; and Teaching Methods. The database can be searched through the use of these categories or through the use of descriptors using the search function within MERLOT.

MERLOT can be a great asset to busy faculty from two standpoints. First when faculty develop web-based materials for student use, those materials can be reviewed and provide the faculty member with documentation that parallels the peer reviewed journal article. This can help faculty gain recognition for the scholarly aspects of teaching. In addition, the availability of the materials in the database can help save time in the task of incorporating web-based materials into our classes.

Using Streaming Technology to Build Video-Cases that Enhance Student Teaching on IT

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Abstract: This paper describes a prototype of a development project for practicum classes in the Hong Kong Institute of Education. An in-house development of a streaming video system is used for improving student teaching by building a digitized video database from a variety of sources. The main objective is to develop an interactive web-based video platform for critical analysis of significant classroom activities and events related to IT teaching skills and strategies. In designing our video system, Synchronized Multimedia Integration Language (SMIL) is used. Video clips can be synchronized and displayed in parallel with text clips showing the teaching sequences and key ideas. Viewing and critiquing the videos side by side in an on-line setting is the key learning strategy that provides opportunities to develop student teachers' reflective thinking skills and interactive reflections with their classmates through on-line forum discussions.

Introduction

In the practicum and methods classes, the student teachers usually conduct trial or experimental lessons that are prepared, taught, and then collectively critiqued. Each period can only highlight a different teaching skill and edited video tapes are sometimes used to supplement for any classroom practice. Recently, there are trends of reducing the contact hours and increasing of class size in IT practicum and methods classes. Within these classroom constraints, teaching skills taught, variety of classroom situations observed as well as number of participating student teachers are limited. The proposed interactive web-based video platform for critical analysis of significant classroom activities will provide repertoires of specific teaching skills as well as diverse classroom situations. Because of the 24-hour availability and accessibility of these videos, student teachers can achieve extensive field experiences prior to teaching practices. Researches (Risko, 1991; Stephens & Leavell, 1999) suggest that viewing video cases student teachers are able to examine the dynamics of school classrooms and benefit from multiple perspectives when viewing is done collectively with classmates or other colleagues in the faculty. Stephens & Leavell (1999) also reported that video minicases which are short vignettes selected as examples of teaching practice can greatly enhance student teachers instruction ability since the vignettes are purposefully selected. Accordingly, student teachers are able to compare their interpretations with those of others when viewing the same video case or similar vignettes.

System Overviews

Traditionally, student teachers can reflect on their own teaching performance or analyse other practicing teachers' performance through videotapes with paper-based observation forms. Preset questions are usually provided for the analysis of the teaching sequences against the intended objectives, designated activities and learning outcomes. The disadvantages of this approach include the following:

1. Physical videotapes are bulky in handling and viewing;
2. It is difficult to annotate important teaching characteristics onto the videotapes;
3. Searching similar characteristics from the repository of related videotapes are not easy; and
4. Critical reflection by student teachers cannot be easily done visually and interactively;

Furthermore, video vignettes can only be produced in video segments which cannot be retrieved or managed easily. Therefore, a digital solution with online viewing, searching and critiquing is highly desirable. Figure 1 illustrates a schematic representation of our desirable system. A video case can be viewed alongside with key ideas explained. Hyperlinks for related video clips or websites to support the topics of interests are timely provided. Critical reflections related to the video segments can be collected.

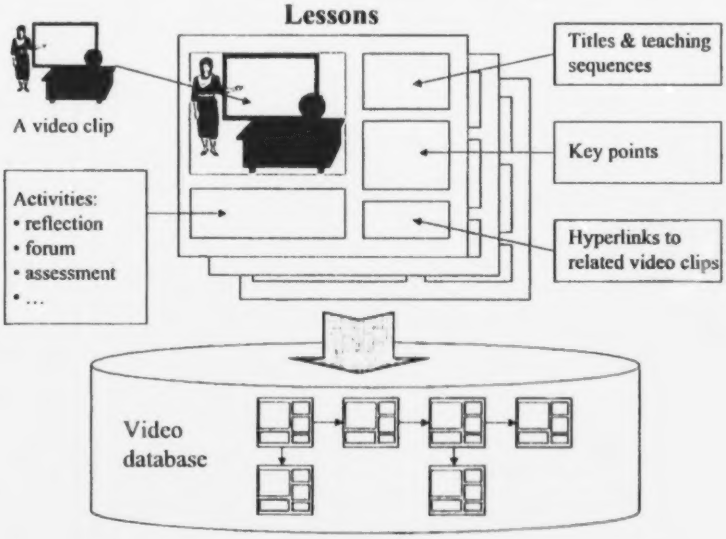

Figure 1. A Schematic Representation of the Video System

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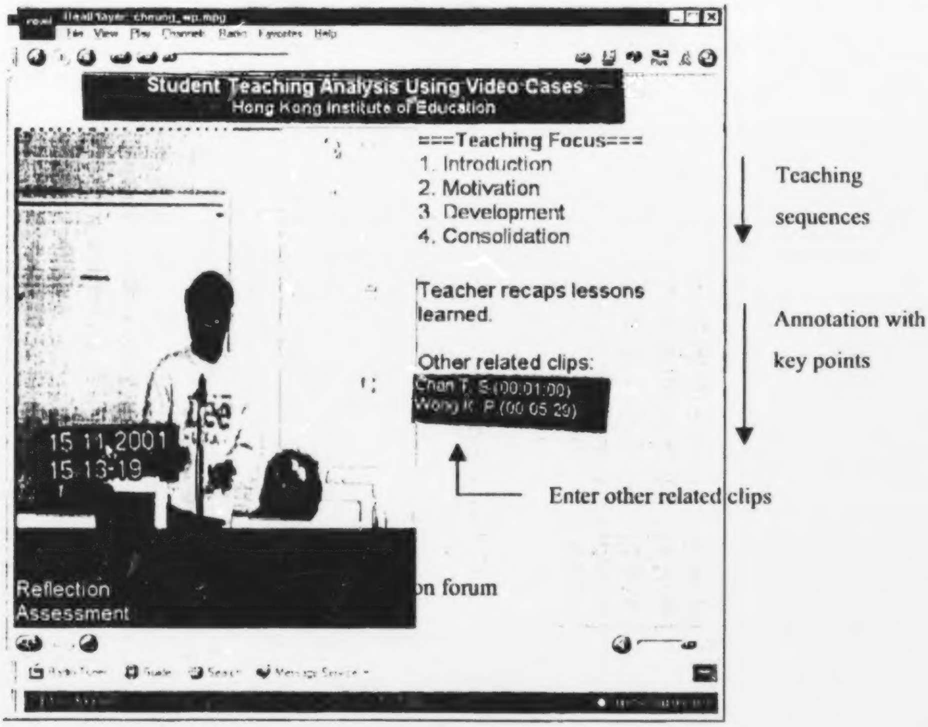
In designing our video system, Synchronized Multimedia Integration Language (SMIL) is used (Alesso, 2000; Kennedy, 2002; Williamson, 2001). SMIL is ideal to our application. Video clips can be synchronized and displayed in parallel with other media information. In conjunction with a streaming server, video cases can be retrieved over the Internet. Figure 2 shows our prototype using SMIL and its related technologies. A student teacher conducts teaching in a practicum class. The four teaching sequences, namely *introduction*, *motivation*, *development* and *consolidation*, can be viewed serially or in any order by clicking the links. Key points are further explained and annotated. Also, if there are existed other video segments related to the key points, hyperlinks are provided for easy access. Figure 3 shows the related clip with the student teacher, Chan TS, after clicking on the item on Figure 2. Student teachers can also enter into the forum for critical reflection at any time as shown in Figure 4.


RealPlayer: chmung_wp.mpg
File View Play Channels Radio Favorites Help
15 11 2001
15 13 19
Reflection
Assessment
Teaching sequences
Annotation with key points
Enter other related clips
on forum

Student Teaching Analysis Using Video Cases
Hong Kong Institute of Education

===Teaching Focus===
1. Introduction
2. Motivation
3 Development
4. Consolidation

Teacher recaps lessons learned.

Other related clips:
Chan T. S (00:01:00)
Wong K. P (00 05 29)

Figure 2. A Sample Screen Shot for our Prototype

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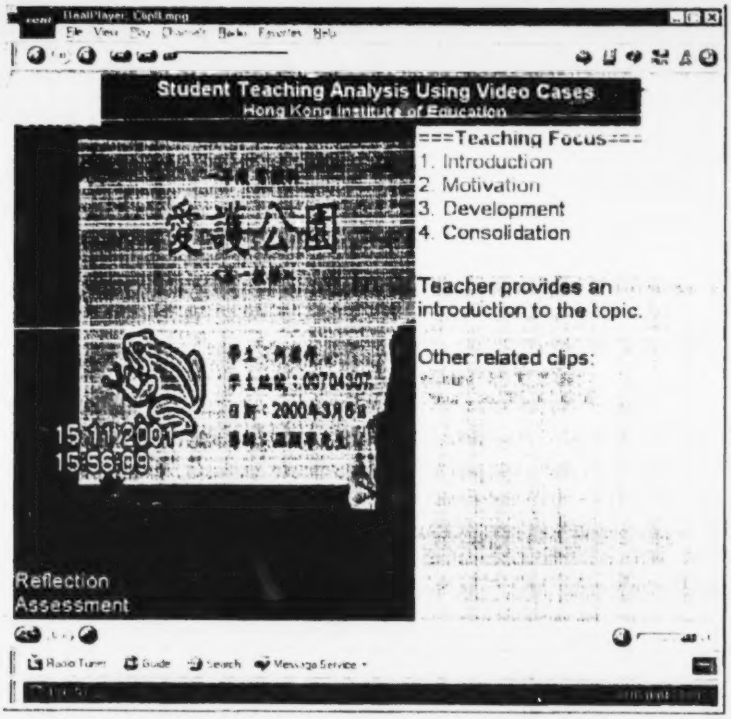

RealPlayer: Clip8.mpg
File View Play Channels Radio Favorites Help
愛護公園
15.11.2001
15:56:09
Reflection
Assessment
Radio Tuner Guide Search Message Service

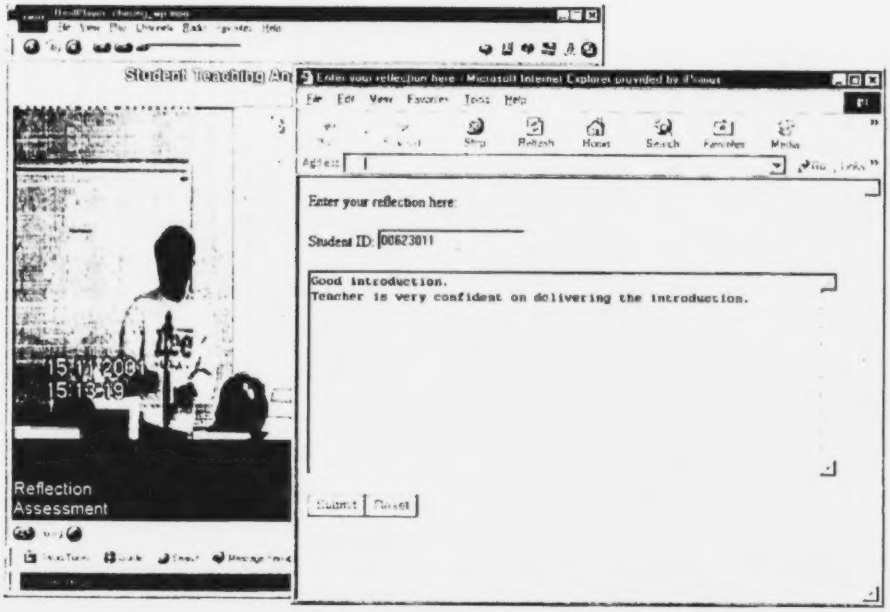
Student Teaching Analysis Using Video Cases
Hong Kong Institute of Education

===Teaching Focus===
1. Introduction
2. Motivation
3. Development
4. Consolidation

Teacher provides an introduction to the topic.

Other related clips:

Figure 3. A Sample Screen shot from Selecting "Chan TS" on Figure 2


Student Teaching An
15.11.2001
15:13:19
Reflection
Assessment
Enter your reflection here - Microsoft Internet Explorer provided by
File Edit View Favorites Tools Help
Stop Refresh Home Search Favorites Media
Address
Go Links

Enter your reflection here:

Student ID: 00623011

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Good introduction.
Teacher is very confident on delivering the introduction.
```

Submit Reset

Figure 4. A Sample Screen shot with Critical Reflection

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Using streaming technology to build the video cases, the advantages of our system are the following:

1. The video cases can be viewed online;
2. We can directly and effectively index into any portion of the video clips in our repository;
3. One can easily control the timeline and important points can be re-visited at ease;
4. We do not need to split and/or merge clips into a single clip for the teaching and learning purpose; and
5. Video stream can retrieve without long delay over the Internet.

Furthermore, by responding to the on-line reflective forum, the student teachers can thoughtfully examine effective teaching principles and practices of each video case. Viewing and critiquing the videos side by side in an on-line setting is the key learning strategy that provides opportunities to develop student teachers' reflective thinking skills and interactive reflections with their classmates. Unlike any class discussions, viewing videos in a detachment setting, student teachers can independently develop their own reflections about a specific teaching skill and then argue with their peers in the web-based discussion forum.

Conclusion and Future Work

The proposed system allows student teachers to reflect on any key events posed in the video cases as well as to link the theory into the practice more coherently. The flexibility of our system is apparent in comparison to the conventional approach of analysing videotapes for teaching practice.

Our future work on this system is to build another "meta" database which can assist us to generate the content of video cases dynamically. By using structured information of the database, we can automatically compose SMIL scripts and related files on-demand.

References

Alesso, H.P. (2000). *E-Video: Producing Internet Video as Broadband Technologies Converge*, Boston: Addison-Wesley.

Risko, V. (1991). Videodisc-based case methodology: A design for enhancing preserve teachers' problem-solving abilities. In B. Hayes & K. Camperell (Eds.), *Developing lifelong readers: Polices, procedures, and programs* (Vol. XI, pp.121-136). Utah State University: American Reading Forum.

Slowinski, M. & Kennedy, T. (2002). *SMIL: Adding Multimedia to the Web*, SAMS Publishing.

Stephens, L., & Leavell, J. (1999). Producing video-cases that enhance instruction. *Journal of Technology and Teacher Education*, 7(4), 291-301.

Williamson, H. (2001). *SMIL for Dummies*, Foster City, CA: IDG Books Worldwide.

Promoting and Diagnosing Collaborative Knowledge Building in Web-based Learning: In Search of the Analytical Unit

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Abstract: This paper describes an ongoing study of the learning quality of online dialogues. It suggests the unit of a language game as suited for a learning perspective, which captures netbased collaborative learning as a process evolving in online communities of practice. The paper suggests some possible modifications to the Global Change course that will allow us to examine in a systematic way the use of an alternative analytical unit.

Introduction

Development of an instructional design that stimulates and supports collaborative dialogue on the Web may require that we start from scratch and create a design that emerges ontologically from a true integration of technology and pedagogy. Design and assessment of learning processes in such an approach should be based on the true premises of the virtual environment (Sorensen 1999). If we think beyond simply creating an online mechanism for dialog to creating a framework that will promote high-quality interaction and allow for relevant evaluation/assessment, we must search for the appropriate analytical unit. In order to do so, we need to start from a clarification of the learning perspective behind the design and construct the analytical unit from this perspective. We present a theoretically based conceptual framework based on the notion of "collaborative learning in online communities of practice" for understanding and identifying collaborative knowledge building dialogue. This includes identification of an alternative analytical and evaluative unit in distributed collaborative knowledge building on the Web, inspired by the concept of "language games". We also discuss implications of this for design learning processes that allow students to collaboratively develop "knowledge tapestries" through meta-awareness of how such language game structure is developed.

Learning Collaboratively in Online Communities of Practice

Our previous pilot study (Sorensen and Takle 2001) focused on analysis of individual comments posted by students in the Global Change course and the influence of setting requirements on higher-level thinking skills in advance of submitting the comment on the web. To examine this issue further, we posed the notion that our previous focus of analysis was misdirected and that we should focus on the *thread* or *collections of threads* rather than the individual comment as the analytical element in evaluating collaborative learning. Acknowledging this shortcoming of our previous attempts revealed that we had inadvertently suppressed the social element of dialog: our over-emphasis on contributions that can be created individually (i.e. without collaboration) was suppressing meaningful interchange among students and suppressing opportunities for true collaboration. The specific learning perspective we want to promote, "collaboration in online communities of practice", is rooted in both the principles of Computer Supported Collaborative Learning (Dillenbourg et al. 1995), and in a social theory of learning taking place in communities of practice (Wenger 1998). We base our search for an analytical unit on these theories. In Wenger's perspective, a social theory of learning must necessarily encompass the elements that denote or characterize social participation as a process of learning. Learning takes place through engagement in actions and interactions in communities of practice. Collaborative learning principles call for the perspective and functioning of group learning, while Wenger's theory points to the learning process as an aspect of the functioning of a community of practice. They both emphasize learning as an individual and a social phenomenon, and they both argue for shared, collaborative and democratic learning efforts, stimulated through participation, engagement, motivation, and ownership.

“Language Games” - An Alternative Unit?

Most attempts to analyze asynchronous electronic discourse seem to lack a theoretical base. The results of such analysis are usual pictorial maps describing the interaction over time. Some have attempted to map *message-interconnection* through analyzing the “threading” to make expose linkages among interactions (Levin et al. 1990; Ellis & McCreary 1985). Such studies demonstrate important aspects of the “threading facility” of most computer-mediated communication systems (CMC), but they fail to go beyond the simple characteristics of message-to-message referencing. Wittgenstein’s (1974) notion of language games offers a holistic, social, and constructive view in which structural coherence forms a key point for establishing any meaningful dialogue. The theory appears suitable for capturing essentially the interactive and dynamic aspects of human communication. One of the attractive features of the language game theory is that it is very general and comprises central aspects and properties of collaborative actions in practice. In the concept of language games, an action must be interpreted in inextricable association with the activity in which it is used. We build up expectations during the course of interaction, which are based on our knowledge of various kind of activities and their rules. Viewing the concept of games in relation to social interaction it becomes clear that a language game is realized as a sequence of actions by participants. This means that in some sense a "player" in the game knows what to do when another player has acted. Actions are subject to specific rules, and the players in the game possess knowledge of rules of the game. Knowledge of the rules is not explicit in the sense of awareness in the players. Describing a sequence of utterances in terms of games is equivalent to assigning it a structure. In particular the linguistic interaction (the dialogue) process can be understood as successive *openings* and *closings* of language games at different levels, where some games, *subgames*, are "embedded" in and controlled by others. Each game opened creates a set of *expectations* about the continuation of the game. The important role of these expectations is that each comment is interpreted according to the expectations. The framework suggested here includes the important elements of dialogue and discourse. It is in agreement with a general theory of social action and comprehension. It supports the view that human interaction can only be interpreted as part of a social context, and that “negotiation of meaning” is not a “defect” of interaction, but is rather constitutive of it, to the extent that specific interactive mechanisms exist that allow mutual understanding to emerge (Dillenbourg et al. 1995, p. 204).

Language Games: Implications for Design

Our previous attempts to establish dialog within the Global Change course created threads that had related ideas but which often lacked substantive interconnections. Students rarely joined together to mutually explore an issue in detail. In some cases there was no evidence that an initiator of a game returned to the game even though it was clearly his/her “turn”. And rarely, if ever, was there any weaving of different threads to form “tapestries of dialog”. Threads of dialog seem to have a natural tendency (perhaps exacerbated by our demands on dialog quantity) to diverge. We seek a solid foundation in learning theory for the development of an instructional design, since paradigms designed for face-to-face learning environments might not apply or might overlook some unique opportunities of the online virtual environment. We have suggested the concept of language games as a basis for considering the issue of closure as well as development of dialog threads. We offer some tentative suggestions that will form the basis for some of our experiments with the next offering of the Global Change course.

References

Dillenbourg, P., Baker, M., Blaye, A., O’Malley, C. (1995) The Evolution of Research on Collaborative Learning. In Reimann, P., Spada, H. (eds.) *Learning in human and machines. Towards an interdisciplinary learning science*, London: Pergamon, pp. 189-211
Ellis, M. L. & McCreary, E. K. (1985): *The Structure of Message Sequences in Computer Conferences: A Comparative Case Study*. In the *Proceedings of the Guelph Symposium on Computer Conferencing and Electronic Messaging* (pp. 2-5). Jan. 1985, Univ. of Guelph. Guelph.
Levin, J. A., Haesun, K., Riel, M. M. (1990): *Analysing Instructional Interactions on Electronic Message Networks*. In Harasim, L. (ed.): *Online Education. Perspectives on a New Environment.* Praeger. New York. 1990, (pp. 204-206).
Sorensen, E. K. (1999): Intellectual Amplification through Reflection and Didactic Change in Distributed Collaborative Learning. In C. M. Hoadley and J. Roschelle (Eds.), *Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference*, pp. 582-589. Palo Alto, CA: Stanford University [Available from Lawrence Erlbaum Associates, Mahwah, NJ]. http://kn.cilt.org/cscl99/A71/A71.HTM
Sorensen, E. K. & Takle, E. S. (2001): Collaborative knowledge building in Wed-based learning: Assessing the quality of the dialog. Presented at the EDMEDIA-2001: World Conference on Educational Multimedia, Hypermedia and Telecommunications. Tampere Finland. 23-30 June 2001. Accepted for publication in the International Journal of Educational Technology (IJET).
Wenger, E. (1998): *Communities of Practice. Learning, Meaning, and Identity.* Cambridge University Press.
Wittgenstein, L. (1974): Philosophical investigations. Oxford: Basil Blackwell.

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Virtual Portfolios for Collaboration in Distributed Web-Based Learning

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Abstract: This paper addresses the problems of collaboration in distributed web-based learning. It reviews, treats and discusses these problems from the learning theoretical perspective of "communities of practice" as presented by Etienne Wenger (1998), with reference to past and future web-based designs. The paper suggests the concept and design of virtual portfolio as a pedagogical tool to be implemented in the virtual environment for the enhancement of distributed collaboration in web-based learning.

Introduction

It is widely accepted that web-based learning environments, on the one hand, offer promising and qualitative potential for distributed CSCL (Computer Supported Collaborative Learning). It is, however, equally shared that they present us with complex challenges in terms of student engagement, interaction, and collaboration. The problems of engagement and interaction in collaborative processes in distributed Web-based learning appear to be recurring phenomena, often stated by the literature (Kaye 1992; Mason 1993; Sorensen 1997; Dirckinck-Holmfeld 1990; Fjuk 1998). It seems to be a stubborn feature in the delivery of distributed CSCL on the web that collaborative initiatives and processes – in their broadest sense – have a hard time coming into existence (Sorensen 1997).

The searching for reasons to these problems and ways of solving them have produced a variety of foci and initiatives, all of which are resting on different assumptions. The role and communicative behavior of the instructor as a unit of analysis has received a considerable amount of attention, based on the assumption that the teacher's behavior in the virtual learning process to a large degree is responsible for a lacking engagement and interaction among students (Davie 1989; Feenberg 1989). Another concern has addressed the nature of the collaborative activities implemented in the learning process, based on the assumption that a main reason for lacking interaction and collaboration most likely were to be found in the way the distributed collaborative tasks and activities were designed (Collis 1996). There is no doubt that both of these research perspectives deal with very pertinent aspects of virtual learning designs and deliveries, but it is equally unlikely that they constitute the whole story, so to speak. What characterizes these perspectives, however, is that both assume the main cause of the problem concerning interaction and collaboration to be situated in the instructional and pedagogical aspects of the learning process. There are alternative studies concerned with the nature and quality of the virtual environment and its ability to support collaboration. One illustration of this is the design of the Virtual-U environment, which can be viewed as a result of design efforts especially directed towards facilitating and scaffolding collaborative interaction in web-based learning (Sorensen 1999). Other perspectives concerned with collaboration, e.g. as a broader concept than linguistic interactions, most often are to be found among software designers, developing shared tools like e.g. shared documents or shared whiteboards to facilitate "tangible" (non-verbal) collaborative (inter)actions in web-based learning.

Discussions around collaborative learning designs often mirror the latent perspective that collaborative learning is more or less synonymous to collaborative (linguistic) interactions. Only few studies seem to address, both the linguistic interaction and the non-linguistic collaboration among students as two sides of the same coin. This paper argues that linguistic interaction and the more tangible carrying-out part of the interaction cannot be separated from each other. We must build shared communities of practice, shared frameworks, and shared histories in order to support distributed CSCL.

This paper presents the hypothesis, that implementing a shared virtual (group) portfolio, in which linguistic and non-linguistic collaboration among students are combined and situated in time and space, will support student engagement, interaction and collaboration and, thus, enhance genuine collaborative learning (Wenger 1998; Salomon 1995; Sorensen 1999). Structures and frames for managing shared experiences and shared histories must be built into a virtual learning environment if engagement, sharedness and collaboration in learning are to flourish and unfold. The implemented virtual portfolio structures from two web-based courses constitute the investigated data. In one of the courses attempts were made to provide structures to support especially the linguistic interactive part of the group collaboration and engagement. In the other course, it was the non-verbal part of the group collaboration that received the structural support. Section 2 of the paper briefly introduces the special conditions of a web-based learning process using some central concepts from the theoretical perspective of "Communities of Practice. Learning, Meaning, and Identity" (Wenger 1998). Section 3 provides a review of potentials of using the virtual portfolio concept. While section 4 provides a discussion of two different types of virtual portfolio (VP) for collaboration, section 5 forms the forum for our conclusions and future perspectives.

Distributed CSCL as Virtual Communities of Practice

Collaborative learning between students is widely recognized as a fruitful way of learning. It is through collaboration that negotiation of perspectives between peers takes place, a process through which students reconsider and reflect on the perspectives of their fellow students and accommodate those to their own knowledge and beliefs (Fjuk & Dirckinck-Holmfeld 1997). Collaboration in learning creates a positive commitment that motivates participation and drives the learning process (Illeris 1981). But collaboration is not something that can easily be implemented in a learning situation. As argued by Salomon, collaborative learning demands that the whole learning environment being designed as an orchestrated whole (Salomon 1995), meaning that all the entities and processes in the learning environment (including curriculum, activities, and roles) must be taken into account. Salomon argues that the design of the technology itself is the least important factor in facilitation of distributed CSCL and that computers alone are not likely to produce a genuine interdependency that creates need for sharing, for joint endeavor and for a pooling together of minds (Salomon 1995).

In principle, we share Salomon's view. Nonetheless, one should not eliminate the role of technology, especially in the context of distributed CSCL, as there are reasons to assume that the less people meet face to face, the more dependent they become of computer tools and their quality in order to succeed in collaboration. The establishment of interdependency between peers, which (according to Salomon) is a fundament for collaboration, is also dependent on the availability of appropriate tools. Virtual collaboration gets established through technological tools allowing minds to focus on the same problem. This means that the medium, on the one hand, enables a group of people to communicate, and on the one hand, allows them to carry out non-verbal collaborative actions and produce shared reifications during their collaborative work process. These tools are important for collaboration in general, but for distributed CSCL they are essential.

The design of these tools demands an understanding of how people learn in social contexts. For that purpose we turn to Etienne Wenger and his concept of "communities of practice" in which he conceptualizes a social theory of learning (Wenger 1998). According to Wenger the core of social learning is the continuous negotiation of meaning between participants in a practice. This negotiation process is an inseparable part of practice. If there is no negotiation of meaning, there is no practice to be part of. The negotiation of meaning is an intricate process. It is not limited to linguistic behavior. It also includes our social non-verbal interactions and relations. Wenger explains the negotiation of meaning as involving two constituent processes: *participation* and *reification*. These two processes exist in duality, affecting each other and being the source of development to each other:

> I will use the term participation to describe the social experience of living in the world in terms of membership in social communities and active involvement in social enterprises. Participation in this sense is both personal and social. It is a complex process that combines doing, talking, thinking, feeling, and belonging. It involves our whole person including our bodies, minds emotions, and social relations (Wenger, 1998, p. 56)

> Reification ... refers to the process of giving form to our experience by producing objects that congeal this experience into "thingness" ...Reification can refer to both to a process and its product (Wenger, 1998, p. 58)

But since production of meaning is distributed across reification and participation, a dynamic relationship between the two must be established in our design and facilitation of learning. If not, the negotiation and construction of meaning may become problematic.

> If participation prevails – if most of what matters is left unreified then there may not be enough material to anchor the specificities of coordination and to uncover diverging assumptions.(...) If reification prevails – if everything is reified, but with little opportunity for shared experience and interactive negotiation – then there may not be enough overlap in participation to recover a coordinated, relevant, or generative meaning (Wenger, 1998, p. 65)

In a community of practice the reificative and participatory aspects form what Wenger denotes as a *shared repertoire*. A shared repertoire is the fundamental resource for negotiating of meaning in a community. It is a product of a community of practice over time, including routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions or concepts that the community has produced or adopted in the course of its existence, and which have become part of its practice. Viewing CSCL as a virtual *community of practice*, a challenge for design is to apply technological tools that constitute a *shared repertoire*. The shared repertoire (the duality between participation and reification) is open and directly available for negotiation in face-to-face learning communities. But in a distributed, symbolic, asynchronous virtuality, which is fundamentally established through technology, the processes of both participation and reification must be built into the technological tools.

In our view, the lack of shared repertoire is one of the most serious shortcomings of most CSCL-environments. Later in this paper we suggest the virtual portfolio as a promising concept for visualizing the shared repertoire. The virtual portfolio is interesting and valuable because it makes explicit, both the negotiation (i.e. the participatory aspects) and reification of meaning.

Virtual portfolios – Up Until Now

Portfolio has become a popular educational tool. It is being used in courses reaching from basic to higher education (Niguidula 1993; Leeman 1997/98), and it has been adopted as a tool for professional development and lifelong learning (Tenhula 1996). Historically, the portfolio concept has developed from artistic professions (e.g. architects, designers, models, etc.). In artistic contexts portfolios are used as collectors of the products of the artists. Likewise, a student portfolio is a purposeful collection of samples documenting the work of a student, exhibiting quality and progress.

From a pedagogical point of view there are two basic reasons for using portfolios (Arter 1995). It is a powerful tool for assessment, and it is a supporting tool for structuring and giving momentum to the learning trajectory. In any case, both of these aspects are meaningless to separate, since they appear to be two sides of the same coin. Our motivation for using virtual portfolios (VP's) in design of distributed CSCL is their potential for structuring the learning trajectory in a way that highlights learning as a constructivist, experiential, reflective and social matter. As the concept of VP is a very open concept, many of the constructivist approaches and netbased learning environments are included. VPs provide useful frameworks for discussing and designing student centered learning environments on the net.

Advantages of using virtual portfolios

From the presented perspective of learning as a phenomenon, taking place socially through negotiation of meaning between participants in communities of practice, VP's represent the following attractive potential for supporting learning:

- VP is activity oriented, as activities aiming at fulfilling learning goals may be implemented
- VP may support student-centeredness, if the VP is owned and controlled by the student
- The student may be involved in the assessment process, as the VP supports self-reflection as a learning activity. By letting students assess their own progress, students become shareholders of their own destiny, so to speak (Sorensen & Takle 1999)
- Assessment can be based on samples demonstrating authentic work focusing on the student as a problem solver
- By focusing at different entities during a time period, VP's make it possible to observe individual student progression (Sorensen & Takle 1999)
- VP's are artifacts especially suited for reification of meaning. They provide the learner with a "picture" of the accumulated experiences and process of development. Meaning is created, reified through visualization, and laid open for individual and collaborative reflection
- VP's provide views and structure to the future learning process by prescribing activities ahead. It can visualize participation as history but also as future events. Structuring within course parts helps to maintain a more detailed, structured overview of course elements and supports the cognitive processes of perception,

categorization, classification, recognition, and integration of details of a theme or phenomenon into a whole (Sorensen 1996).

Nevertheless, implementing VP's do not automatically guaranty successful learning. As default, a VP provides a structure of a process over time, but the quality of the VP for supporting collaborative learning in online communities of practice is entirely dependent on the pedagogical perspective and techniques that get implemented in the VP (Sorensen & Takle 2001).

Disadvantages of using virtual portfolio

VP's also have some fundamental limitations:

- VP's are, traditionally viewed, individual tools. The focus is on the individual learner as a constructor of knowledge. One may argue that publishing a virtual portfolio on the Web will enhance collaboration, but it does not happen automatically that sharing of knowledge provides collaboration. If we want VP owners to get engaged in each other's work, we must design for that to be a VP activity.
- There is only aminor distance from supporting to controlling the learner. VP's contain the potential of being tools for control and surveillance. VP's may be used for controlling what the student should learn, and how he should learn. An instrumental pedagogical approach may be implemented in which the VP activities are shaped as tasks with predefined answers, instead of problems to be solved. Viewed from such a perspective, there is some risk that the portfolio may be a tool for reproduction of knowledge, instead of a tool for supporting democratic learning, marked by ownership, personal engagement and lack of authoritative power mechanisms.

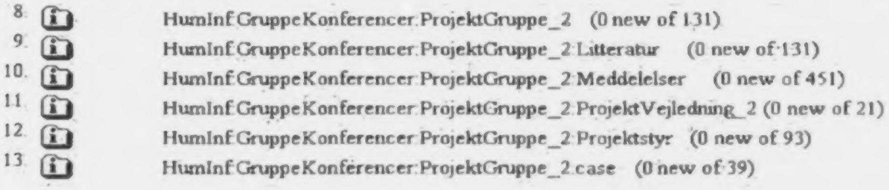
Two Different Types of Virtual Portfolio for Collaboration

In order to illustrate the relation between participation and reification and their significance in design of a virtual community, which supports collaboration, we present two different implementations of VP's, both inspired by the portfolio idea. The first example is an implementation that strongly supports participation, but support for reification of meaning is limited by the environment. The second example is designed with reification as the primary goal. In this case, students are using portfolios for constructing their individual curriculum, but not seeking participation and knowledge construction in a social practice.

Participation but limited reification

The first example of a VP is provided by a one-year distance education course on how to employ ICT in learning, offered at Aalborg University in Denmark. The course was delivered mainly as distributed CSCL and attracted 36 participants from all over Denmark. The main part of the course was carried out over the Web, using the virtual learning environment, Virtual-U. An additional four face-to-face seminars were held during this one-year period. Project-based group work constituted the main activity of the course. The supervision of the project work took place, both at the face-to-face seminars, but mainly asynchronously in the Virtual-U environment. Inthe problem-based project work, the students specialized in a particular area within the main subject. They departed from a research problem that they themselves identified and formulated, a problem that was related to their concrete daily work and work interests. The problem of their project work was elucidated through study of relevant literature and different types of data collection within the problem area.

The students were provided with a communicative forum as the collaborative space for their project work. No other structuring "environmental" facilities were offered. As argued above, a virtual environment is not necessarily a rich environment, and in order to get more overview and meaning out of their dialog the students were encouraged to create sub-conferences as their need arose(Fig. 1).



8. HumInf:GruppeKonferencer:ProjektGruppe_2 (0 new of 131)
9. HumInf:GruppeKonferencer:ProjektGruppe_2:Litteratur (0 new of 131)
10. HumInf:GruppeKonferencer:ProjektGruppe_2:Meddelelser (0 new of 451)
11. HumInf:GruppeKonferencer:ProjektGruppe_2:ProjektVejledning_2 (0 new of 21)
12. HumInf:GruppeKonferencer:ProjektGruppe_2:Projektstyr (0 new of 93)
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Figure 1: The VP structured by means of conferences (were used)

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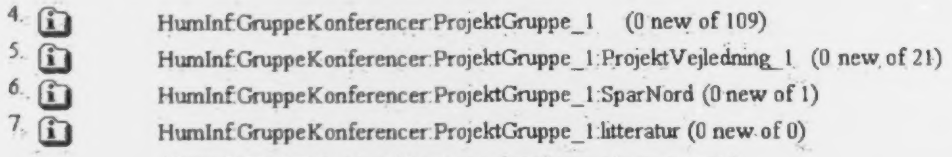
Although the names in figure 1 are all in Danish, it is clear that project group 2 created five sub-conferences: one for literature, one for announcements, one for project guidance, one for project steering, and one for discussing cases. Sub-conferencing may be attractive for structuring the dialog. But it is not an ideal resource for reifying a meaning, which is not obvious to everyone.

In fact, several project groups demonstrated severe difficulties in using sub conferences for both participation and reification. E.g. the example below (Fig. 2) mirrors the collaboration of project group 1. They created several sub conferences, but they never used them.



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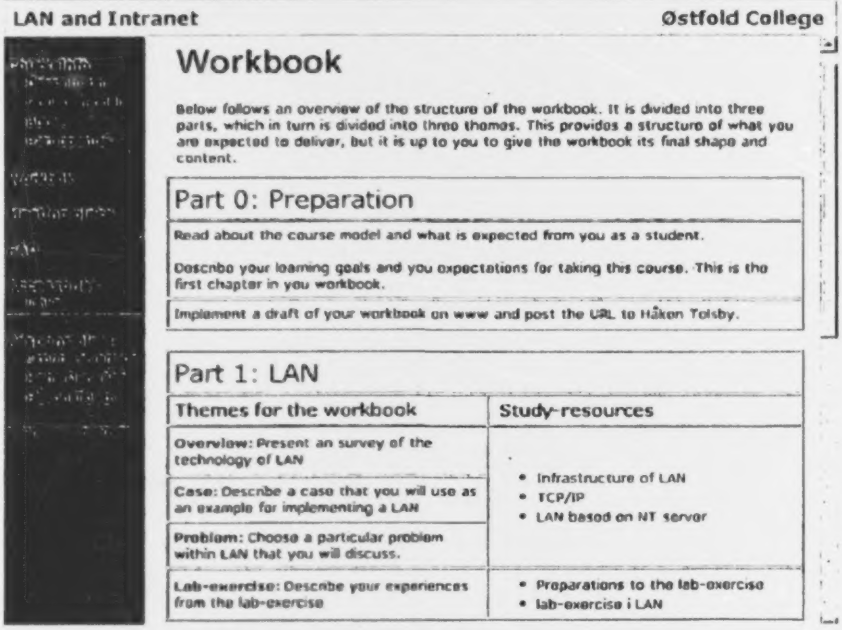
5. ⓘ HumInf:GruppeKonferencer:ProjektGruppe_1:ProjektVejledning_1 (0 new of 21)
6. ⓘ HumInf:GruppeKonferencer:ProjektGruppe_1:SparNord (0 new of 1)
7. ⓘ HumInf:GruppeKonferencer:ProjektGruppe_1:litteratur (0 new of 0)

Figure 2: The VP structured by means of conferences (were not used)

Many virtual learning environments reify meaning, but mainly as sequences of written text adapted to a dialogical structure. A virtual conference may mirror the negotiation process chronologically or sorted by several criteria as e.g. date, participants, thread, etc. But, as argued by Wenger (1998), although linguistic interaction is essential, it is only one of several aspects in the negotiating meaning. In principle, virtual learning environments have provided limited functionality and support for genuine group collaboration in terms of reification. In general, they provide good support for the involved participatory processes, but not necessarily for the reificative part of the learning process.

Reification but limited participation

The second example stems from a course in computer science from Ostfold University College in Norway. The subject was LAN (Local Area Network) and Intranet. I was an open and flexible course, which was attended by both local and remote students, in total 120 participants. The course was carried out without ordinary lectures, but was organized around the structure provided by the student VP. In the course the metaphor of a workbook was used (instead of the term "VP"), as we wanted to use the metaphor to indicate the expected work style (a book is supposed to be thoroughly prepared).



LAN and Intranet **Østfold College**

Workbook

Below follows an overview of the structure of the workbook. It is divided into three parts, which in turn is divided into three themes. This provides a structure of what you are expected to deliver, but it is up to you to give the workbook its final shape and content.

Part 0: Preparation

Read about the course model and what is expected from you as a student.

Describe your learning goals and you expectations for taking this course. This is the first chapter in you workbook.

Implement a draft of your workbook on www and post the URL to Håkon Tolsby.

Part 1: LAN

Themes for the workbook	Study-resources
Overview: Present an survey of the technology of LAN	• Infrastructure of LAN • TCP/IP • LAN based on NT server
Case: Describe a case that you will use as an example for implementing a LAN	
Problem: Choose a particular problem within LAN that you will discuss.	
Lab-exercise: Describe your experiences from the lab-exercise	• Preparations to the lab-exercise • lab-exercise i LAN

Figure 3: The VP structured as a workbook

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The workbook was divided into four chapters, one preliminary and three main chapters covering different aspects of the subject matter. In the preliminary chapter, the student was supposed to describe his/her learning goals and motives for attending this course. The three main chapters covered important aspects of the subject mater. Each of them consisted of a set of themes, which structured the work of the student. Our experience from the course was that the workbook motivated the students to work in an experiential manner (Kolb 1983). They used the workbook as an artifact where they reified their understanding. They were continuously returning to the workbook as they got more insight and elaborated on the problems, and they created workbooks based on personal experiences and interests. They also browsed each other's workbook. They compared their own workbook with others. They borrowed ideas from each other, but they did not become engaged in each other projects. There were no real interaction or social participation. They were sharing experiences, but they were not contributing to a shared knowledge building experience. There were no common goals for sharing, no joint enterprises, no mutual engagements. In other words, there was no construction of a community of practice.

Conclusion and Future Perspectives

In this paper we have argued for the need of tools, such as VP's, to support the processes of both reification and participation in the negotiation of meaning in distributed CSCL. This, however, appears not to be a simple task.

> Participation and reification must be in such proportion and relation as to compensate for their respective shortcomings. When too much reliance is placed on one at the expenses of the other, the continuity of meaning is likely to become problematic in practice (Wenger 1998, p. 65)

Although VP has been developed as an individual tool for learning, we envision that the concept can be expanded to comprise also the idea of a "shared VP" (i.e. for a group). A shared experience consists of both individual and collaborative contributions, and by collecting them and making them visible and accessible for the community of the group, a *shared repertoire* for collaboration may be established. The shared VP includes collaborative constructions and collaborative reflections. A shared VP should not be viewed as a substitute for the individual VP. On the contrary, a shared portfolio is dependent on the personal engagement that the individual portfolio provides. You cannot share and you cannot collaborate without having something to contribute – and without reflecting on what you contribute. And in a digital environment you are not equipped for collaboration without a set of digital resources that can present your knowledge and experience. However individual portfolios have limited value to a learning community if they are not shared and used for collective reflection and development.

References

Arter, Judith (1995): Portfolios for Assessment and Instruction, ERIC Digest, http://www.ed.gov/databases/ERIC_Digests/ed388890.html

Collis, B. (1996): *Tele-learning in a Digital World*. International Thomson Computer Press. 1996.

Dirckinck-Holmfeld, L. (1990): Kommunikation på trods og på tværs. Projektpædagogik og datamatkonferencer i fjernundervisning. PICNIC-NYT, No. 9, Alborg University. Aalborg. 1990.

Fjuk A. & Dirckinck-Holmfeld, L. (1997): Sammenføyningsarbeid i distribuerte kollektive læreprocesser. In: Danielsen (ed.): Læring og Multimedier. Aalborg Universitetsforlag. 1997.

Feenberg, A. (1989): The Written World. In Mason, R. & Kaye, A. R. (eds.): *Mindweave. Communication, Computers, and Distance Education*. Pergamon Press. Oxford. 1989. (22-40).

Kaye, A. R. (1992): Learning Together Apart. In Kaye, A. R. (ed.): *Collaborative Learning Through Computer Conferencing*. NATO ASI Series, vol. 90. Springer-Verlag, 1992. (pp. 1-24)

Kolb, D. A. (1983): Experiential Learning: Experience as the Source of Learning and Development, Prentice Hall; ISBN: 0-132-952-610.

Illeris K. (1981): Modkvalifiseringens pædagogik – problemorientering. Deltagerstyring og eksemplarisk indlæring. Unge Pædagoger. ISBN 87-87400-44-8.

Leeman-Conley, Marsha (1997): An Electronic Portfolio for an MBA program for Working Professionals. International Conference on Innovation in Higher Education. Kobe-Japan.

Leeman-Conley, Marsha (1998): Electronic Portfolio in Higher Education: Their Value for Faculty, Students and Employees, The International Conference on Innovation in Higher Education, Los Angeles.

Mason, R. D. (ed.) (1993): *Computer Conferencing. The Last Word*. Victoria. Beach Holme Publishers.

Niguidula David (1993): The Digital Portfolio. A Richer Picture of Student Performance. Coalition of Essential Schools. Http://www.essentialschools.org.

Salomon, G. (1995): What Does the Design of Effective CSCL Require and How Do We Study Its Effects? In Schnase, J. L., Cunnius, E. L. (eds.): CSCL 95. Computer Support for Collaborative Learning, pp. 147-156. Lawrence Erlbaum Associates Inc., Mahwah, NJ.

Sorensen. E. K. (1997): *Learning in Virtual Contexts. Navigation, Interaction, and Collaboration*. Ph.d.-afhandling. Aalborg University. Danmark. 1997

Sorensen, E. K. & Takle, E. S. (1999): Distributed Collaborative Learning across Disciplines and National Borders. In C. M. Hoadley and J. Roschelle (Eds.), Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference (pp. 575-581). Palo Alto, CA: Stanford University [Available from Lawrence Erlbaum Associates, Mahwah, NJ]. http://kn.cilt.org/cscl99/A70/A70.HTM

Tenhula T. (1996): Improving Academic Teaching Practices by Using Teacher Portfolio – The Finnish Way to Do It. ICED Conference.

Wenger E. (1998): Communities of practice. Cambridge university press 1998, ISBN: 0521430178

Adaptive Learning Environment in WINDS

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Abstract: This paper describes a new methodological approach to design education on the web employed in the system called ALE. The system will be used to build a large knowledge base supporting Architecture and Civil Engineering Design Courses and to experiment a comprehensive Virtual University of Architecture and Engineering Design. The ALE system integrates the functionality of a complex e-Learning system with adaptive educational hypermedia on the Web. In this paper we outline the system architecture and focus on the design and functionality of its adaptive learning environment.

Introduction

WINDS (WINDS 2002) is an ongoing European project with the objective to implement an e-Learning environment called ALE integrating an intelligent tutoring system, a computer instruction management system and a set of cooperative tools. We have developed the current version of the system and our project partners from universities prepare more than 20 on-line courses that should be used by students from autumn 2002.

Today there are relatively many web based educational systems (e.g. Hyperwave eLearning Suite) including commercial ones available for teachers and students. On the other hand several tools for developing adaptive courseware (e.g. InterBook) exist, mainly as academic developments. But it is not easy to find a solution that would integrate the functionality of a complex e-Learning system with adaptive educational hypermedia on the Web. And this is the objective we try to address developing the ALE system.

For reaching our goals we have taken into account several of the existing standards and semi standards on learning objects, learner models and their storage and exchange (LOM 2001, AICC 2001). We build on our experience with development of adaptive hypermedia environments like ISIS-Tutor (Brusilovsky & Pesin 1994), ELM-ART (ELM-ART 1998), and ACE (Specht & Oppermann 1998).

The ALE system produces individualized courseware for students depending on their current state of knowledge, their preferences and learning styles. The author specifies the metadata according to which such adaptation methods like additional explanation, prerequisite explanation, comparative explanation, explanation variants or sorting can be implemented, taking into account the user model. In this way, the system can adapt the sequence of content blocks according to the chosen learning strategy. For instance, a concrete example can precede or complement an abstract statement if the student needs it. To reduce the cognitive overload of the learners various annotation techniques are implemented.

ALE is designed to support various learning strategies and their combinations. Paragraphs contain materials for expository (explanatory) education. Discovery learning is encouraged not only by hyperlinks but also by index terms and their interconnection with learning objects and external documents. Collaboration facilities promote constructivistic learning approaches.

This paper describes the ALE integrated environment. First we introduce the basic modules of the system. The main focus is on the adaptive learning environment, especially its domain model, user model, learning object states, annotation techniques, as well as the interconnection with the course index and external documents. Finally we summarize the paper and outline future perspectives.

ALE Modules

A user of the ALE system can have one or more of the following three roles assigned:

- Student
- Tutor
- Author
- Administrator

Each role has access to one special environment – *Learning, Tutoring, Authoring* and *Administration*. Additionally each user can access *Workspace, Tools, News* and *Help*.

The learners are not only passive receivers of knowledge but can themselves contribute to the corpus writing private or public annotations, providing feedback to the author, or discussing course related issues with colleagues and tutors in a discussion forum. In this way students can answer some questions themselves and can cultivate their ability to formulate problems and give argumentations.

The main tools provided by the system for collaboration purposes are:

- *Workspace* based on the BSCW system (Bentley et al. 1997) to store and exchange documents, support common projects and submit homework.
- *Discussion forums* created by authors for each course.
- *Annotation facilities* to add private or public notes to study materials.
- *Chat facilities* (external) for synchronous communication.

An important feature of the system is the awareness support - the user can see which other students have registered for a certain course and who is currently working in it. The underlying principle is that the system presents all collaboration tools in a thematic context of the current learning unit or index term, i.e. the students and tutors can start a discussion about a single picture or a paragraph in a course and create a cooperation folder in the shared workspace for solving a special exercise.

Students can be assessed when they solve tests and exercises. Tests are evaluated immediately and automatically. Various types of tests like single- and multiple-choice, gap fillings and matching pairs are provided and some others are planned.

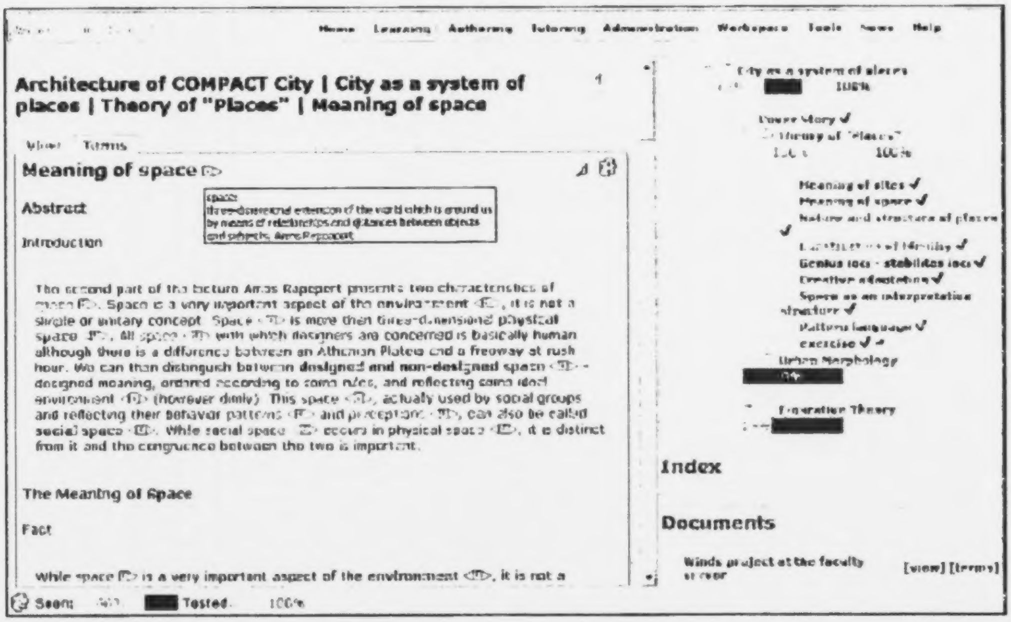
More complicated exercises (e.g. design tasks or Bayesian network exercises) are carried out with special external tools, which should be installed locally on the student's computer or downloaded as an applet. The result should be submitted as homework to the student's folder. Additionally the system provides interface for external learning components to send messages to the learner model to synchronize external and internal learning support by a consistent learner model. These interfaces can be used to request information about a single learner and statistics about the class progress in a course and to submit information about users from peer reviewing procedures or tutor reviewing forms or automatic exercise evaluations.

The types of learning objects in ALE as well as detailed descriptions of the authoring environment can be found in (Specht 2001a, Specht 2001b). Functionality of the learning environment is described in (Specht 2002a, Specht 2002b).

Adaptive Learning Environment

The ALE learning environment (Fig. 1) is both *adaptive* and *adaptable* (Brusilovsky & Maybury 2002). It means the system can automatically adapt to the user given a user model and the user can influence the adaptation by means of the preferences. The user can always enter a configuration dialogue to specify such parameters like the preferred language, learning style (access to related questionnaires is provided), and media type. Based on this information the system selects the appropriate learning environment components and a suitable way of presentation. To support mobile users we plan to enhance the system to take into account additional parameters like computing platform, bandwidth, location, and time to specify the context of the user's work.

Adaptation of the content presented to a particular user depends on the *domain model* and the *user model* (Kobsa 2001). Students can be clustered mainly according to their learning styles to provide certain types of learning objects with higher priority.


Home
Learning
Authoring
Tutoring
Administration
Workspace
Tools
News
Help
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Tested
100%
City as a system of places
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Meaning of sites ✓
Meaning of space ✓
Genius loci - stabilitas loci ✓
Urban Morphology
Index
Documents
[view] [terms]

Architecture of COMPACT City | City as a system of places | Theory of "Places" | Meaning of space

Meaning of space

Abstract

Introduction

The Meaning of Space

Fact

While space is a very important aspect of the environment, it is not a

Figure 1: ALE displaying a learning element with highlighted index terms and the first of them explained.

The learning environment in ALE consists of the following parts (Fig. 1):

- Learning object display
- Annotated course structure
- Index terms
- External documents
- Student's progress

Domain Model

The domain model includes the learning objects, their metadata, and relations between them. The learning objects in ALE are designed to support reusability and flexibility in production of individualized courseware. The following basic types of learning objects are provided: course units, learning units, learning elements (paragraphs, tests), and index terms.

All the learning objects can be associated with a subset of the Learning Object Metadata defined in the IEEE LOM specification (LOM 2001). The course authors can also specify basic relations between learning objects based on a subset of the Dublin core recommendations (DCMI 2001). These will include prerequisite relations, relations between course units, learning units, and learning elements. Additionally all ALE learning objects in a course unit will be linked dynamically by the underlying index defined by the course authors. Each learning element has its own didactical goal and the authors can select from a set of pre-defined templates according to the Cisco strategy for reusable learning objects (Cisco 2000).

User Model

The system records all the user's educational events, called *user episodes*. These episodes include events of different types:

- Student actions
- System evaluation (tests)

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- Tutor evaluation (homework)
- Student evaluation (self assessment)

Based on the episodes the user model is constructed. It includes the user *preferences* and the user *knowledge* that can be assumed (seen learning objects) and verified (by the system, tutor, or student). Concerning the verified knowledge the last record is valid, but the user (student or tutor) can specify the priorities of the resources for knowledge assessment. Additionally the user model contains also the user *goals* specified either as learning objects or index terms. Later on as we adjust the application for mobile users the *context* model will be added too.

The user model always reflects the current state of the user's progress. The information is available both for the tutor to control the student's study process and for the system to adapt the course presentation and navigation for the student. Recommendations are generated according to the user's learning style and previous behaviour of similar users but only if they were successful.

The states of the learning objects in ALE can be considered from several points of view or in several dimensions. The system distinguishes three of them that are relatively independent: *user's readiness*, *interaction history*, and *tested knowledge*. Additionally some other characteristics can be defined depending on the followed objectives, e.g. current task or context. Interaction history and tested knowledge can be expressed by quantitative information defining the extent of the seen learning object or the tested knowledge, user's readiness is nominal information and depends on the prerequisites specified by the author and on the interaction history of the user.

Interaction History

Depending on the history of the user interaction with the system a *learning object* can be *seen*, *partially seen*, or *not seen*.

A *learning element* is *not seen* if it has not been accessed yet. If the element has been accessed it is considered as *seen*.

A *learning unit* is *not seen* if the unit has not been accessed yet. It means none of the learning elements under this unit has been seen. A unit is *seen* if all the learning elements recursively contained in this unit are seen. A unit can be also *partially seen*, where the ratio of the seen part can be specified as SLE/LE, where SLE stands for the number of the seen learning elements and LE means the number of all the contained learning elements in the learning unit. In both cases the considered learning elements are not just directly but also recursively contained in the learning unit. The student can see both numbers to have a clue about the size and state of the learning unit.

Thus this state of a learning object can be generally characterized by quantitative information. It is the most general information about the learning object that should be always applicable.

Tested Knowledge

A student can check his or her knowledge by means of special learning objects called *tests*. Each test checks the student's knowledge that can be related to one or more learning objects specified by the author of the test (currently each test item can be associated with one or no learning object – learning element or learning unit).

Generally the student's knowledge of a learning object (learning unit, learning element – paragraph or test) can be expressed by quantitative information. This state of learning objects is applicable only if the author provides corresponding tests.

User's Readiness

If the author has specified the *learning object prerequisites* the system can distinguish the learning objects for which the student is *ready* from those for which the student is *not ready* according to the interaction history or alternatively tested knowledge.

It is nominal information that defines this state of the learning object.

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Adaptive Techniques

To represent various states or dimensions of an information space various visual emphasis techniques can be used. Some studies (Bertin 1967/1999) of visual perception recommend the following visual attributes for different kind of information:

- Nominal information: texture, color (hue), position
- Quantitative information: length, position

Adaptive navigation support techniques are employed to display the annotated course structure in ALE. The different states of learning objects are represented by adaptive link annotations using icons and alternative texts. Another solution we use illustrates the level of the interaction history for a learning object by color (hue) and the tested knowledge by text size. It can be considered as *adaptive text presentation* based on dimming. Beside the selection of preferences of students we give the authors and the tutors of a course the possibility to adapt the applied annotation techniques depending on the target group and user features. Tutors can specify that the course annotation and navigational guidance should be more restrictive for novice users (hiding advanced materials with missing prerequisites) and less restrictive for advanced users. This is based on empirical findings and post-hoc studies preformed by (Specht & Kobsa 1999).

Course Index

With each learning object corresponding index terms are displayed. Index terms provide means to interrelate heterogeneous course contents and to find individualised paths through the learning materials. The ALE course index component maintains the index terms together with their respective descriptions, synonyms, different types of relations (e.g. *is_a*, *part_of*, *related_to*, *is_similar_to*) between terms, their occurrences in the course materials as well as in external documents. The student can access all the information about a specific term by choosing it in the *Index* frame.

The index component can retrieve and highlight occurrences of index terms within the course materials as well as within registered external documents. We consider it as a step towards open corpus adaptive hypermedia (Brusilovsky 2001) that is a modern trend in the field.

External Documents

External documents relevant to the course domain explain in more detail some specific issues or provide up-to-date information like specialized portals do. Such external documents serve also as resources for homework and projects. These materials can go into more details than the course or give alternative views of the domain. In the *Documents* frame the student can choose an external document related to the current learning object and view this document either with or without emphasized index terms.

Conclusions and Further Research

In this paper we gave an overview of the current state of the ALE system, especially its adaptive learning environment. It presents learning objects as adaptive educational hypermedia courseware. One of the primary objectives of the ALE system is to make the authoring process relatively simple and to support sharing of resources. Currently several tens of authors test the usability of the system and their comments and suggestions help us to make the system more advanced and reliable. The experience shows that creating study materials of high quality with proper metadata, relationships, index, and library is a very complex process even for teams of skilled authors.

But the potential of the system is high. The created learning objects can be delivered in a variety of ways, from classical web-based training to combinations of classroom events and online seminars, or even as personalized books. Beside the possibility for cross media publishing and the flexible combination of learning objects in individualized curricula the indexing system and the connection of the learning objects allows for personalized coaching of students.

References

AICC (2001). Aviation Industry CBT Committee, AICC Guidelines & Recommendations for CMI, http://www.aicc.org/pages/down-docs-index.htm.

Bentley, R., Appelt, W., Busbach, U., Hinrichs, E., Kerr, D., Sikkel, K., Trevor, J. & Woetzel, G. (1997). Basic support for cooperative work on the World Wide Web, *Int. J. Human-Computer Studies*, 827-846.

Bertin, J. (1967/1999). *Semiologie Graphique*, Paris: Editions de l'Ecole des Hautes Etudes en Sciences (Les reimpressions).

Brusilovsky, P. & Pesin, L. (1994). An intelligent learning environment for CDS/ISIS users, *Proceedings of the Interdisciplinary Workshop on Complex Learning in Computer Environments (CLCE 94)*, University of Joensuu, Finland, http://cs.joensuu.fi/~mtuki/www_clce.270296/Brusilov.html.

Brusilovsky, P., (2001). Adaptive Hypermedia, *User Modeling and User-Adapted Interaction*, 11, 87-110.

Brusilovsky, P., & Maybury, M.T., (2002). From adaptive hypermedia to the adaptive web, *Communication of the ACM*, 45 (5), 30-33.

Cisco (2000). Cisco Systems, Inc. Reusable Learning Object Strategy, Version 3.1, http://www.cisco.com/warp/public/- 10/wwtraining/elearning/learn/whitepaper_docs/rlo_strategy_v3-1.pdf.

DCMI (2001). Dublin Core Metadata Initiative Documents, http://dublincore.org/documents.

ELM-ART (1998). ELM-ART project, http://www.psychologie.uni-trier.de:8000/projects/ELM/elmart.html.

Kobsa, A. (2001). Generic User Modeling Systems, *User Modeling and User-Adapted Interaction*, 11, 49-63.

LOM (2001). LTSC IEEE, Draft Standard for Learning Object Metadata, IEEE P1484.12/ D6.1.

Specht, M., & Oppermann, R. (1998). ACE, Adaptive courseware environment, *New Review of Hypermedia and Multimedia*, 4, 141-161.

Specht, M., & Kobsa, A. (1999). Interaction of domain expertise and interface design in adaptive educational hypermedia, *Proceedings of Workshop on adaptive hypermedia* held on UM99 and WWW99 conference.

Specht, M., Kravcik, M., Pesin, L., & Klemke R. (2001a). Integrated Authoring Environment for Web Based Courses in WINDS, *Proceedings of ICL 2001 Workshop*, Villach, Austria.

Specht, M., Kravcik, M., Pesin, L., & Klemke R. (2001b). Authoring Adaptive Educational Hypermedia in WINDS, *Proceedings of ABIS 2001 Workshop*, Dortmund, Germany.

Specht, M., Kravcik, M., Pesin, L., & Klemke R. (2002a). Personalized Distance Learning in WINDS, *Proceedings of Networked Learning Conference (NL2002)*, Berlin, Germany.

Specht, M., Kravcik, M., Pesin, L., Klemke R. & Hüttenhain, R. (2002b). Adaptive Learning Environment for Teaching and Learning in WINDS, *Proceedings of Adaptive Hypermedia Conference (AH2002)*, Malaga, Spain.

WINDS (2002). WINDS project, http://www.winds-university.org

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Statewide Collaborative Web Resources for Faculty Supporting Information Literacy

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Abstract: Librarians and faculty working together through Utah's Academic Library Consortium (UALC) are developing a Web site to share library instruction and information literacy competency support materials statewide. These materials include handouts, guides, tutorials, interactive exercises, glossaries, lists of Web links, and assessment instruments. Through Web based sharing, each institution saves a great deal of time and effort by reducing the need for duplication of resources and increasing the quality of resources.

Background:

The Utah Academic Library Consortium was established in 1973 and has developed many cooperative programs for collection development and resource sharing. UALC includes 14 academic libraries at 11 colleges and universities; nine of these are public and two are private institutions. The mission of UALC is "to cooperate in continually improving the availability and delivery of library and information services to the higher education community and to the State of Utah." There were over 126,000 students enrolled in UALC institutions in Fall 2000. Previous UALC collaborations have involved statewide collection management for serials and online databases (Pioneer Utah's Online Library, http://pioneer.lib.ut.us/), reciprocal borrowing, and electronic article delivery services. One of the latest programs being developed is a Web site to share library instruction and information literacy competency support materials across Utah. This project grew out of the need for a statewide clearinghouse for library instruction materials and from the redesign of UALC's online information literacy course, The Internet Navigator (http://wwwnavigator.utah.edu). The Faculty Resource Web site also builds on the national instruction material clearing house model developed by LOEX (Library Orientation Exchange) in Michigan in the 1970's. As more shared databases are made available, library and Internet instruction needs are becoming more similar across institutional and geographic boundaries.

Many of the resources on the new Faculty Resource Web site were originally developed for the Internet Navigator online course. The UALC online course consists of four modules, each with its own exercises, assignments, quiz, and glossary. This course has been used successfully by thousands of distance and online learners throughout Utah and beyond since 1995. A team of librarians and faculty from throughout the state of Utah worked during Spring and Summer of 2000 to completely redesign the course in order to address the dynamic changes in library information environments and to meet the latest information needs of students. As the new content was being developed, the UALC team members realized the value of having access to much of the content in a variety of formats for multiple uses, independent of the larger course, as needed. A decision was made to develop a generic header and provide the same content in a "stand-alone" format for use in any other traditional face-to-face or online instruction sessions. This was the beginning of the Faculty Resource Web site.

UALC Faculty Resource Web Site:

The Web site idea grew from a few handouts to a more comprehensive clearinghouse of instruction materials. Although librarians and faculty have shared materials in the past, the Web site makes this much easier and more effective. A graphic designer was hired to design a generic layout for the materials. The Web site contains three main sections, plus a suggestion form. These sections are:

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Instructors Pages: These pages are designed to be used by new Internet Navigator instructors. This section provides guidelines for teaching the course, including suggested grading rubrics, links to the grade database, and standardized email replies. Most of the links in this section are password-protected and accessible only to current course instructors.
Instruction Handouts: This section is a clearinghouse of instructional aids designed for librarians and faculty from all institutions. All are printer friendly, available in html and/or PDF format, and can be downloaded and customized for each institution's needs. As this page matures, guidelines will be developed to catalog information, either by developing institution, by subject area, or a combination of the two. Handouts or Web readings with broad usage generated from the Internet Navigator course materials include: Outline of the Research Process; Using Reference Tools; Using Internet Search Engines; Using Article Databases; Using Library Catalogs; Creating Search Statements Using Keywords or Controlled Vocabulary; Introduction to HTML; Using Boolean Logic and Other Techniques to Enhance Search Statements; Publishing and Types of Publications; Critically Evaluating Information; Scholarly versus Popular Information; Note Taking Tips; Documenting Sources; Creating Annotations; and Information Ethics for Students. In addition, several interactive exercises have been developed that can be used independently of the Navigator course. Most of these are developed with Flash programming and require student interaction to complete. These include: Finding Call Numbers; Citation Builder (APA and MLA); and a Web Site Evaluator.
Instruction Web Sites: This section includes a collection of links on various instructional topics: Information Literacy Competencies; Copyright and Fair Use; Resources for Distance Learners; Teaching Tips; Instructional Technology Sites; Related Professional Associations, Guidelines & Standards; Assessment Materials & Information; Teaching & Learning Styles; Examples of Syllabi for Library Instruction; Assignment Tips & Examples; and UALC Library Instruction Pages. Current plans are to limit the number of sites listed to the best 10 to15.

In addition to the collaboratively developed segments of the Internet Navigator course listed above, the *UALC Reference and Information Literacy Committee* has solicited a variety of additional materials to be included on the site from all of the UALC institutions. These include handouts, brochures, database guides, and other instructional materials. Some of these materials are institution specific, but are included as useful models. Most items, with the exception of the password protected "Instructors Pages", are publicly accessible and may be copied, printed, downloaded and customized to meet the needs of any particular individual, class, course, or institution.

Future Plans:

This Web based collection of resources will continue to grow and expand as more quality materials are added. Future plans may include the development of more interactive tutorials using dynamic Web programming, a searchable interface, more extensive development policies and guidelines, usage statistics, publication of assessment data and other studies done on the UALC Internet Navigator course and this Web site.

Conclusion:

Information literacy instruction in Utah is becoming more similar across institutional boundaries as we continue to purchase more shared online databases and as students access other shared resources such as online article delivery and full text journals. As electronic resources and instructional pedagogies change, each institution spends much time and effort designing new learning resources and updating existing ones. Because Utah libraries share so many of these resources, there is also quite a bit of duplication. Utah is fortunate to have a history of cooperative programs linking librarians and library faculty. Sharing instruction materials statewide via the Web is a natural and cost effective outcome of UALC's ongoing cooperative efforts. The UALC Faculty Resource Web site will serve as a central location for updated versions of electronic resource guides, offer variations in teaching and learning strategies, and serve as a center for new instructional ideas. In addition, institute-specific information may be posted as a model for others. These materials will continue to improve and expand as more inter-institutional Web based sharing occurs. This site enhances support for information literacy competency across the state and region.

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Hierarchy of Navigation and its Effect on Content: A Designer's Perspective

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Abstract:
Over the last 3 years the author has worked with a team of Physics faculty + student designers on interdisciplinary, web development projects. Regardless of the specific visualization objectives, ease of navigation was paramount in all of the projects. This, presentation will analyze projects that contain the similar attributes of: 1. large data set, and 2. varied presentation requirements, as similar design attributes were manifested in all three cases. Even though the authors were working with several different publishers and different design teams, the analysis of the information to create an intuitive navigation system yielded similar visualizations and hierarchic organizations.

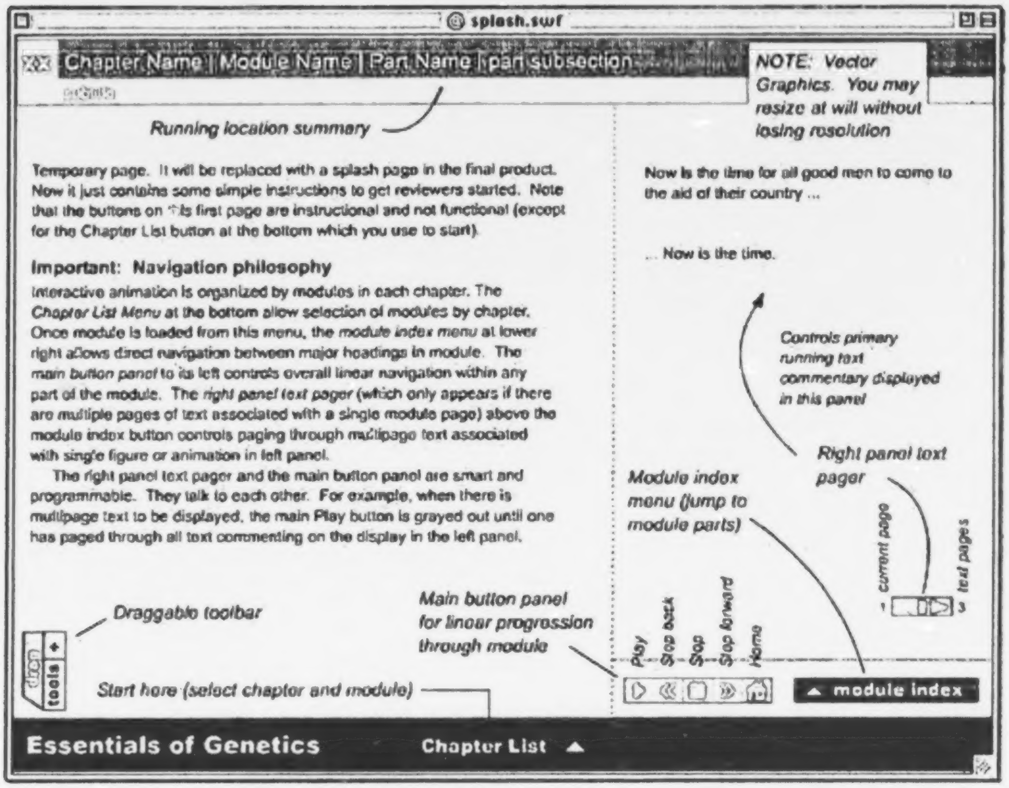
Paper:
In this case study the author will present three design projects: Biology + Genetics, Web Design and Astronomy. In all cases the intent was similar: to design an interface to facilitate the acquisition of information by beginning level college students or elementary school teachers. The interface had to accommodate text, imagery, video, animations and interactive laboratory tutorials. In short, the interface design problem was how to create navigation that left enough room for content.

Different groups of design students were included in the investigation. All three sets of students were asked to analyze the problem without the benefit of viewing the other teams work. All three teams came to similar conclusions regarding placement and organization of content, chapter, unit and site navigation, differentiation between tools and navigation, use of a site map, use of "bread-crumbing" as a navigational tool and as a design element as well as typeface use and hierarchy.

Navigation vs. Tools
For the purpose of this experiment, Navigation + Tools were differentiated and defined as follows. "Navigation" refers to the resources available to the user to move through the information: either from level to level or through individual pages in a specific level. "Tools" refer to the electronic resources available to the viewer through out the experience: this includes calculators, web links, glossaries, etc.

True vs. Evaluative Audiences
In all cases navigation and tools were differentiated. Navigation was considered primary, however, in all cases, every effort was made to make the navigation "intuitive". This posed a design problem in that there was a "true" audience, the students who would need to access the information, and an "evaluative" audience, faculty and publishers who had to approve the project and who had the ability to make global changes. In several instances, the "evaluative" audience showed itself not to be as computer literate as the "true" audience. In terms of interface design, the "true" audience was much more experienced in non-linear navigation than the "evaluative" audience.

In figure 1 the template for the Genetics project is outlined. While the author does not support the notion that all sites should have the same gestalt, the author does present a template that provides a good starting point for projects with large, complex information sets.


splash.swf
Chapter Name | Module Name | Part Name | part subsection
NOTE: Vector Graphics. You may resize at will without losing resolution
Running location summary
Controls primary running text commentary displayed in this panel
Right panel text pager
Module index menu (jump to module parts)
current page
text pages
1
3
Draggable toolbar
Main button panel for linear progression through module
Play
Step back
Stop
Step forward
Home
module index
tools
Start here (select chapter and module)
Essentials of Genetics
Chapter List

Temporary page. It will be replaced with a splash page in the final product. Now it just contains some simple instructions to get reviewers started. Note that the buttons on this first page are instructional and not functional (except for the Chapter List button at the bottom which you use to start).

Important: Navigation philosophy

Interactive animation is organized by modules in each chapter. The *Chapter List Menu* at the bottom allow selection of modules by chapter. Once module is loaded from this menu, the *module index menu* at lower right allows direct navigation between major headings in module. The *main button panel* to its left controls overall linear navigation within any part of the module. The *right panel text pager* (which only appears if there are multiple pages of text associated with a single module page) above the module index button controls paging through multipage text associated with single figure or animation in left panel.

The right panel text pager and the main button panel are smart and programmable. They talk to each other. For example, when there is multipage text to be displayed, the main Play button is grayed out until one has paged through all text commenting on the display in the left panel.

Now is the time for all good men to come to the aid of their country ...

... Now is the time.

Fig.1 | http://csep10.phys.utk.edu/klug/

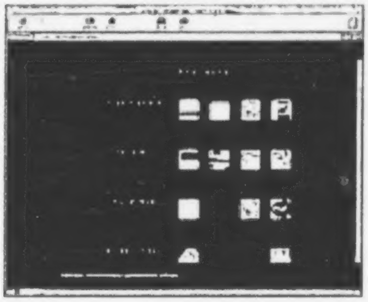


Fig.2 | http://sunsite.utk.edu/verbal
Fig.3 | http://csep10.phys.utk.edu/webteacher2002/winexp/flashmenu/intro4.html

Figures 2 + 3 illustrate different uses of the same organizational principles. While text placement has moved from the right hand side to the left hand side, approximately 2/3 of the field is utilized for primary information and 1/3 is used for support information. Imagery is considered primary information in Figure 2 while text is considered primary information in Figure 3.

These three interfaces also illustrate different approaches to programming. The Genetics site was programmed in Flash, the Verbal/NonVerbal site uses Java and the WebTeacher site uses html.

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Over-hyping the Web: Directories, Gateways, Resources and Higher Education Pedagogy.

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Abstract

The paper focuses on the adequacy and role of freely available Web resources in higher education courses in the social sciences. In the United Kingdom various higher education related funding bodies have been responsible for channelling resources into the provision of electronic information system resources for use by academic staff and students. Part of these has been directed at funding the development and maintenance of subject gateways. This paper explores some issues relating to the quality of the resources provided and their likely use by those that they are targeted at.

The report of the UK National Committee of Inquiry into Higher Education, the *Dearing Report*, 1997, noted that:

> the innovative exploitation of Communications and Information Technology (C&IT) holds out much promise for improving the quality, flexibility and effectiveness of higher education. The potential benefits will extend to, and affect the practice of, learning and teaching and research. .... We believe that, for the majority of students, over the next ten years the delivery of some course materials and much of the organisation and communication of course arrangements will be conducted by computer. Just as most people will come to expect to be connected to, and to make use o f, world communications networks in their daily lives, all students will expect continuous access to the network of the institution(s) at which they are studying, as a crucial link into the learning environment. § 13.1, 13.3 (available at http://www.leeds.ac.uk/educol/ncihe/, accessed 26 April 2002)

Long before this report was published, the Higher Education Councils had been investing significantly in the development of broadband-networked communications, linking universities and, subsequently, Colleges of Further Education to each other, and to Internet hubs. Universities themselves, partly through the influence of the funding councils, have sunk substantial resources into providing various electronic information system resources (EIS), and in training staff and students in their use. The European Union has also been heavily involved in providing monies for research into the uses and application of EIS in institutions of higher education, under its telematics and other programmes.

Access for UK staff and students to EIS resources is provided principally through the Joint Information Services Committee (JISC), which was established in 1992 and which has a budget of approximately £80 million per annum. Much of the online content, in the form of access to electronic publications, and electronic databases/datasets, is provided through the Distributed National Electronic Resource, DNER, which serves some 6.3 million staff and students in the UK. In the JISC five year strategy plan, 2001-05, particular emphasis is placed on the role of the Internet in enhancing learning and access to resources: "The Internet has become vital to further and higher education, not just to enhance distance and flexible learning but as a useful tool in traditional learning and teaching, administration and management and, of course, in research ... teaching staff, managers, administrators and students are all increasingly using the Internet from home as well as the office. Use of the Internet is nearly ubiquitous within further and higher education, as it has been for some years in the research community." (http://www.jisc.ac.uk/pub01/strat_01_05/exec.html Accessed 11 March 2002)

Another type of resource that is made available through JISC funding, organised by the Resource Discover Network (RDN), are subject gateways, or hubs. Subject gateways are online catalogues of Internet resources. For the most part these resources are freely available to all those who access them, not only to members of the UK higher education community. These gateways provides access to a series of Internet resource catalogues that list what are considered to be high quality Internet sites and materials, selected and described by specialists from within UK academia and affiliated organisations. Five hubs are currently running, covering the Health and Life Sciences (BIOME), Engineering, Mathematics and Computing (EEVL), Humanities (Humbul), Physical Sciences (Pslgate), and the Social Sciences (SOSIG).

The rationales for providing these services, leaving aside the vested interests of those funded from public sources, were stated in a paper focusing specifically on the social science gateway, SOSIG, and are twofold. First, that "the information needs of social science researchers can increasingly be met via the Internet. Electronic information resources relevant to the social sciences, including data and datasets are being made publicly available world-wide and the Internet offers the potential for researchers to access these from their desktops."[1] Secondly, that these resources, as they can be uploaded by anyone, are of variable quality, and that staff, and particularly students, are not always in a position to evaluate their worth: "Without publishers, editors, peer-review and other 'filters', much of it may be invalid, inaccurate or irrelevant to academics." Accordingly, "the gateway provides access to Internet resources via an online catalogue where each resource has been classified and described by an information professional. The SOSIG team locate, assess and describe high quality networked resources from around the world, adding value and saving time and effort for researchers and users of their research by providing the facility to browse and search resource descriptions and connect directly to resources of interest."[2]

There are a number of problems with this analysis and the solution that is provided through the medium of subject gateways. First, when Internet resources are contrasted with printed materials, the underlying assumption is always that the latter are necessarily superior because of the factors mentioned above. This, of course, is far from always being the case; libraries and journals are full of materials whose worth is problematic. Second, the cataloguing is largely done by librarians, or, as they are now more commonly known, Library Information Specialists. Such specialists are unlikely to be sufficiently familiar with the detailed teaching or research requirements of academic staff in particular fields, or to posses the requisite mastery of the discipline that the resources being evaluated relate to, so as to be in a position to assess their adequacy, other than on the basis of largely superficial surface characteristics. A substantial proportion of the items catalogued by subject gateways, SOSIG and Humbul, for instance, are not likely to be of much use to either research students or academic staff. Third, it is often easier and faster to locate useful resources in a particular subject area by means of effective use and knowledge of search engines, and by links from key sites, than by way of trawls through subject directories. Fourth, the surface characteristics relied upon in the process of classification, institutional affiliation, for instance, fail to take into account that many of the resources uploaded by academic staff are of exceptionally poor quality, and should, in fact, be uploaded on Intranets, rather than the Internet. Fifth, two annual reports by the JISC Scientific Adviser indicate that neither staff nor students, in significant numbers, are using any of the EIS resources provided by the JISC, including subject gateways, despite considerable resources being expended on publicity, and the fact that most library pages of institutions of higher education in the UK reference them.[3] The reason for this, although not adequately covered by the monitoring research funded by the JISC, is probably related to the fact that neither academic staff nor students have the requisite time to do so, which is reinforced by the poor quality of many resources freely available when they do. Staff and students would in all probability be better served, in both the short and longer term, by more extensive training in the effective use of search engines, and the evaluation of online resources, than by the funding of subject gateways. These, in any event, cannot conceivably keep up with the volume of resources being uploaded.

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[1] Debra Hiom, "The Social Science Information Gateway: Putting Theory into Practice." *IRISS '98: Conference Papers*, International Conference, 25-27 March, 1998. Available at http://www.sosig.ac.uk/iriss/papers/paper54.htm

[2] Ibid

[3] Jennifer Rowley, *JISC User Behaviour Monitoring and Evaluation Framework*. First Annual Report, August 2000. Available on Web from http://www.jisc.as.uk; Jennifer Rowley, *JISC User Behaviour Monitoring and Evaluation Framework*. Second Annual Report, August 2001. Available on Web from http://www.jisc.as.uk

Wireless meets Wireline eLearning

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Abstract: A lot of software products currently promise to support eLearning but only few efforts are done to detach eLearning from wireline desktop devices toward small mobile and portable ones. This paper investigates how this kind of mobility can broaden the mind of eLearning. It is pointed out that current eLearning products can be classified towards a relatively low maturity level of eLearning. Based on special constraints and additional benefits of ubiquitous learning processes are emphasized which are well suited to be supported pervasively. The Model-View-Controller (MVC) architecture is recommended as a design pattern for integrated learning solutions.

Introduction and Motivation

Economy is evolving to a knowledge based economy. The life of knowledge and human skills is shorter than ever. Well educated and skilled stuff and as a result intellectual capital is becoming the keystone for organizations to get and stay competitive in dynamic markets. For employees this fact increases the pressure to remain at the forefront of education and training throughout their whole career. Four or five year degrees are just the beginning of a life long continuing education (see also Urdan et al. 00). For organizations life long learning of their staff members is as well a competition weapon as a cost factor. Learning has to happen therefor quickly, situative and as effective as possible.

Technology has changed the way we live, think, work and learn. Technology has revolutionized business and now it must revolutionize learning. Life classroom based training is becoming too costly and cumbersome. 80 % already use computers on the job. So eLearning can be seen as a means supporting life long learning with a lot of benefits (see also Rosenberg 01, 30ff). The worldwide web, high-capacity networks and high speed computers make learning available to people 24 hours a day in their office, at home or also in hotel rooms during a business trip around the globe. ELearning enables it to access learning when it is convenient. A lot of web based eLearning solutions are available on the market jet. As we will see later on they can be assigned to different maturity levels of eLearning. But one thing they have in common: the extent of their 'anywhere and anytime' is limited mostly to resident desktop computers with very comfortable user interfaces. Through the rapid development of wireless technologies and pervasive computing (see also Burkhardt et al. 01) also the topic of 'mobile learning' (mLearning) will become more and more significant. Currently eLearning applications running on small and handsome devices supporting wireless technologies or integrating wireline and wireless eLearning approaches are almost not existent in the marketplace. This paper treats features learners will be expecting from mobile learning environments and gives so hints for the further development of appropriate applications. The following key questions are investigated :

- What are the maturity-levels of eLearning, what achieve current products and how can mobility be anchored in this context ?
- What are the constraints and additional benefits for wireless learning ?
- What learning processes are well suited to be supported wirelessly ?
- What drives wireless eLearning and how can it be integrated best into wireline eLearning ?
- How can wireless and wireline solutions be integrated best ?

A conclusion summarizes the key statements and gives some future perspectives.

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The Nature of eLearning

For the most people learning is symbolized through the classroom. This is the reason to see eLearning mainly as the online-version of classroom learning in the sense of eTraining. Instruction and eTraining is one perspective of eLearning, drilling knowledge in form of structured multimedial content presentations accompanied by active elements like self tests, quizzes and various communication possibilities. Constraints for successful eTraining are discussed in (Steinberger 01) and are not detailed further in this paper. Despite of its powerfulness eTraining is not always the accurate way to convey knowledge. Learning is not teaching and eLearning must not be viewed only from the point of view of eTeaching. It must be thought in terms of what the learner needs. Often there exist situations in which learning happens best and in a very efficient way through selective access to collected knowledge. Training is not necessary in this situation what makes eKnowledge an as important and successful aspect of eLearning (see also Rosenberg 01 and Maurer 00). Table 1 mentions the typical characteristics of this eLearning approaches.

Etraining	**Eknowledge**
Drill of knowledge	Delivery of information
Structured nature, less flexibility	More flexibility, random access nature
Long lead-time for development, developed by special authors	Created also by expert users
Focused on a specific learning outcome	Focused on a specific access and view of content
Purpose is defined by designer or coach	Purpose is defined by user
Based on the user characteristics and needs	Based on the knowledge discipline
Sequenced for optimum memory retention	Sequenced for optimum reference
Contains presentation, practice, feedback, communication and assessment components	Primarily centered on effective presentation

Table 1: Characteristics of eTraining and eKnowledge

There exist a lot of eLearning products on the market supporting eTraining. Some of them also support knowledge management mechanisms but only few focus on user knowledge collection and access in particular (e.g. Future Learning Environment, Muukkonen et al.99) but mostly knowledge management systems are seen as systems separate from eLearning. Only very few prototypical eLearning products add the possibility to augment learning also to small mobile devices. But in most cases this is done only in excerpt form (e.g. downloading of the course calendar to a PDA in WebCT).

Depending on their properties eLearning products can be assigned to one of five maturity levels of eLearning. Table 2 shows some characteristics of these maturity levels (see also Lytras et al.01). The lowest level covers pure eTraining, drilling in an inflexible teacher-defined process manner locking knowledge in 'course-boxes' with no course independent random access. Level 2 enhances level 1 through eKnowledge functionality and makes knowledge available independent from its pertinence to a special course. Level 3 makes it possible for the learner to select his favorite learning process which makes the content delivery more flexible. Moreover level 4 and 5 enhance the learning possibilities trough customization and integration aspects.

Level		**Some Characteristics**
1	ETraining with static content delivery	Pure course orientation that supports a predefined, static and sequential way of learning; the poor flexibility is inadequate to support dynamic nature of learning; Often no interoperability of learning objects; No random access to learning objects; Content producing authors, content consuming learners;
2	Enhanced eTraining coupled with Knowledge Management	Utilization of learning objects databases; Reusability, Metadata , Interoperability; Communication Tools;

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	mechanisms	Random access to eLearning objects; Acquisition of user knowledge;
3	ETraining based on Learning Process Specifications	Pool of available Learning scenarios for eTraining; Orientation to learning processes and learning stiles; Makes content delivery more flexible;
4	Customized Learning Scenes	Learning needs recognition, learners profiling; high flexibility, extensive parameterization of learning platforms
5	Integrated Learning	Integrate eLearning systems with other enterprise solutions

Table 2: Maturity Levels of eLearning

Most of today's eLearning Products are settled on maturity levels from one to two. If they support knowledge management at all it is mostly fixed to inputs form special context authors and does not provide user centered knowledge production and distribution. The user is seen almost ever as the knowledge consuming partner in a learning management environment. Learning process specification and customized learning (levels 3 and 4) are still research topics of eLearning. Anyhow some products try to integrate learning and administrative systems via a learning portal and to bridge the gap between level one/two and level five.

Borders between wireline and wireless eLearning are basically independent from the maturity level of a solution. Mobility could also be realized on level 1 and 2 but it is rarely done. Constraints for wireless eLearning and what eLearning processes are best supported in a wireless manner is discussed in the following sections.

Constraints for wireless Learning

In future we will see a tremendous increase of wireless multimedia network terminals that are similar to today's mobile phones or PDAs (handhelds). Wireless technologies like wireless LAN, Bluetooth and GPRS will multiply potential handheld applications. According to IDC in 2000 12.9 millions handhelds were sold. For 2004 they forecast 63 millions handhelds to be sold. Whereas handhelds today are primary sold to private persons IDC believes that in 2004 about 30% will be sold to organizations. About 38% will be smartphones, integrating PDA functionality with features for communication. Also the possibility to use Java (J2ME) on mobile clients will contribute to the success story of the new mobile devices also in the area of mobile wireless learning.

This mobile eLearning devices will be characterized by the following properties:

- small, portable device
- is a full fledged PC
- has a global positioning system
- has speech in- and output
- serves as portable player
- has an integrated camera
- ‚Everynet‘ with high performance is always available
- serves as electronically wallet
- has an integrated graphic pad to enable simple notices
- can operate without socket-power for a long time

Because of the nature of their user interface these powerful mobile devices cannot compete with the user interface of standard desktop or laptop devices. The user interface is one of the key constraints for wireless augmented eLearning. This is the main reason why mobile learning must not be seen as a simple wireless prolongation of eLearning as it happens on desktop or laptop machines. Differences regarding requirements and utilization between learners using small, portable devices and learners using desktop devices have to be seen making eLearning mobile (see also table 3).

The most important criteria for the efficiency and acceptance of mobile eLearning are (see also Zobel 01,166ff):

5 minute value: to achieve a benefit for learners using mobile learning devices within a short time; mobile devices are mostly used in niche times to communicate or get information as quickly and simultaneously as possible (e.g. use a discussion forum). For a longer session the desktop device is mainly preferred;
Simplicity: to be simple and adapted to the limited display and input possibilities of the mobile device. E.g. although it is technically possible nobody would enjoy to scroll complex and multimedial content files using a PDA-like interface;

Additional value: to produce an additional benefit as compared with desktop solutions; one important additional benefit of mobile solutions could be the usage of context dependent information. There can be distinguished between four kinds of context in which a learner can be located (see also Zobel, 50ff):

- location context: the system knows the location the learner resides;
- behavioral context: there are some activities related with the location the learner resides;
- temporal context: there are dynamic and time dependent data related to the location the learner resides;
- interest specific context: the preferences of the learner are addressed in a specific manner;

A pure mapping of desktop eLearning functionality onto mobile devices will fail therefore. It makes more sense to support special learning processes according to the learner needs using mobile devices and boosting the strengthens of the mobile approach this way. Processes that need a sophisticated user interface should rather be kept on the desktop integrating wireless activities of the learning community.

Criteria	**Wireline eLearning**	**Wireless eLearning**
Access	Tedious	One touch
Usage	Time > 30 minutes	Access time < 5 minutes
Navigation	Browsing	Aimed random access
Functionality	Abundant, complex	Simple, funny, added value
Content	Deep, multimedia, complex user interface, lot of data	Area of specialization
Utility value	Over a longer period of time	Immediate

Table 3: Differences in the way to use wireline and wireless eLearning Technology

What drives wireless eLearning

The willingness of learners to use eLearning is relatively high but they will never tolerate bad solutions only because they are web based or wireless. Therefore it is necessary to support learning learner-centered with high usability fulfilling users needs. Table 4 mentions the most important learning processes that have to be supported in an eLearning environment of maturity level two from an learners point of view.

Mobile technologies could significantly augment some of these processes and support processes wireline solutions can not support. But also some processes are not well suited for mobility at all. Table 4 expresses the process capability to get wireless evaluating the 5-minutes value (A), simplicity (B) and additional value (C).

Prozess	**Description**	**A**	**B**	**C**
Consume training events focused on a specific learning outcome (WebCasts)	Conventional training events are transmitted so that many distributed learners can participate	-	+	+
Consume topic presentations focused on	Read, listen to, watch carefully crafted	–	–	–

a specific learning outcome	multimedial explanations; Make annotations			
Retrieve special knowledge	Consume specific access and view of content	++	+	++
Do guided research	Gather, analyze and report on information	-	-	-
Do teamwork	Work in a coordinated team to solve a problem	-	-	-
Use virtual labs	Experiments with simulated equipment	-	+	+
Participate in a brainstorming process	Discussion in a distributed group	+	++	+
Do Case studies, Role–playing scenarios	Study a detailed example of a real world event	–	–	-
Take hands on activities	Perform a real task outside the lesson	–	–	-
Participate in discussions, ask and answer questions, give feedback		++	++	+
Generate reports	Writing down results, upload reports	–	+	-
Play learning games	Learning by playing	+	+	++
Self evaluation and testing	Apply the learned concepts, skills and attitudes	+	++	-
Drill and practice activities	Repeatedly practice applying special knowledge	–	-	-
Group critiques	Receive and react to criticisms	++	++	+
Make available knowledge of ones own to the others		-	+	-
Use context dependent knowledge		++	+	++
Get general course information	Get news, dates, activity indicators in the learning community, grades,..	++	++	++

Table 4: Mobility of eLearning Processes (from ++ well suited to -- badly suited)

To summarize table 4 and the evaluation performed there it can be fixed that processes with a high mobility potential typically show some of the following typical properties:
- they focus on communication (e.g. mail or discussion forums to be supported in a SMS like manner);
- if they have to present content mobile this has to be done in a modest form (this is also valid for special knowledge retrieval) – smaller chunks of information are retrieved (with adjusted presentation templates);
- they assess eKnowledge;
- they use the mobile device as portable TVs or mepia-players to become multimedial;
- they entertain the learner in niche times ('gameboy effect')
- they are context driven

To make sure an adequate mobile process support language input and integrated graphic tablets will have to replace the desktop keyboard and mouse functionality. Appropriate bandwidth and global positioning technique are assumed.

To integrate resident and mobile process support eLearning an orientation on the MVC (Model-View-Controller) architecture seems to be adequate to realize integrated solutions (see also Burbeck 92). In the MVC paradigm the user input, the modeling of the external world, and the visual feedback to the user are explicitly separated and handled by three types of object, each specialized for its task. The **view** manages the graphical and textual output to the portion of the display that is allocated to its application. The

controller interprets the inputs from the user, commanding the model and/or the view to change as appropriate. Finally, the **model** manages the behavior and data of the application domain, responds to requests for information about its state (usually from the view), and responds to instructions to change state (usually from the controller). This design pattern makes it possible to present a eLearning model on small ubiquitous devices in a different view and with a different controller than on desktop solutions. The common model guarantees by this way a global synchronized learning environment.

Conclusions

The most eLearning solutions focus desktop devices and so complex views on eLearning models. Not all eLearning processes are well suited for supporting them ubiquitous. But desktop eLearning functionality can be approved adding additional benefits for the learner through context information, ad hoc access, random access to very special information chunks, having fun and filling niche times. The best mobile process areas can be found in communication and special knowledge retrieval.

The MVC design pattern seems to be the right architecture for integrated eLearning solutions. To reach this goal mobile applications views will have to be designed in a much simpler way compared to desktop views guaranteeing a quick and simple access. In future 'Information in places' could highlight context benefits and make learning really ubiquitous. Communication tools like chats, discussion forums or instant messaging with language interfaces could be used. Global position technology could make it possible to identify persons with similar interests in the neighborhood and to start virtual initiated communication in real space at the end. ELearning systems have been seen as a 'pull-systems' until today, expecting the user to browse for information. Using mobile technology the significance of 'push-systems' will grow and proactive applications could be developed.

References

Burkhardt J., & Henn H., & Hepper S., & Rindtorff K., & Schäck T.(2001). Pervasive Computing, Addison Wessley.

Burbeck S. (1992). How to use Model-View-Controller (MVC), ParcPlace Systems Inc., see http://stww.cs.uiuc.edu/users/smarch/st-docs/mvc.html;

Horton W.(2000). Designing Web-Based Training; Wiley.

Horster P. (Editor) (2001). Elektronische Geschäftsprozesse, it Verlag.

Lytras M. & Pouloudi N. (2001). Expanding e-learning effectiveness in ED-MEDIA, 1184-1189.

Maurer H. (2000). E-Learning Has to be Seen as Part of General Knowledge Management, ED-MEDIA 1249-1253.

Muukkonen H., Hakkarainen K., Lipponen L., Leinonen T. (1999) : Computer Support for Knowledge Building, Ninth European Congress on Work and Organizational Psychology, 12-15 May 1999, Finland, see also http://mlab.uiah.fi/fle/research/eawoppaper.html.

Palloff R., & Pratt K. (1999). Building Learning Communities in Cyberspace, Jossey-Bass Publishers.

Rosenberg M.. (2001). E-Learning, McGraw-Hill.

Sharples M. (2000). The design of personal mobile technologies for lifelong learning in: Computers&Edication 34, 177-193.

Steinberger C. (2001): Elektronische Unterstützunge von Aus- und Weiterbildungsprozessen in Horton (2000),108-118.

Urdan Trace A., Weggen Cornelia C. (2000) : Corporate E-Learning: Expoloring a New Frontier; WRHambrecht+CO.

Zobel J. (2001): Mobile Business and M-Commerce, Hanser.

Open Classes in Closed Schools – Six Pedagogical Issues In the Integration of On-Site and On-Line Learning

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Abstract: The networking of small schools between rural communities has led to the development of new electronic educational structures (school district digital intranets) and processes (virtual classes). As teachers integrate on-site with on-line instruction they are, increasingly, teaching not just in classrooms but between classrooms. New professionals are being appointed to networks of schools in Atlantic Canada: E-Teachers (electronic teachers) and M-Teachers (Mediating teachers who facilitate interaction (on-site) between on-line students and e-teachers).Six pedagogical issues have emerged in this new electronic environment in which open classes are constructed between schools that have traditionally been closed to one another.

E-Learning in rural schools in the Canadian province of Newfoundland and Labrador has moved through three phases over the last five years. The first phase began with E-learning in a single high school in which research was undertaken in science and mathematics education. In the second phase, Elearning was undertaken in a networked, on-line environment, through the creation of the Vista School District Digital Intranet (VSDDI). This provided an innovative structure in which teachers, administrators and researchers were able to collaborate in exploring issues in E-learning, E-teaching and the management of virtual educational environments. Instead of engaging in teaching and learning exclusively within a conventional school, teachers and students began to consider ways of teaching and learning between schools (Stevens, 2001). The third phase in the development of E-learning in this part of Canada began in September 2001 in a move away from research in a single school district digital intranet to a structure that spans the province. In the new E-Learning environment, ten different subjects were introduced to students across a range of grade-levels in ten school districts.

In the current school year two new teacher categories have emerged: e-teachers (electronic teachers) and m-teachers (mediating teachers who facilitate interaction, on-site, between on-line students and e-teachers). The development of E-Learning in High Schools in Newfoundland and Labrador has highlighted six pedagogical issues for teachers as they seek to integrate traditional on-site instruction with on-line learning in classrooms that have become, in effect, sites within teaching and learning networks.

Pedagogical Issue One: *What is the pedagogical justification for providing instruction in virtual educational environments?*

Increasing numbers of teachers in Newfoundland and Labrador High Schools now have to make professional decisions whether instruction is more appropriately provided in traditional classrooms or in virtual classes (E-learning). As many students in small schools in Newfoundland and Labrador access instruction in these dual environments, teachers have to be able to provide pedagogical justification for on-site or on-line learning.

Pedagogical Issue Two: *To what extent should schools that are horizontally-integrated across dispersed sites, seek to develop vertical integration in their local communities?*

Schools in Newfoundland and Labrador have, to an increasing extent, become academically and administratively integrated. Teaching and learning can, and to an increasing extent is, being provided in the emerging electronic system between classrooms across dispersed sites. This horizontal integration of schools across dispersed sites has provided new pathways for learners by extending curriculum offerings in small schools in remote locations which, until recently, was not possible because of economies of scale. At the present time schools are able to consider vertical integration within their local communities so that they can access such local resources as parents, businesses, libraries and a range of services. By vertically integrating to complement horizontal pathways, education can be extended to adults and "second chance" students at the community level, thereby promoting equity through the provision of opportunities to engage in a society in which learning is increasingly important. Without vertical integration, it is possible that small schools in rural communities could promote social divisions between those with access to digitized learning, and those without access.

Pedagogical Issue Three: *Should pedagogy for e-learning reflect horizontal and vertical integration?*

Schools that are horizontally integrated are able to move resources between participating sites (eg specialist teachers and curriculum materials). In this new, electronic educational environment, can collaborating schools promote knowledge-building through student collaboration? In the process of knowledge building, what is the role of peer-tutoring?

Pedagogical Issue Four: *How should e-teachers choose between synchronous and asynchronous instruction?*

The integration of on-site and on-line learning in horizontally-linked schools across dispersed sites enables teachers to choose between synchronous and asynchronous instruction. The choice of synchronous and asynchronous instruction by educational professionals, will, increasingly, have to be defended on pedagogical grounds and in terms of potential learning outcomes.

Pedagogical Issue Five: *In classrooms in which on-site and on-line instruction is available, to what extent should asymmetric knowledge advancement be encouraged?*

On site and online learning raises new possibilities of classrooms becoming places in which the development of knowledge can be both symmetric as well as asymmetric, thereby accommodating diverse approaches to learning.

Pedagogical Issue Six: *To what extent should e-learning promote the development of personal intranets?*

On-site and on-line teaching and learning is now at a stage when moves from structural intranets (eg as defined by specific schools academically and administratively interfacing in a designated region) to personal intranets can be contemplated. In a personal intranet students have the opportunity to develop understandings within customized learning environments, with access to a range of teachers. This pedagogical development has the potential to be modified to accommodate and coordinate teaching and learning styles.

Conclusion

Education at the high school level in rural Newfoundland and Labrador is being extended in terms of curriculum opportunities at a time when many small community schools are being closed. The integration of on-site and on-line education has promoted a situation in which there are now classes that are open to one another across dispersed sites, linking schools that otherwise remain autonomous and closed to one another. In this changing educational environment, a number of pedagogical issues have emerged. Engagement in the emerging pedagogical issues of e-learning will to a large extent define new professionals who teach between as well as in schools. As Keegan (2000) recently noted, it is time to take stock of where we are as a profession at a time of change.

References:

Keegan, D. (2000), *Distance Education – Taking Stock at a Time of Change*, London, Routledge-Falmer

Stevens, K. (2001), The Development of Pedagogy for TeleLearning Within Knowledge-Building Communities, *Proceedings of Ed-Media*, Tampere, Finland

TO MAKE E-LEARNING WORK, SEND CLEAR MESSAGES!

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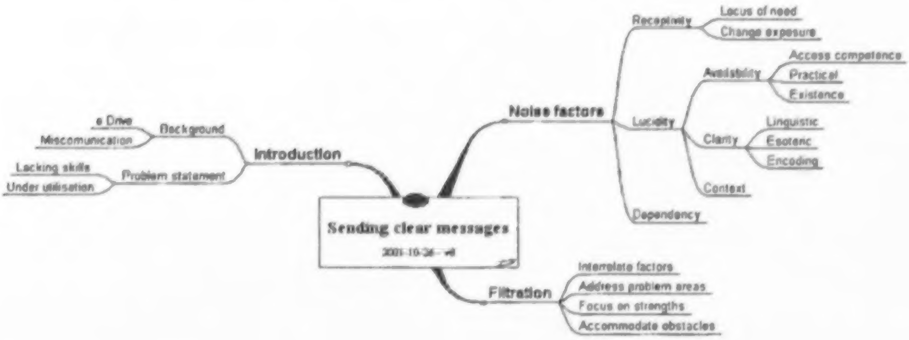
Abstract

All too often, a need is seen as e-need. Higher education and learning however calls for a human process, an interaction between facilitator and learner. A customised approach to individualised problems is more than just electronic delivery. The crucial issue is not the mode of delivery, but the skills required to facilitate learning. Unfortunately, evidence of a subtle re-definition of education and instruction seems to emerge in some quarters, a re-definition that leans toward information delivery rather than education.

Facilitators live under an impression that the necessary information is available and yet learners do not utilise opportunities to expectation. The problem can be that the message received is not an exact replica of the intended message originally sent. The 'noise' accumulated during 'transmission' obscures the true value of the 'signal'.

Fortunately an increased awareness is growing to identify best practice in terms of learning facilitation in the new technologically enriched environment. To address this issue requires more than technical competence. This paper acknowledges that a combinational approach is called for and proposes a framework within which the role of the e-options can find its rightful niche within the realities of modern educational practice once the current 'signal to noise ratio' has been modified to send clear messages.

Visual overview


Sending clear messages
2001-10-26 - v8
Introduction
Background
e Drive
Miscomunication
Problem statement
Lacking skills
Under utilisation
Noise factors
Receptivity
Locus of need
Change exposure
Lucidity
Availability
Access competence
Practical
Existence
Clarity
Linguistic
Esoteric
Encoding
Context
Dependency
Filtration
Interrelate factors
Address problem areas
Focus on strengths
Accommodate obstacles

1. Introduction

1.1 Background

There are no quick fixes in education. Arguments given here are not intended to be universal recipes for success. Neither are they aimed at defining simplistic solutions. This paper aims to:

- ✓ highlight contributing factors;
- ✓ identify methods by which behaviour can be understood; and
- ✓ elude to key concepts to be aware of when approaching technologically enhanced education.

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1.2 Problem statement

The problem is discussed under the following headings:

- ✓ e Drive: technology chasing .
- ✓ Miscommunication: One-way decontextualised information flow
- ✓ Lacking skills: Faculty not trained educators
- ✓ Under utilisation: Tools and opportunities available not used

2. Noise factors

2.1 'Receptivity'

Receptivity is a term used to indicate the degree to which individuals would be willing to participate out of free will. Some may see this as another opportunity for technology to provide solutions (Shih & Sorcinelli, 2000), but increased time commitment and lack of money were the top *barriers* to electronic delivery of education as identified by Berge & Muilenberg (2000). Simplistic solutions of throwing technology at problems do not have a realistic chance of succeeding.
To explore factors impacting on the likelihood of succeeding, one needs to first determine to what extent your audience would be susceptible to change interventions.

2.2 Factors influencing receptivity

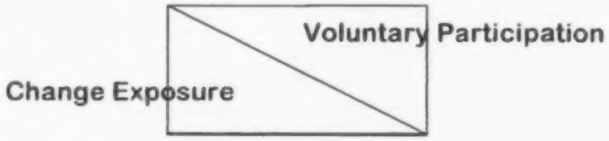
The first dimension to receptivity is the locus of apparent need. Should change agents offer interventions on issues that perceived as valuable in order to address an immediate need, individuals would be more likely to participate. Another factor impacting on the receptivity deals with the effect of change on individuals and their ability to deal with change in a manner that is constructive. Brock & Salerno's 1993 change cycle is valuable reading in this regard.

People who should find themselves in the early stages of the change cycle, experience feelings that will prohibit them from utilising the opportunities to work through those changes. The feelings of people who are experiencing the first three stages of change namely loss, doubt or discomfort, are not the type of feelings that foster thoughts conducive to the types of actions that will bring people to volunteer for developmental activities.

Receptive attitudes are fertile ground and add value to co-operative learning environments. This correlates with the high value rating respondents gave to networks and peer support.

Change per se can therefore not be identified as the sole determinant of whether people will utilise the opportunities for development or not. The key factor is the reaction to the change and the resulting attitudinal position within the change cycle.

Unless learners are made aware of this impact of change on their attitudes, their natural reactions to change therefore would indicate an inverse proportionality between the likelihood of volunteering participation and their exposure to change.



Lucidity

2.4.1: Availability

Some pieces of information are just not available. Non-existence is one form of not being available, but there is a magnitude of information that is available in the sense of existence, but possibly not available for lack of access. Factors like fire walls, privacy and language come to mind together with instances where information was not properly recorded in the first place like the techniques used to create many of the Seven Wonders of the World. Breivik moves beyond the issue of media as prime determinant of access. "*...But where most politicians see the problem as one of access to computers and the Internet, a growing number of leaders in higher education see it more as an issue of literacy — information literacy (*Breivik, 2000)."

For the purpose of this paper, availability is representative of the combination of three interdependent elements of availability namely:

- ✓ Ability of the individual to utilise opportunities;
- ✓ Practical accessibility of the information; and
- ✓ Existence of applicable information.

2.4.2: Clarity

Unless instructions and or guidelines are understood properly, their impact would be limited proportionally to the lack of clarity.

The problem of clarity is not limited to everyday language issues. Subject specific terms and layout can also reduce clarity. See *http://lme.mankato.msus.edu/class/629/dhmo.html* for an example. The fact that information is available does not guarantee that the true meaning will be clear to all.

2.4.3: Context

The University of Pretoria currently has a (recently improved) maximum Internet bandwidth of 5Mbps. Compare this to the 155Mbps that Dutch institutions have for international Internet access and the staggering 622Mbps link available between some universities! (Steyn, 2001).

While the merits of global competition are not the issue here, the need for adoption of theorems for local conditions and context becomes apparent.

2.5. Dependency

Professor Robert Kraut from Carnegie Melon University caused a stir some three years ago when he reported his findings. His studies revealed that the social networks of heavy Internet users declined and that they reported feeling of loneliness (Kraut, 1999). Now he seems to have results from a follow up study that contradict his earlier findings (Guernsey, 2001).

When it comes to group dependence and the adoption or rejection of technological options individual characteristics like learning style preferences will come into play.

2.5.1: Learning style preference

All individuals do not work in groups as a result of choice. Social learning style preferences differ. Kneak (2001) distinguishes between individual & group learners The intention is not to say that individual learners cannot function well in a group, but their natural choice would not be to be dependant on others.

2.5.2: Dependency impact

The preference of the target audience for either individually or group centred approaches are not crucial to the success of technology as a factor in facilitating learning. This is because there are various technical options available that can accommodate either preference. What is important though is that facilitators take note of these factors, provide alternatives and accommodate the individual differences.

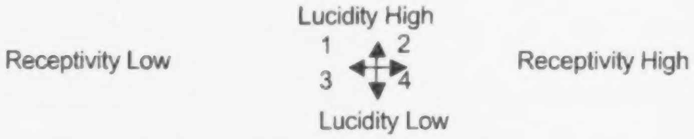
Dependency is not sufficiently crucial to singularly determine success. Important though, to keep its implications in mind. A metaphorical way of thinking about dependence could be to compare it to a flat surface. Nowhere higher or 'better' than anywhere else, yet representative of a whole open area of positions and possibilities.

3. Filtration

In order to create a visual model and enhance understanding, the quality of communication can be improved or 'filtered' by interrelating these issues.

3.1 Receptivity and Lucidity

Plotting these two factors against each other creates four quadrants.



This first quadrant is the one where barriers need to be broken. To only make information available would not be likely to add major value, as individuals low on receptivity, would not be likely to conscientiously take on-line courses or participate in discussion groups.

The barrier of low receptivity can be broken by first moving to quadrant # 2. In this instance the information is still readily available, but this time the receptivity of the audience stems from their perception of need.

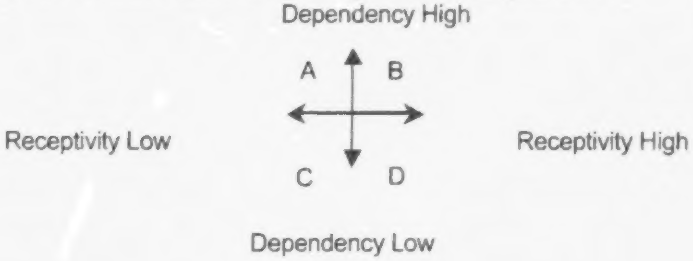
Where quadrant 2 conditions apply, people may be receptive enough to browse through web page content, since they could get access to information in their own time and according to own priority. Clearly a position of choice.

The final quadrant where there is a common receptivity, but lacking lucidity. The reason for the lacking clarity needs to be explored in order to address the problem. If the problem resides in lacking skills to access the relevant information, interventions to provide the necessary skills may be received positively.

A different approach would be apparent when the information is not available or consensus not reached. Where competence and access allows for electronic discussion, there are various virtual communities that will be able to assist in identifying solutions or options.

3.2: Receptivity and dependency

Plotting these two factors against each other again creates four quadrants.



Quadrant A is where learners typically are not receptive, but highly dependent. These people like to work in groups, prefer synchronous communication and contact.

Technological options are not likely to prove the ideal tool for the situation.

Quadrant B holds the double high. The high receptivity provides the opportunity for peer interaction and reflection activities. While this traditionally is the domain of physical contact, some technological innovations like chat rooms or video conferencing could also play a part.

Individual learners with low receptivity typify quadrant C people. Again something needs to be done to break the non-receptivity. Mettal recorded such a case.

> *"... ignored our services. Word soon came around that he was horrible ..., but he still avoided us. One of his friends ... suggested that he talk to me about it. ...He came over and we talked for several hours. I gave him "new perspectives" on what was happening between him and [his peers]..., etc. (Basically, I talked to him about to be a nice person.) The next semester went much better. I was shocked that such a short intervention helped, but he has thanked me several times since* (Indiana, 2001*)* "

The last quadrant (D) in this interrelation deals with highly receptive individuals. Technology has much to offer these people. The search capabilities of computers make information available to work with at leisure. Some individual interventions

may be necessary in order to equip the individual with the skills to utilise the technological options.

> *"A colleague that would not touch the computer for his life now uses computers in his instruction* (Louisiana, 2001).

3.3: Receptivity, Lucidity and dependency

All three these factors can be combined in one three dimensional interrelation with x, y and z axis.

The front octants containing the low dependency quadrants and the back octants containing the High dependency quadrants. This relation may assist facilitators to sufficiently analyse each particular situation in order to class it accordingly.

Attempting to assign particular technological solutions to specific combinations would limit the use of the classification to the items specifically measured and mentioned. A more inclusive and flexible understanding comes from evaluating the factors in terms of their impact on technology use.

The impact of the dependency dimension is not as important to determine whether technological solutions could be applied, but rather to inform on different options which need to be considered.

4. Conclusion:

Facilitators need to adjust to the new environment. Strategies should allow for differences in personality types and their reactions to change. The variety of new possibilities and technological options requires more than technical competence. This paper acknowledges that instructional design should be a combinational approach and calls for and proposes a framework within which the role of receptivity, lucidity and dependency could be interrelated to inform on issues that will impact on acceptance of new strategies. Technological options will find its rightful niche within the realities of modern educational practice once the current 'signal to noise ratio' has been addressed to send clear messages.

References

Berge, Z.L. and Muilenburg, L.Y. (2000). *Barriers to Distance Education as Perceived by Managers and Administrators: Results of a survey*: In Melanie Clay (Ed.), Distance Learning Administration Annual 2000: http://www.gl.umbc.edu/~berge/man_admin.html.

Breivik, P.S. (2000). *Information Literacy and the Engaged Campus: Giving students and community members the skills to take on (and not be taken in by) the Internet*. [S.l]:AAHE Bulletin. http://www.aahe.org/bulletin/nov2000_1.htm

Brock, L.R. and Salerno, M.A. (1993). *The (inter)Change Cycle: The secret to getting through life's difficult changes*. Durban: Bridge Builder Media

Felder, R.M. (1994). *The myth of the Superhuman Professor*. Journal of Engineering Education; Vol.83, No.2, pp105-110.

Guernsey, L. (2001). *Professor who once found isolation online has a change of heart*. New York: New York Times, July 26, 2001

Kneak, W.C. (2001). *Learning Styles: Applications in Vocational Education*, [S.l]: Information Series No.254.

Kraut, (1999). In Guernsey, L. (2001) *Professor who once found isolation online has a change of heart*. New York: New York Times, July 26, 2001.

Plato (360BC). *Phaedrus*, translated by Benjamin Jowett, available on-line http://riccistreet.net/port80/lighthouse/socrates.htm.

Shih, M.Y. and Sorcinelli, M.D. (2000). *TEACHnology:Linking Teaching and Technology in Faculty Development*. Bolton: Anker, To Improve the Academy, 18, p151.

Steyn, A.B. (2001). *Reisverslag: Eindhoven April 2001*. Pretoria: University of Pretoria, Unpublished report

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A Case for Multimedia: Designing a Problem-Based Interactive Learning Environment

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Abstract: This paper discusses the development of a multimedia case study which will provide the opportunity to develop the cognitive and communicative skills in the management of the neurological patient. The authors argue that the substantive structure of the discipline is constructed when the methodology (syntactical structure) of the discipline is implemented. The paper considers elements of an authentic learning environment and discusses the challenges for the instructional designer when designing for authentic learning environments. The paper furthermore provides a brief description of the program and documents the findings of the first formative user evaluation.

Introduction

The implementation of a problem-based curriculum and problem-based learning in the Department of Physiotherapy in the Faculty of Health Sciences at the University of Pretoria has resulted in the development of new learning environments which move away from traditional approaches to physical therapy (physiotherapy) education.

The focus of problem-based learning (PBL) is the integration of facts, concepts, principles, skills and techniques directed at solving a unique clinical problem and the mastery of cognitive, psychomotor and communicative skills inherent to the subject being studied. Problem-based learning aims to reduce the shortcomings of the more traditional approaches to physical therapy education, in which learners focus on the memorisation of facts, concepts, skills and techniques which are then applied to clinical practice.

Eksteen and Slabbert (2001) distinguish between the substantive and syntactical structure of physical therapy as a discipline. The substantive structure refers to the conceptual structure of the body of knowledge of a discipline. The syntactical structure refers to the way in which a body of knowledge about a discipline comes into being or the process implemented to gain new knowledge in a discipline.

Implementation of problem-based curricula and the concomitant adoption of problem-based learning (PBL) approaches to physical therapy education do not implicitly guarantee the successful mastery of the relevant skills. The implementation of problem based learning in the Department of Physiotherapy, University of Pretoria, has been problematic due to factors such as a lack of basic knowledge about the problem-based learning approach and the fact that it is very time consuming to implement this approach. Another concern is that even though the learner collects, analyses, organises and critically evaluates content or knowledge with the primary purpose to use this knowledge in practice, assessment practices focus heavily on the content base of the curriculum. (Eksteen & Slabbert, 2001).

Physical therapy practice always constitutes a problem to be solved as a point of departure, therefore, despite these shortcomings and the concern that problem-based learning as it is currently being implemented is not based on the substantive and syntactical structure of the discipline, physical therapy education should continue to have as its focal point the construction of new meaning through solving relevant problems. Construction of meaning and preparation for the demands of practice can best be achieved within the context of problem solving because problem-based learning is an apprenticeship for real-life problem solving.

Foundations of problem-based learning

Problem-based learning (PBL) has many applications. It can briefly be described as a learning experience during which the learners use an iterative process of assessing prior learning, identifying what they further need to master, gathering information; and collaborating on the evaluation of hypotheses in light of the data collected, in order to solve the problem (Stepien & Gallagher, 1993).

In the process of problem-based learning, learners crisscross a variety of disciplines. They build substantial knowledge bases through increasingly self-directed study. Through collaboration with their peers they refine and extend their skills and knowledge base, within a conceptual framework (of the discipline), in such a way that will promote transfer of knowledge and skills to solve new problems. The learner is continually constructing meaning. The role of the teacher / educator also changes in the problem-based learning approach. Teachers take on new roles in problem-based learning, acting as facilitators, coaches and tutors, probing findings, hypotheses and conclusions, sharing their thinking when students need a model, and encouraging the development of metacognitive skills.

There are three factors which facilitate learning within a problem-based approach:

- prior-knowledge is activated;
- the greater the similarity between the formulated 'problem' and reality, the better the learner's success in acquiring the relevant skills;
- new knowledge is better understood, processed and recalled if the learners have the opportunity to elaborate on the knowledge they have mastered within the conceptual framework of the discipline (Schmidt, 1983).

A study which investigated the processes used by students in developing conceptual knowledge in physical therapy found that the students in the study used an active, experiential approach to learning that included a reliance on the senses during the learning process. The study concluded that the type of learning processes used by students may be enhanced by educational methods such as collaboration and group learning, situated cognition and use of authentic contexts, cognitive apprenticeship and whole-part-whole learning (Graham, 1996).

Instructional design for an authentic learning environment: a case for interactive multimedia

The need for authentic contexts within which to design learning environments and experiences in a physical therapy program has many challenges for the educator. While there may be differences in the exact implementation, all physical therapy education programs have both an academic and clinical component. Learners are required to complete a certain number of hours in the clinical setting. The amount of time spent in the clinical setting does not guarantee that the learners will be exposed to the entire range of problems – both in quantity and complexity - within a specific specialty. There are also many ethical issues which arise when designing learning environments in the clinical setting, which require learners to have mastered the relevant cognitive, psychomotor and communicative skills before entering their clinical blocks.

These constraints could prompt the physical therapy educator to look at alternative methods for providing problem-based learning experiences. Alternatives include practice in a simulated setting in a laboratory and, more recently, the use of technologies such as the world wide web and interactive multimedia. The principal theorists of situated learning have rejected the idea that the computer could provide an authentic learning context, arguing that the courseware becomes the learning environment and not the authentic situation. However, researchers and teachers have continued to explore the model of situated learning using the computer and there is increasing agreement that such technology can be used effectively without sacrificing the authentic context of the learning experience (Herrington & Oliver, 2000).

It was within this context that the Department of Physiotherapy at the University of Pretoria requested funding for the development of a series of interactive multimedia programs, based on the problem-based learning approach, which would engage the learner in an authentic learning environment. The author of this paper is responsible for the instructional design of the program.

Instructional design challenges

Instructional design of interactive multimedia learning environments grounded in a problem-based learning approach needs to consider both the requirements for authentic, problem-based learning and instructional design theory. Development of educational multimedia programs has in recent years largely been driven by constructivist learning theory and traditional instructional systems design.

The task of the designer is to incorporate contextual factors appropriately into the design of interactive multimedia learning environments (Boyle, 2001). The central challenge for educational multimedia designers is to create contexts that promote effective learning. As designers, we need to engage learners in interactive scenarios. We impact on the learner through our skill in creating these contexts. The skilled designer who can design / create the context and interaction in such a way that the actual courseware becomes seamless will have made progress in overcoming the criticism of the situated learning theorists, namely that technology becomes the focus for learning instead of the authentic context.

Description of the program

The content specialist had been afforded the opportunity to capture on video the complete evaluation of patients with selected neurological deficits. The range of problems these patients presented was both unique and complex. Learners in the clinical setting will seldom have the opportunity to perform such comprehensive evaluations. The instructional designer was requested to use all the video footage and the information provided by the content specialist to create an interactive multimedia learning environment with a case study approach as the methodology of choice. The specific module (theme) in the first series of case studies is the management of the patient with an upper motor neuron neurological diagnosis. The content specialist also intends that the program enable the learner to acquire the way in which new knowledge is generated in the discipline - the methodology of the discipline.

The management of the patient is divided into several phases:

- The comprehensive evaluation of the patient – subjective, objective and biomechanical evaluation;
- Identification of the specific problems the patient has (problem formulation);
- Formulating the goals for the management of the patient (goal formulation); and
- Planning the treatment.

Each section has several questions which guide (facilitate) deep learning (construction of meaning). The learner must, in most cases, study the video clip available at that point in the program and then attempt to answer the question. Answers are entered electronically and saved for later retrieval. Once the learner has attempted the answer he/she may viewthe expert answer. There are a total of 22 questions in the program.

Exercises which require the learners to reflect on their success in terms of their competence in the completion of the tasks / questions are included at strategic points in the case study. The aim with the reflection exercise is to facilitate the construction of the conceptual framework (body of knowledge) of physical therapy as learners work through the case study. The expert answers play a key role in the self evaluation and reflection of learners on their process of acquiring the relevant competencies required from them in the clinical field. The process, as well as the competencies learners have to implement while working through the case studies, simulate the syntactical structure of physical therapy as a discipline. The instructional designer designed an interactive approach - the use of game techniques, question and answers and multiple choice questions - to facilitate learner interaction with the content.

The techniques, tools and strategies used by the designer, together with this valuable material, greatly facilitated the creation of a unique learning environment which could be extended far beyond the clinical sessions which a learner could, at most, hope to experience. The latter together with the reflection exercises facilitate self evaluation, the development of metacognitive skills and independent, self-directed learning The option to re-visit such an authentic context, using the electronic medium, also transcends the many ethical problems which arise when working with patients in the clinical environment. Table 1 summarises the design elements which contribute to the problem-based learning approach and the creation of an authentic learning environment.

Foundations of problem-based learning	**Operationalisation in this multimedia/learning environment**
An iterative process of assessment	Opportunity to review expert answer once learner has tried to answer question. Acquiring relevant knowledge / recognition of prior learning while observing the physiotherapist interact with the patient. Assessment of contribution in group discussion classes.
Collection of information	Review of knowledge base at appropriate points in lesson.
Collaboration	If learners use the multimedia in groups, otherwise the educator plans to have group discussions after the multimedia has been used.
Integration of various disciplines	Knowledge base from various disciplines embedded into program.
Modeling by educator	Provision of expert answer.
Application of metacognitive strategies / Reflection	Interaction designed specifically to enable reflection of progress – at least three points in program where this occurs.
Elements of authentic learning (Herrington & Oliver, 2000)	**Operationalisation in this multimedia/learning environment**
Provide authentic contexts that reflect how the knowledge will be used in real life.	Case study approach using video footage of an actual case.
Provide authentic activities.	Management of a current case (not constructed for teaching / learning purposes)..
Provide access to expert performances and the modeling of processes.	Can always view expert answer.
Provide multiple roles and perspectives.	Learner observes both physiotherapist evaluating the patient and the patient, although cannot hear patient communicate.
Support collaborative construction of knowledge.	Not explicitly embedded into design of multimedia. The case study is also discussed in a contact session during which collaborative construction of knowledge could occur
Promote reflection to enable abstractions to be performed.	Interaction designed specifically to enable reflection of progress – at least three points in program where this occurs.
Promote articulation to enable tacit knowledge to be made explicit.	Learner required to enter own answer and submit this / use it as basis for class discussions.
Provide scaffolding, learning facilitation and coaching at critical times.	Use of expert answers, availability of theoretical knowledge at selected points in the program.
Provide for authentic assessment of learning within the tasks	Entire case study approach to the learning environment.

Table 1: Operationalisation of design elements to meet criteria for problem-based and authentic learning

Evaluation of the program

Due to the fact that the design and use of multimedia for problem-based learning is a new experience for the instructional designer, content specialist and learners it was decided to commence with formative evaluation very early in the development cycle. Development commenced in March 2001 and the first evaluation was conducted

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in September 2001. Thirty seven final year students, who were due to write their final examination in October 2002, participated in the evaluation. Both the instructional designer and the content specialist designed questionnaires for the learners to complete at the end of the evaluation session. The instructional designer also observed the learners using the program. The content specialist focused on the learner's perceptions of the contribution of the program to the learning process. The instructional designer looked at elements of the instructional design which could both positively and negatively affect their learning. Particular attention was paid to navigation issues.

At the time of evaluation some of the expert answers had not yet been finalised, the knowledge base was only available in a dull, non interactive text -based format and no help screens had been designed. The learner also had limited control over certain features of the program. This included control over the video clips and the ability to navigate backwards and forwards in the program. It had been decided that the learners had to work through the questions in the exact order determined by the content specialist. Learners could only return to previous screens by following a linear path through the program. The programming required when using the multimedia in a computer laboratory rather than a stand alone PC was also not complete. The first evaluation session aimed to investigate some of the functionality of this programming. The instructional designer anticipated that there might be some problems with the manner in which learner input was stored and displayed. These potential problems were communicated to the students at the beginning of the evaluation session.

Evaluation of the instructional design and learning environment

The open-ended questions in the questionnaire generated a host of responses. The responses were categorized and the number of responses in each category quantified. Tab.2 summarises the design elements which the learners liked and which contribute to an effective learning environment. Tab 3 summarise the design elements which the learners disliked and which could negatively influence effective learning.

Instructional and interface design elements	**Strategies / techniques which create an authentic learning environment**
Program is easy to use. There was control over the pace at which learning occurs. Learners had control over the number of times they could return to previous video clips, expert answers and content screens. 'Good' colour. Well organized and 'fluent'. Audiovisual presentation supports the information. Legible. Nice graphics. Liked the display of own answer next to the expert answer	The expert opinion which was always available after learner had completed a question (n=19). Good quality of the video. Expert answers are very comprehensive. Content of video clips relevant. Program simulates the way in which the physical therapist thinks when evaluating a patient. Clips and sound clear and very descriptive. Aspects which the learner needs to focus on are highlighted by the very nature of the question Informative. Opportunity to attempt to answer the question before viewing the expert answer.

Table 2: Design elements which the learners liked and which contribute to an effective learning environment

Design elements which could negatively influence the learning environment	**Elements which are part of an authentic learning design and environment**
Lack of control over the video clips – cannot pause, rewind. Lack of control over navigation in program – bound by the linear navigation path Lack of information about how long the video clip is. Did not like the voice over – would have liked to hear the patient speak. Were not able to see how many questions still had to be completed. Expert answers were too long - would have liked them	Have to remember a lot of detail in the clips and some of the clips provide an answer to other questions in the program Have to concentrate really hard Some of the answers are complex

to be more concise and to the point, presented as a bulleted list Lack of information about how to use the program. Program was very long and time consuming Parts were very monotonous Content screens contained a lot of information	

Table 3: Design elements which the learners disliked and which could negatively influence effective learning

Some of the problems experienced during the evaluation related to the incompleteness of the program and the fact that some of the programming appeared to be incorrect. A few students commented on the inappropriateness of the content of the expert answer to the question.

Future direction for the development

Despite the problems and many suggestions for improvement, the overall impression was that learners perceived the program as a useful tool which is both comprehensive and thorough. During the evaluation learners were requested to provide suggestions for improving the program. The most frequent request was for better control over the video clips and navigation in the program. Some of the comments seemed to indicate that the interface design and navigation were not yet seamless. Learners should not have to waste time struggling to use the technology, but should rather be able to interact effectively with the learning environment.

Further development will focus on implementing the suggestions and improving and refining the design. The content specialist will also be looking at the formulation and layout of some of the expert answers as well as limiting the questions to those which facilitate learning most effectively - avoiding questions which make the duration of the programme too long.

Conclusion

The development of a multimedia program using a case study approach to problem solving is in itself an authentic learning experience, especially when the case study is based on a real patient. The challenge for the instructional designer is to consciously design the learning elements in such a way that the nine criteria for an authentic learning environment are operationalised and that the focus remains on the learning environment and not the technology.

References

Boyle, T., (2001). Towards a Theoretical Base for Educational Multimedia Design. *Journal of Interactive Multimedia Design*. Pre-print Under Review.

Eksteen, C.A. & Slabbert, J.A., (2001). Problem-Based Curricula and Problem-Based Learning in Physiotherapy: A Critical Review. *South African Journal of Physiotherapy*. 57(4), 23-28.

Graham, C.L., (1996). Conceptual learning processes in physical therapy students. *Physical Therapy*. 76(8), 856-866.

Herrington, J. & Oliver, R., (2000). A Framework for Authentic Learning Environments. *Educational Technology Research and Development*. 48(3), 23-48.

Schmidt, H.J., (1983). Problem-based Learning: Rationale and Description. *Medical Education*. 17:11-16

Stepien, W. & Gallagher, S., (1993) Problem-based learning: as authentic as it gets. *Educational Leadership*. 50(7), p 25.

Learning to Integrate Technology in the Classroom:

A Case-Based Reasoning Approach

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Abstract: This paper offers a new perspective in teachers' education regarding the effective technology integration. The core theoretical background is Case based Reasoning. We develop a knowledge repository filled by indexed stories collected directly from teachers who use technology in their classrooms. The index is developed and under continuous revision according to the experience we gather through the interviews. The stories are collected and the system developed by a consortium of eight universities. The stories can be retrieved in a Web-based interface, that is powered by a custom made engine, that uses a near-neighbor algorithm. Future research will be around the use of this system by teachers and teacher educators.

Rationale

A 1998 National Center for Education Statistics (NCES) study, *Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers*, that although many educators consider technology as a vehicle for transforming education, only 20 % feel well prepared to integrate technology into the classroom. To improve the level of technology integration, a 1999 study entitled *Will New Teachers be Prepared to Teach in a Digital Age?* recommended that researchers, professional societies, and education agencies should identify, study, and disseminate examples of effective technology integration on an ongoing basis.

Mission

In order to meet these challenges to educate tomorrow's teachers to effectively integrate technology in their classroom instruction, we at the University of Missouri have begun the Knowledge Development for the Technology Integration Community Project. This project is a Catalyst grant from the U.S. Office of education that involves a consortium of eight partners institutions collaborating to address issues in creating and diffusing technology integration knowledge.

The project's mission is to build a K-16 community of practice through a case library of teacher stories about technology integration. In order to fulfill this primary goal, we have designed a case library for teachers and teacher educators and are currently collecting and indexing cases to be added to our case library. Once completed, teachers and teachers' educators will be able to access successful and unsuccessful attempts to integrate technology from the case library. The case library is being built according to principles of case-based reasoning.

Theoretical Background – Case based Reasoning (CBR)

In order to educate teachers and teacher educators to effectively integrate technology into instruction, we should expose them to stories generated by other teachers. One way to do this is by exposing them to narratives or stories or cases that have been compiled into a case library (database of stories made available to learners as a form of instructional support). Why should we do this?

Supporting learning with stories can help new teachers and teacher educators to vicariously gain experience. Some researchers believe that hearing stories is tantamount to experiencing the phenomenon oneself (Ferguson, Bareiss, Birnbaum, & Osgood, 1991). This kind of reasoning (reasoning from stories or cases) provides support for "inferences necessary for addressing the kinds of ill-defined or complex problems that come our way in the workplace, at school, and at home" (Kolodner, 1997, p. 58). The process of understanding and solving new problems using case libraries has three parts: recalling old experiences, interpreting the new situation in terms of the old experience based on the lessons that we learned from the old experience, or adapting the old solution to meet the needs of the new situation (Kolodner, 1993).

This whole process is described by Aamodt and Plaza (1996) as the CBR cycle. An encountered problem (the new case) prompts the reasoner to retrieve cases from memory, to reuse the old case (i.e. interpret the new in terms of the old), which suggests a solution. If the suggested solution will not work, then the old and or new cases are revised. When the effectiveness is confirmed, then the learned case is retained for later use. The main process in developing a Case Based Reasoning tool for problem solving is as presented by Jonassen et al (1999).

Collecting and Indexing Stories

Currently, we are collecting stories to be included in our case libraries. The story collection process is being carried out by Knowledge Scouts at eight different institutions. These scouts are making appointments with teachers in schools and interviewing them. We applied elements of the critical incident method into our interview strategies. The interviewers then transcribe the interviews, and the team at Missouri will index the interview and build narrative sequences out of the interview.

Building the Retrieval Engine

For the retrieval, we use a near-neighbor algorithm to match a query-case (given by any user at our web-based interface) with existing cases. For this purpose the query case will be converted into a feature vector, and therefore can be used in the knowledge repository. The user-friendly interface is a web-based,dynamically created out of our Oracle database and allows the user to search and browse.

Future research

When we have added and indexed a sufficient number of cases into the library, we plan to begin studying how teachers and teacher educators will use the case library. We hope to be able to present research findings on these questions at the next conference.

References

Aamodt, A. & Plaza, E. (1996). *Case-based reasoning: Foundational issues, methodological variations, and system approaches*. Artificial Intelligence Communications, 7 (1).

Ferguson, W., Bareiss, R., Birnbaum, L., & Osgood, R. (1991). *ASK Systems: An Approach to the Realization of Story-Based Teachers*. The Journal of the Learning Sciences, 2(1), 95-134.

International Society for Technology in Education (no year). *Standards for Basic Endorsement in Educational Computing and Technology Literacy*, http://iste.org/standards/nacate/ last visited at 10/05/2001

Jonassen, D.H., Tessmer, M., & Hannum, W.H. (1999). *Task Analysis Methods for Instructional Design*.

Kolodner, J. (1993). *Case-based reasoning*. New York: Morgan Kaufman.

Kolodner, J. L. (1997). *Educational Implications of Analogy—A View from Case Based Reasoning*, The American Psychologist, 52(1), 57-66.

Debunking the Buzz Words OR Can hermeneutic analysis be used to evaluate pedagogically based learning objects designed from constructivist epistemological ontologies defined in XML Metadata?

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Arguably the biggest 'buzz word' of the current year has been 'learning or knowledge object'. To understand the learning object and why it should be such a highly desirable commodity, we need to unpack not only this concept but more importantly revisit some contributing concepts and constructs (more buzz words) that support the building of truly pedagogically informed reusable objects (Boyle & Cook 2001). The words and relationships explored in this paper are:

- **Learning or knowledge objects** - the desirable construct in today's E-learning environment.
- **Ontologies** and ways of expressing them through **topic maps** as they allow us to define and describe the components of an entity
- **Metadata and XML** used to create categorise, label and communicate the value of these objects
- **Hermeneutics and phenomenology** as they refer to the interpretation of experience and events and evaluation of learning events

Learning or knowledge objects

Learning objects (also known as knowledge or instructional objects) are digital learning events that are discrete, reusable, able to be aggregated and are tagged with defining Metadata. The impetus for the development of learning objects comes as much from not wanting to reinvent the wheel as wanting to find ways to adequately define and categorise online instructional events. The form, size and shape of these learning objects can be as varied as the respective face-to-face events from lecture, course or discussion to simulation and role-play.

Downes (2001) succinctly describes the programming roots of learning objects. *To delve more deeply into the construction and organization of learning objects, it is necessary to introduce another concept from computer programming, object-oriented design (e.g., Montlick, 1999). The idea behind object-oriented design is that prototypical entities, once defined, are then cloned and used by a piece of software as needed.* (Downes 2001 pp 7)

Speaking from an educational perspective, Reigleuth and Nelson (1997) propose that the breaking down into instructional components (learning objects) is akin to the typical practice of instructors when they develop a course or learning sequence. The content and relationships are broken down and the learning strategy and evaluation is then selected for each component. However it is the technological not the educational agenda that dominated the earliest discussions of development, categorisation and location of learning objects. We cannot deny the importance of this aspect, for reusable objects would not find users if the content and form were not able to be effectively defined, described and delivered. More recently and very importantly there has been a cry for pedagogical aspects of learning objects to drive the process of development and definition. (Boyle & Cook 2001, Ip & Morrison 2001) Indeed Ip & Morrison would draw us back to the programming roots of the term learning objects and propose that until the contextual rendering of these objects occurs they are not learning objects at tall but digital resources.

The issues that surround the value of the seemingly simple concept of learning objects appear manifold and go directly to the heart of the nature of instruction. The actual objects, their granularity, interoperability and reusability and how the learning event/s or exchanges they involve can be fully described, identified and evaluated are topics for hot debate. How small do components need to become to be discrete and reusable? What exactly does it mean for a learning object to be reusable? For whom is it reusable and can it be rendered for all learning contexts and paradigms? How will instructors be able to identify and select the appropriate learning objects for their instructional context?
Can these learning objects be seen as dynamic and iterative in an evaluation cycle involving their users? We hope to touch on some of these issues and highlight some of the key researchers working through these issues.

Epistemological Ontologies

Traditionally ontology dealt with the area of metaphysics, which defined the fundamental distinct entities to which existence could be ascribed. Within a particular area of interest, such as that of Teaching and Learning Systems, we need to qualify this to allow a plurality of ontologies of which a specific one constitutes a valid domain in its own right. Smith (Smith, 1998) thus distinguishes R-ontology (reality-based ontology) and E-ontology (epistemological ontology). While the first deals in the general meaning of 'being', the second provides the basis of a conceptualisation of a particular domain.

Ontology construction of this kind is now an accepted tool in a number of disciplines. In the field of Geographic Information Systems, for instance, Fonseca and Egenhofer describe one such system thus. *Ontology plays a central role in the definition of all aspects and components of an information system in the so-called ontology-driven information systems. The system presented here uses a container of interoperable geographic objects ... This approach provides a great level of interoperability and allows partial integration of information when completeness is impossible* (Fonseca & Egenhofer, 1999 pp.14). Researchers have described the value of this process, even at an intermediate or tentative stage. Gaede and Stoyan state, *Supposing that universally valid terminology is neither near nor realistic, partial domain as well as pedagogical ontologies ... have already proven fruitful.* (Gaede, & Stoyan, 2001 pp. 535).

Epistemological ontologies form a suitable area for the use of these methodologies. Of particular relevance to learning systems, constructivism offers one such radical approach, which has been characterised as *an epistemology of learning rather than a framework of teaching* (Nunes, McPherson, Rico, 2001). Thus it has been argued that *A constructivist epistemology views knowledge as a construct of individual's understanding. When individuals come together, such as in a learning environment, their construction undergoes continuous revision due to cognitive conflict which occurs as a result of different constructions among individuals.* (Hendriks & Maor, 2001 pp. 732).

Nevertheless, even this social constructivist viewpoint still poses the question of how methodologically a constructivist epistemology can be incorporated in an objective model of learning. One approach to this we could postulate would be to attempt to derive a constructivist epistemological ontology. This would allow the interfacing and inter-relating of different constructivist models into a single coherent working framework. Would this aim violate the underlying principles of constructivism? This need not be the case as the process of ontology derivation itself, as dynamic and subject to progressive development, could be considered within the constructivist framework, as an activity at a meta-level, carried out by constructivist educational practitioners rather than the learners themselves.

Ontology construction can also employ techniques, such as conceptual graphs and topic maps. Futhermore, development environments exist that will allow these in turn to be mapped to HTML/XML representations. For instance, the collaborative environment, Veda (Prata, Paraguacu & Reis, 2001 pp.1512), is described in the following manner. *The conceptual graphs ... provide a form to represent knowledge through the ontology (application domain) and logic (logical first-class). Following its formalism, we can represent graphical form in linear form and create a computational model. This computational model together with the features of hypertext, allows indexing the knowledge in HTML format.* In addition to the techniques discussed earlier for ontology development generally, the process of constructivist ontology construction can draw on a variety of other techniques from various fields. Stutt, for instance, suggests the use of "ontological and other (problem solving) categories from knowledge engineering, a basically constructivist rather than mirroring approach to knowledge and, finally, computational models of and computer support for argumentational structures" (Stutt, 1997). It is an approach similar in principle to this, which could utilise topic map representations to derive learning objects implemented in XML, that we intend to investigate further.

Conceptual Graphs and Topic Maps

Topic Maps: ISO standard (ISO 13250, http://www.y12.doe.gov/sgml/sc34/document/0129.pdf) in its SGML/HyTime-implementation. Final 1.0 version of the XML http://www.topicmaps.org/xtm/1.0/ .

The technology of topic maps is nothing but formalising relationships of concepts using topics, associations and occurrences, in a machine-readable and platform independent format. The connection to the real world and its learning material is maintained by links called "occurrences", which allow for linking out of the abstract topic cloud to files, URLs, or learning objects in a learning environment.

From a technical standpoint, topic maps can be represented using valid XML documents with basically three different sorts of elements: topics, associations and occurrences. A topic is anything the designer of the map wants it to be, mostly the abstract representation of a "thing" or a concept, which is connected to other things via associations. These associations are themselves topics, and an association has roles for the two topics it connects, defining the role each connected topic is playing in the association. With this set of elements it is possible to structure and represent an ontology in an abstract and technologically independent manner. The topic map itself is created while parsing ("reading") the topic map exchange document and building the n-dimensional mesh of topics and associations in the memory of the computer.

When two topics are merged, the result is a single topic whose characteristics are the union of the characteristics of the original topics, with duplicates removed. It is an approach similar in principle to this, which could utilise topic map representations to derive learning objects implemented in XML that system designers need to investigate further. Consider if we chose a given a domain, for instance civil engineering, where it is rather easy to divide the domain into basic concepts (such a concept would be "Newton" – apple falling from tree…). Then it should be possible to create a topic map made out of these concepts and linking associations, thus covering the domain knowledge on an abstract level. The next step is to mediate these concepts through learning objects such as course material or resources (text, animation, movie and audio) which itself is built so that it is basically context-free, modular, reusable in different places. Given those two conditions a learner might 'walk' his/her way not only through predefined paths (defined by teacher for a certain course or lesson), but also leave the path and look via the topic map to adjacent topics, and from there to other learning objects.

XML and Metadata Standards

XML, Extensible Markup Language is a W3C recommendation (not yet a standard), derived from SGML (ISO standard), somewhat similar to HTML, as it is markup, but with freely definable tags.

Metadata is commonly described as being "Data about data", which provides a means by which the multimedia's semantics can be described in a structured fashion for use by various applications. More technically Metadata is standardized information to describe digital information resources (Dorner, 2000 pp. 74). Metadata can be seen as sets of rules and meaning/usage of tags lead to the following specifications: IMS, Dublin Core, LOM, SCORM, and EML. On a higher level Metadata can be viewed as technical/administrative Metadata vs. didactical Metadata http://eml.ou.nl/forum/faq/index.htm#A10.

It is possible to define one's own tags, which allow a parser to know what text between tags (element) *is*. This gives not only the freedom to separate the content from the formatting (big advantage, as we can now reformat according to the *meaning* or *being* of an element), but also the freedom to define things according to our needs. This includes the possibility to set up rules allowing or forbidding the existence of an element at a certain position (e.g. within other elements) using DTDs or schemata a parser can determine the *validity* of a given XML document against a given set of rules. With this, we have a first step towards the computational model mentioned; machine readable content with mark-up allowing for meta-information and meaning.

Holzinger et al (2001), Kassanke et al (2001) and Bick et al (2001) very ably unpack the development and need for educational Metadata and the instructional uses of XML. *Current approaches more or less focus on the representation and structuring of learning contents, e.g. the Learning Material Markup Language (LMML) (Suess, 00). Another good example for the increased significance of XML in CAL is the XML binding for the Instructional Management Systems Project (IMS) Learning Resource Meta-data Information Model, which is based on the IEEE Learning Technology Standards Commitee (LTSC) Learning Object Metadata (LOM) base document (Anderson, Wason, 00).* (Bick et al 2001 pp. 145)

The indexing could occur in a broader Metadata framework using such emerging tools as the Open Archives Metadata Harvesting Protocol, an important new infrastructure component for supporting distributed networked resources. The Protocol is a mechanism that enables data providers to reveal their chosen Metadata, whether it be XML or some other. This approach brings ontological construction into a more comprehensive systems and services architecture (Lynch, August 2001).

What kinds of issues need to be considered pedagogically? The current IMS specifications contain implicit pedagogical models. The absence of a generalized representation of pedagogical models has the potential to lock out other models, and indeed ones that have yet to be developed. This could lead to all kinds of practical problems, especially in terms of interoperability. The EML philosophy is that EML should be capable of a complete description of a course, including the content, the work processes between the actors (learners and staff), and that this description should be independent of the LMS (learning management system) is order to ensure long-term interoperability, sustainability and opportunities for re-use.

Hermeneutic Analysis

Hermeneutics and phenomenology are closely linked and although they share common concerns, they offer different perspectives. Phenomenologists focus on the lived experience of people, and seek out the commonalties and shared meanings, whilst hermeneutics refers to an interpretation of language. Hermeneutics derives from the Greek noun 'hermeneia' which translates as 'interpretation'. Hermeneutics has a dual value in helping educators to understand how learners experience both conceptual change and how they use the new e-learning environments, and hence it has insights to offer in terms of usability testing and evaluation. In this sense hermeneutics can offer a model for pedagogy, to promote active learning, whilst at the same time acting as a research tool for exploring the individual and collaborative learning experience (Rogoff, 1990).

As a research methodology, hermeneutics assumes that meaning making is embedded in the process of dialogue between interpreter and narrator. The hermeneutic circle is a way of articulating and interpreting discourse. Hermeneutic phenomenology is based on the philosophy of Heidegger and Gadamer (van Manen, 1990). Hermeneutic phenomenology is both descriptive and interpretative. It is an attempt to do the impossible, *to construct a full interpretation of some aspect of the life-world, and yet to remain aware that life is always more complex than any explication of meaning can reveal.* (van Manen, 1990 pp.18)

A conception always has two dimensions, one focusing on *what* people experience, i.e. the *content* or the referential aspect, and the other focusing on *how* someone thinks about the specific phenomenon, i.e. the *structural* aspect. (Marton, 1996) According to phenomenography, knowledge is always linked to specific content and can only be described as knowledge about something. This means that knowledge is always provisional and qualitative. To become more knowledgeable in a subject implies a qualitative change to a deeper and more complex understanding of a phenomenon. Marton's work is a key influence in establishing a phenomenographic approach to researching learning and teaching. Knowledge objects can be designed to engage students in deep learning, which promotes real understanding. By students engaging in critiques of existing theories and ideas new knowledge and understandings can arise. (Marton & Booth, 1997)

Phenomenography offers a unique approach to understanding student experiences. The process can uncover the essence of a phenomenon by gathering stories from students engaged with learning objects in an e-learning environment, interpreting those stories and offering implications for practice. It is akin to action research in that the students are not simply subjects of the study, but active participants. The research process creates opportunities for reciprocal learning, metacognitive learning for the student and an awareness of how the e-learning environment is experienced by the researcher.

Hermeneutic analysis can show the development of varying perspectives from which individual learners understand a task. It can also track the development of a joint approach to a collaborative task and can illuminate the process of learning. A fine-grained hermeneutic analysis can provided a framework for 'listening to' what learners can tell us about the appearance of the shared space to individual contributors. It can tell us how individual perspectives are different from one another, and from our own as researchers or as instructional designers. This insight will prove to be vital when evaluating the effectiveness of electronic learning materials designed to foster a social construction of knowledge.

Conclusion

Can hermeneutic analysis be used to evaluate pedagogically based learning objects designed from constructivist epistemological ontologies defined in XML Metadata? It really isn't just a string of highfalutin buzzwords but a question to stimulate thinking about the full cycle of development of learning objects. This paper set out to explore is the nexus of conceptual and theoretical foundations, systems design and current pedagogical frameworks found to be relevant on the road to developing true learning objects. If we can begin by investing the time to construct thick epistemological ontologies and make explicit ontology/ies through representational tools like topic maps, we can begin to answer the detractors who see learning object development agenda as being stolen by programming considerations. These topic maps in turn can be translated into the rich data carriers and renderings possible with XML and Metadata. The representation of the domain in related and merged topic maps has the potential to allow learners to articulate, direct, share, relate and critique the learning experience from their personal perspective. The hermeneutic analysis discussed here gives designers and instructors the opportunity to do that listening to learners. In terms of usability testing this approach offers insights into how learning is experienced, not simply how the instructional designer conceptualises it. The learning process is not separate from specific learning content and context. The learning experience is a composite of the learner, the domain and the e-learning environment.

References

Bereiter, C., & Scardamalia, M. (1993). *Surpassing Ourselves-an inquiry into the nature and implications of expertise*. Chicago, Illinois, USA: Open Court.

Bick, M., Pawlowski, J.M. & Veith, P. (2001). The Essen Learning Model - A Step Towards a Representation of Learning Objectives. In C. Montgomerie, & J. Viteli (Eds.). *Proceedings of ED-MEDIA 2001: World Conference on Educational Multimedia, Hypermedia & Telecommunications*. Tampere, Finland, June 25-30, 2001. Norfolk, VA: Association for the Advancement of Computing in Education (AACE) ISBN: 1-880094-42-8. pp. 145-150

Boyle, T. & Cook, J. (2001) Towards a pedagogically sound basis for learning object portability and re-use. In G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds), *Meeting at the crossroads*. Proceedings of the 18th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (pp. 101-109). Melbourne: Biological Multimedia Unit, The University of Melbourne.

Clifford A. Lynch (2001), "Metadata Harvesting and the Open Archives Initiative," *ARL: A Bimonthly Report on Research Library Issues and Actions 217*(August 2001).

Dorner, Dan (2000): Cataloging in the 21st century — part 2: digitization and information standards. *Library Collections, Acquisitions & Technical Services*, 24, 73-87.

Downes, S. (2001) Learning Objects: Resources For Distance Education Worldwide International Review of Research in Open and Distance Learning (2001) ISSN: 1492-3831 Available: [Accessed December 20, 2001]

Ekeblad, E., & Lindstrom, B. (10/12/2001). *Collaboration as Pedagogy, Collaboration as Window*. Available: http:/www-cscl95.indiana.edu/cscl95/ekeblad.html [Accessed December 20, 2001]

Fonseca, F., Egenhofer, M.J. (1999) Ontology-Driven Geographic Information Systems, *7th ACM Symposium on Advances in Geographic Information Systems, Kansas City, MO, 1999, p14-19*

Gaede, B., Stoyan, H. (2001) A Generator and a Meta Specification Language for Courseware, *Proceedings of Ed-Media 2001, p533-539*

Hendriks, V., Maor, D. (2001) Understanding the Quality of Students' Interactions through Computer Conferencing in Higher Education from the Social Constructivist Perspective, *Proceedings of Ed-Media 2001, p730-735*

Holzinger, A., Kleinberger, T. & Mueller, P. (2001) Multimedia Learning Systems based on IEEE Learning Object Metadata (LOM) In C. Montgomerie, & J. Viteli (Eds.). *Proceedings of ED-MEDIA 2001: World Conference on Educational Multimedia, Hypermedia & Telecommunications*. Tampere, Finland, June 25-30, 2001. Norfolk, VA: Association for the Advancement of Computing in Education (AACE) ISBN: 1-880094-42-8. pp. 772-777

Ip, A. & Morrison, I., (2000). Learning objects in different pedagogical paradigms In G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds), *Meeting at the crossroads*. Proceedings of the 18th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (pp. 289-298). Melbourne: Biological Multimedia Unit, The University of Melbourne.

Kassanke, S., El-Saddik, A. & Steinaker, A. (2001) Learning Objects Metadata and Tools in the Area of Operations Research. In C. Montgomerie, & J. Viteli (Eds.). *Proceedings of ED-MEDIA 2001: World Conference on Educational Multimedia, Hypermedia & Telecommunications*. Tampere, Finland, June 25-30, 2001. Norfolk, VA: Association for the Advancement of Computing in Education (AACE) ISBN: 1-880094-42-8. pp. 202-206

Marton, F. (1996). Cognosco ergo sum- Reflections on reflections. In G. a. H. Dall'Alba, B. (Ed.), *Reflections on Phenomenography. Towards a Methodology?* (Vol. 109, pp. pp 163-187). Goteborg: Goteborg Studies in Educational Science.

Marton, F., & Booth, S. (1997). *Learning and awareness*: Mahwah, N.J: Erlbaum.

Nunes, J.M.B., McPherson, M., Rico, M. (2001) Constructivist Instructional Design and Development of a Networked Learning Skills (NICLS) Module for Continuing Professional Education Distance Learning. *Proceedings of Ed-Media 2001, p86-91*

Prata, D.N, Paraguacu, F., Reis, A. (2001) A Collaborative Environment for Visual Representation of the Knowledge on the Web – Veda. *Proceedings of Ed-Media 2001, p1512-1513*

Smith, B. (1998) An Introduction to Ontology. In D. Pequet, B. Smith, B. Brogaard (Ed.), *The Ontology of Fields*

Reigleuth, C. M. & Nelson, L. M. (1997). A new paradigm of ISD? In R. C. Branch & B.B. Minor (Eds.), *Educational media and technology yearbook* (Vol. 22, pp. 24-35). Englewood, CO: Libraries Unlimited.

Rogoff, B. (1990). *Apprenticeship in thinking; Cognitive development in social context*. New York: Oxford University Press.

Stutt, A. (1997) Knowledge Engineering Ontologies, Constructivist Epistemology, Computer Rhetoric: A Trivium for the Knowledge Age, *Proceedings of Ed-Media 1997, p1914-1919*

van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy*. New York: State University of New York Press.

Vygotsky, L. S. (1978). *Mind in Society*. Cambridge MA: Harvard University Press.

Introducing a "Means-End" Approach to Human-Computer Interaction: Why Users Choose Particular Web Sites Over Others

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Abstract: Gutman's means-end theory, widely used in market research, identifies three levels of abstraction - attributes, consequences, and values - associated with the use of products, representing the process by which physical attributes of products gain personal meaning for users. The primary methodological manifestation of means-end theory is the laddering interview, which is claimed to generate better insights than other qualitative/ quantitative methods. This study asked: Can means-end theory, and its concomitant laddering methodology, be successfully applied in the context of human-computer interaction research, specifically to help understand the relationships between Web sites and their users? The study employed laddering interviews to elicit data concerning Web site attributes, their consequences, and user end-values. This data was duly processed and the results were subsequently appraised. Examination determined that means-end chains indeed characterize the process by which physical attributes of Web sites gain personal meaning for their users, thus proving the theory's applicability.

Introduction

Gutman's means-end theory (see Gutman 1982), which discusses the core underlying values that motivate consumers' purchase decisions, is immensely popular in the marketing research community (Peter & Olson 1994), and enjoys an impressive track record in the commercial sector where it is often used to generate message strategy themes for promotional campaigns (Gengler et al. 1999). The most common methodological manifestation of means-end theory in the field of marketing research is laddering, a method by which the core attributes and values that motivate product users are identified through a special form of in-depth, one-on-one interviews that force the respondent up a ladder of abstraction, thereby bridging relatively concrete product meanings at the product attribute level with more abstract meanings at the consequence and personal value levels (Gengler et al. 1999).

In support of laddering, Fortini-Campbell (1990) claims that other quantitative/ qualitative social scientific research methods – such as focus groups, surveys, and demographic information – often fall short of generating key insights about a product and of identifying a target audience in concise and well-defined terms, since common responses to the question of why a person chooses a particular product do not even begin to describe the deep underlying psychological and emotional reasons that influence people's choices.

Meanwhile, the celebrated consumer psychologist and University of Minnesota Professor Emeritus Dr. William D. Wells suggested to this researcher that means-end theory could very well prove to be *an excellent point of reference for unearthing the underlying core values that motivate Web site users as well*, and that he did not know of any prior studies that have used this theory in the substantive context of Web usage, or anywhere else within the broader field of human-computer interaction or HCI (W. D. Wells, personal communication, July 2000).

This study could therefore be a potentially valuable introduction of this new theoretical and methodological framework to the field of Web usage research in particular, and HCI in general. It is hoped that the insights uncovered by this study – along with those generated by subsequent studies of a similar nature – could be subsequently drawn upon to describe and delineate the characteristics of distinct Web user segments, through the use of techniques such as consumer prototyping, at an appropriate future occasion. Information of this nature would be of great potential significance to academic researchers, as well as to professionals in the Web industry.

Research Question

This research study essentially poses the question: Can means-end theory, and its concomitant laddering methodology, be successfully applied in the context of human-computer interaction research, specifically to help understand the relationship between Web sites and their users? The study attempts to explore this question by employing a laddering methodology with the aim of eliciting data concerning the site-attributes, consequences, and end-values that motivate Web users to choose particular Web sites over others. With the resultant data at hand, detailed analysis can be done to conclude if means-end theory is indeed useful in the context of Web usage in particular, and HCI in general.

Review of Literature

Means-End Theory

Means-end theory examines the important meanings that users associate with the products they choose and consume, by distinguishing three levels of abstraction associated with the use of a product (Olson & Reynolds 1983): product attributes; consequences of product consumption; and personal values of the user. Product attributes are concrete meanings that represent the physical or observable characteristics of a product. Consequences of consumption are more abstract meanings that reflect the perceived benefits/costs associated with specific product attributes. Finally, personal values are highly abstract meanings that refer to centrally held, enduring beliefs, or end states of existence, that people seek to fulfill through their choice and consumption behavior (Rokeach 1973). Taken together, this pattern of associations from attributes to consequences and from consequences to personal values represents a special type of knowledge structure called a means-end chain (Gutman 1982, Howard 1977, Olson et al. 1983). The means-end chain model provides a simple way of characterizing the basic pattern of relationships by which the physical features or attributes of products gain personal relevance or meaning for users (Gengler et al. 1999).

Laddering

Laddering is the principal methodological manifestation of means-end theory. It is a technique by which the core attributes and values that drive product users are identified through a special form of in-depth, one-on-one interviews (Wansink 2000). This procedure is called laddering because it forces the respondent up a ladder of abstraction, and thus bridges relatively concrete product meanings at the attribute level with more abstract meanings at the consequence and personal value levels (Gengler et al. 1999). This is done by repeatedly asking "Why is that important to you?" questions. Data gathered by laddering interviews is analyzed to produce an accurate depiction of the concepts germane to the decision and the relationships between associated concepts, facilitating inferences and enabling the researcher to identify patterns that might not be evident in the raw data (Gengler et al. 1995, 1999).

Reynolds & Gutman, in their seminal (1988) article, describe the processing of laddering data as follows: The initial task of the data processing is to content-analyze all of the elements from the ladders, recording the entire set of ladders across respondents on a separate coding form, and developing a set of summary codes that reflect everything that was mentioned. Once the summary codes are finalized, numbers are assigned to each. These numbers are then used to score each element in each individual respondent's ladder. The next step involves the construction of an implication matrix, which displays the number of times each element leads to each other element. Once the implication matrix has been prepared, a hierarchical value map (HVM) can be constructed, which graphically represents all the respondents' ladders in the aggregate. Once a HVM is constructed, one typically considers any pathway from bottom to top as a potential chain representing a perceptual orientation that warrants consideration.

Reynolds & Gutman (1988) claim that that such quantitative processing of qualitative interview data is one of the unique aspects of laddering. They cite several particularly valuable types of information afforded by HVMs obtained through laddering procedures, which can serve as a basis for segmenting users with respect to their value orientations for a product class or brand; assessing brands or products in a fashion similar to the use of more traditional ratings; evaluating competitive advertising; and developing advertising strategies.

Method

Interviewing

As part of the study, 50 in-depth laddering interviews were conducted. Through these interviews, an attempt was made to examine two different kinds of Web site use by respondents: use for primarily entertainment purposes; and use for primarily information gathering purposes. These distinctions were made on the basis of several preliminary interviews with random Web users, which suggested that they generally browsed the Web either to gather information relevant to their professional lives, or to access content that contributed to their personal lives by entertaining them. To operationalize the distinctions for the purpose of this study, a particular Web site was deemed an "entertainment" site if the respondent described his/her use of the site as primarily entertainment-oriented; and was deemed an "information" site, if the respondent described his/her use of the site as for primarily information gathering purposes. Of the 50 laddering interviews, 25 concentrated on entertainment Web sites and the other 25 on information Web sites.

The laddering interviews were conducted over the first four months of 2001. Respondents for the interviews were of diverse ages and ethnicities, came from varied walks of life, and were distributed across three U.S. states – Minnesota, Illinois and Connecticut. In each interview, the respondent was first asked to name his/her most favorite Web site, and to subsequently define whether s/he considered it to be an entertainment Web site or an information site. Once the particular genre of the Web site (within the broader entertainment/information category) was established (e.g. News, Astrology, Sport, Cooking, Music, Motorcycles, Chat, Search Engine, etc.), Reynolds & Gutman's (1988) "preference-consumption difference" technique was used to elicit attribute distinctions. The respondent was asked to name two other competing Web sites of the same genre as his/her favorite site, and was then asked why s/he favored this particular site over the other two. In the interests of consistency, only the highest-rated attribute was used as the basis for building an attribute-consequence-value ladder during the remaining part of the interview.

Data Processing

Strictly following the pioneering methodological procedure established by Reynolds & Gutman (1988), once all 50 laddering interviews were concluded, the first step in analyzing the data gathered using the interviews was to develop a set of summary codes that reflected every attribute/ consequence/ value mentioned by the respondents. Then followed the assignment of numbers to each code. Once the codes were established and numbered, their numbers were then used to score each element in each ladder producing a "raw" matrix (not shown here) with rows representing an individual respondent's ladder and columns corresponding to the sequential elements within the ladder. The number of columns corresponded to the number of elements in the longest ladder. With these coded raw matrices compiled, the final set of matrices, i.e. the implication matrices, were constructed in order to display the number of times each element leads to each other element, both directly and indirectly. In these matrices, the numbers are expressed in fractional form, with direct relations to the left of the decimal point and indirect relations to the right. Once the implication matrices were prepared, work started on the construction of the respective hierarchical value maps or HVMs. The HVMs were gradually built up by connecting all the chains formed by considering the linkages in the implication matrices, with a cut-off level of two direct relations established for the purpose of plotting the HVMs (Fig. 1-2). In these HVMs, any pathway from bottom to top can be considered as a chain representing a significant perceptual orientation.

Findings

Both sets of interviews raised six attribute codes each. It is noteworthy that 10 out of 12 attribute codes (barring "Better Site Design" and "Familiarity of Site") deal with content issues. From this data, it appears that content has been a very important factor in the choice of Web sites for the respondents in this study. Meanwhile, it is also interesting to note that both sets of ladders elicited exactly the same value codes – Satisfaction, Relaxation, Happiness, and Emotional Security. This indicates that both sets of respondents were essentially motivated by the same set of values in their choice of Web sites, whether for entertainment or for information.

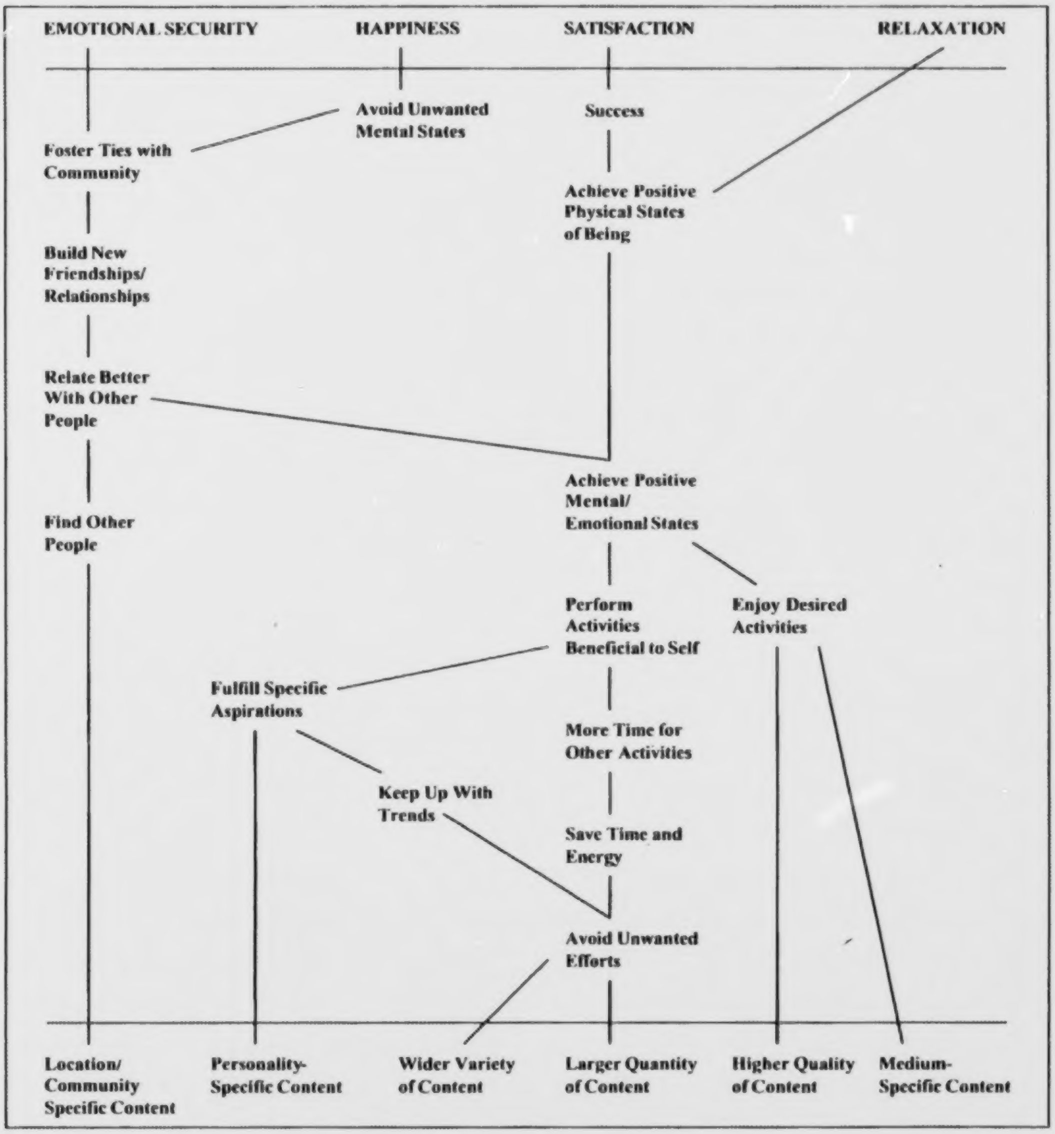
EMOTIONAL SECURITY
HAPPINESS
SATISFACTION
RELAXATION
Avoid Unwanted Mental States
Success
Foster Ties with Community
Achieve Positive Physical States of Being
Build New Friendships/ Relationships
Relate Better With Other People
Achieve Positive Mental/ Emotional States
Find Other People
Perform Activities Beneficial to Self
Enjoy Desired Activities
Fulfill Specific Aspirations
More Time for Other Activities
Keep Up With Trends
Save Time and Energy
Avoid Unwanted Efforts
Location/ Community Specific Content
Personality-Specific Content
Wider Variety of Content
Larger Quantity of Content
Higher Quality of Content
Medium-Specific Content

Figure 1: Hierarchical Value Map for Entertainment Web Sites

Furthermore, among the consequence codes, some are reasonably similar to each other (e.g. Save Time/Energy, Find/Interact with Other People, More Time for Other Activities, Success), while others are unique to entertainment Web Sites or to information Web sites. There could possibly be some valuable aspects of Web site usage indicated by the above differences also.

Meanwhile, looking at the HVMs can reveal certain interesting segmentations in the manner by which attributes are linked to particular consequences and values. For instance, in Fig. 2, a clear division can be made down the center of the map, between the linkages leading to Positive States of Being and on to Satisfaction/ Emotional Security on the one hand, and the linkages leading to Get Information Quickly/ Save Time and on to Relaxation/ Happiness on the other. Similarly, in Fig. 1, the path leading from Location/Community-Specific Content to Emotional Security/ Happiness is fundamentally different from that leading from, say, Larger Quantity of Content to Satisfaction/ Relaxation.

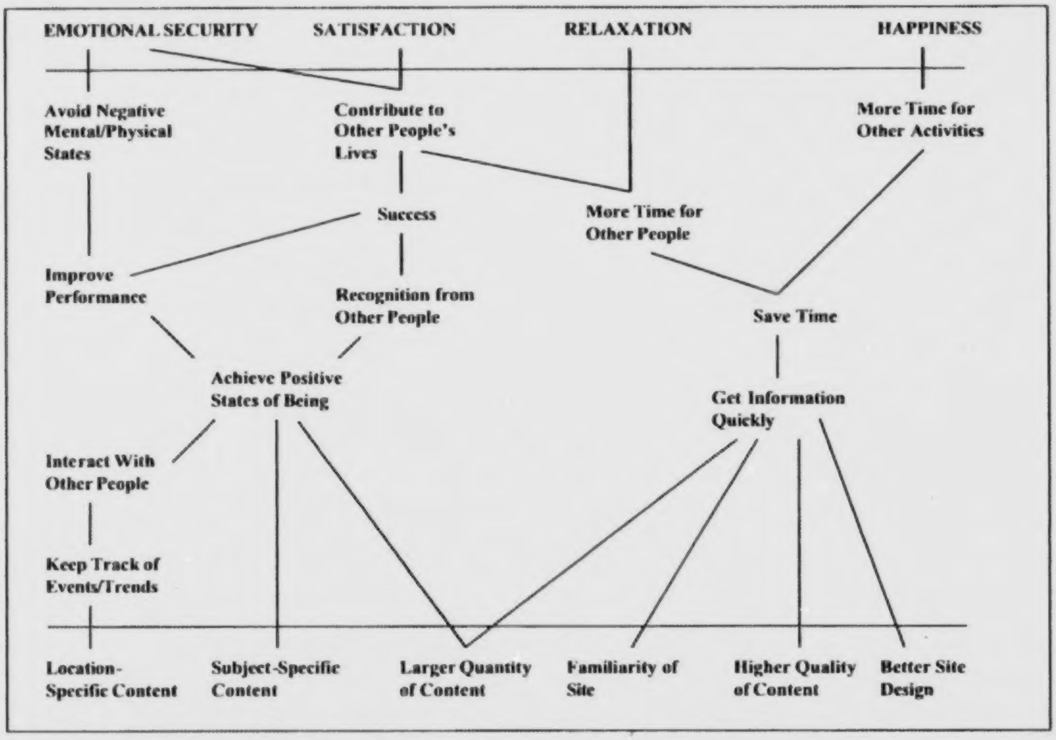
EMOTIONAL SECURITY
SATISFACTION
RELAXATION
HAPPINESS
Avoid Negative Mental/Physical States
Contribute to Other People's Lives
More Time for Other Activities
Success
More Time for Other People
Improve Performance
Recognition from Other People
Save Time
Achieve Positive States of Being
Get Information Quickly
Interact With Other People
Keep Track of Events/Trends
Location-Specific Content
Subject-Specific Content
Larger Quantity of Content
Familiarity of Site
Higher Quality of Content
Better Site Design

Figure 2: Hierarchical Value Map for Information Web Sites

Thus, a marketer attempting to segment users of his/her information Web site could reason thus: "There are basically two types of users of such sites. There are those that visit these sites in order to achieve certain positive states of being, which leads to improved performance/ recognition, which in turn helps them to succeed and to avoid negative states. This helps them contribute to other people's lives, thus achieving emotional security and satisfaction. These users seem to be attracted to location and subject-specific content. Meanwhile, there are those busy people that visit solely to get information quickly, which helps them save their precious time. This gives them more time to devote to other people/activities, which brings them relaxation and happiness. Such users look for site attributes such as familiarity, high-quality content, and good design."

Similarly, the marketer for an entertainment Web site could reason thus: "There are two types of users for sites like mine. There are those that use the sites to interface/network with other users, relate, build relationships, foster community ties, and thus achieve emotional security, happiness, and avoid unwanted mental states. These "people-minded" users are attracted primarily to location-specific content. Meanwhile, there are those who basically use these sites as a means of avoiding unnecessary efforts. With the time they save, they perform activities that helps them achieve positive goals. This helps them to relax, and to succeed, which in turn brings them satisfaction. It looks like these "success-minded" users desire access to a large, varied quantum of content through the site."

Implications

Therefore, can means-end theory, and its concomitant laddering methodology, be successfully applied in the context of HCI research, specifically to help understand the relationship between Web sites and their users? To begin with, the very fact that all of the 50 respondents who participated in the laddering interviews were able to name distinct site-attributes, articulate the consequences of these attributes, and identify the end-values served by these consequences, suggests that means-end chains do undeniably characterize the basic pattern of relationships by which the physical attributes of Web sites gain personal relevance or meaning for their users. It can thus be proposed that means-end theory can indeed be applied in the context of new media research, to help understand the relationships between Web sites and their users.

Meanwhile, it was also possible to successfully perform all the analysis techniques detailed by Reynolds & Gutman (1988) on the data gathered by the laddering interviews conducted as part of this study. This included formulation of meaningful content codes, compiling the raw matrices with coded rows representing individual respondents' ladders, preparing the implication matrices from the above coded data, and finally plotting the hierarchical value maps. If means-end chains could not be used to describe the relationships between Web sites and their users, it can be argued that it might not have been possible to perform all of the above operations and obtain consistently meaningful results. For instance, the fact that all 30 potential perceptual orientation chains in the HVM for entertainment Web sites (Fig. 1) and all 31 chains in the HVM for information Web sites (Fig. 2) make logical sense is an example of the results' meaningfulness.

Besides, the fact that a majority of the respondents named content-related site-attributes as most relevant to them is in congruence with the opinion of many leading webmasters that good content is what motivates users to visit a Web site more than any other site attribute. To quote Silverio (1995 section 4 para. 2), "You can make your pages look absolutely fabulous but if they don't say anything, nobody's going to care." Meanwhile, according to Nelson (2000 para. 7), "Content is everything," and encourages repeat visits by users.

Final Remarks

The most important contribution of this study, in the researcher's opinion, is its successful demonstration of the applicability of Gutman's means-end theory – an important part of marketing research literature – in the context of human-computer interaction research (or more specifically, Web usage research). By describing the relationships of 50 Web users with their favorite Web sites in terms of attribute-consequence-value linkages, the study indicates that means-end chains definitely characterize the basic pattern of relationships by which the physical attributes of Web sites gain personal relevance or meaning for their users. The chief limitation of this study is that the current findings may not be generalizable to the whole universe of Web users, since the study only involves 50 respondents selected on a non-random basis. But then, the object of this study was simply to be an introductory demonstration of the use of a new theoretical and methodological framework within the substantive context of Web usage research, and not the formulation of meaningful hypotheses about the characteristics of Web users. The latter could be the goal of a future study, or meta-analysis, that enjoys access to a much more extensive set of interview data. This might actually permit the drawing of generalizable inferences, which would be of great significance to academic researchers of HCI as well as to professionals in the Web industry.

References

Fortini-Campbell, L. (1990). *The Customer Insight Book*. Chicago: The Copy Workshop.

Gengler, C. E., Klenosky, D. B., & Mulvey, M. S. (1995). Improving the graphic representation of means-end results. *International Journal of Research in Marketing 12*(3), 245-256.

__________ , Mulvey, M. S., & Oglethorpe, J. E. (1999). A means-end analysis of mother's infant feeding choices. *Journal of Public Policy & Marketing 18*(2), 172-188.

Gutman, J. (1982). A means-end chain model based on consumer categorization processes. *Journal of Marketing 46*(April), 60-72.

Howard, J. C. (1977). *Consumer Behavior - Application of Theory.* New York: McGraw-Hill.

Nelson, E. (2000, August 18). Top ten design tips for commerce sites. *Webreview.com*. Retrieved from http://www.WebReview.com/2000/08_18/strategists/08_18_00_1.shtml

Olson, J. C. & Reynolds, T. J. (1983). Understanding consumers' cognitive structures: Implications for advertising strategy. In L. Percy & A. Woodside (Eds.), *Advertising and Consumer Psychology, Vol. 1*, 77-90. Lexington, MA: Lexington Books.

Peter, J. P. & Olson, J. C. (1994). *Understanding Consumer Behavior*. Burr Ridge, IL: Richard D. Irwin.

Reynolds, T. J. & Gutman, J. (1988). Laddering theory, method, analysis and interpretation. *Journal of Advertising Research 28*(1), 11-31.

Rokeach, M. J. (1973). *The Nature of Human Values*. New York: The Free Press.

Silverio, C. J. (1995). *Why the Web sucks, II*. Retrieved October 20, 2001, from C J Silverio Web site: http://www.ceejbot.com/Words/show.php?page=rant.web

Wansink, B. (2000). New techniques to generate key marketing insights. *Marketing Research 12*(2), 28-36.

Automatic Camera Control System for a Distant Lecture with Videoing a Normal Classroom

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Abstract: The growth of a communication network technology enables us to take part in a distant lecture. Although many lectures are held by using Web contents in universities, normal lectures using a blackboard are still held. The later style lecture is good for teacher's dynamic explanation. All the way to modify it for a distant lecture is to capture by a video camera. When we video lecture scenes for the distant lecture, a camera-person usually controls a camera to take suitable shots; alternatively, the camera is static and captures the same location all the time. Both of them, however, have some defects. It is necessary to control a camera automatically. We are developing ACE (Automatic Camera control system for Education) with computer vision techniques. This paper describes our system, our camera control strategy and an experiment of applying it to a real lecture.

1 Introduction

The growth of a communication network technology enables people to take part in distant lectures. There are various methods to held such a lecture. For example, it could be held by an web page-based method and a method of sending visual and audio of lecture scenes. One of the authors have been studying some supporting systems for a distant lecture. In the recent years, Suganuma et al. [Mine 2000, Suganuma 2000] have been developing a Computer Aided Cooperative Classroom Environment (CACCE) and an Automatic Exercise Generator based on the Intelligence of Students (AEGIS) for the web page-based lecture.

Indeed some lectures, for example the information technology or the programming, are frequently held by using visual facilities or computers in many universities but many lectures are held by the traditional style. It seems that such lectures will not disappear in the future although they will hold by combining the blackboard and a visual facility such as an OHP or Power Point software. We are, consequently, also developing another supporting system for the distant lecture with videoing the traditional lecture. This paper describes an Automatic Camera control system for Education (ACE).

We envisage that scenes of a lecture held in a normal classroom are recorded by a video camera and students in remote classroom take part in the lecture by watching the scenes projected on a screen. Figure 1 illustrates a form of the distant lecture by videoing the traditional classroom. A teacher teaches his students in an ordinary classroom. There is a blackboard in the room. He writes and explains something on it. Watching it and listening to his talk, students in the room take part in the lecture. Some cameras are setting in the room and take a lecture scene in order that the captured scene is sent to distant classrooms. On the other hand, students in the distant rooms take part in the lecture by watching a scene reflected on a screen.

When we video lecture scenes for the distant lecture, a camera-person usually controls a camera to take suitable shots; alternatively, the camera is static and captures the same location all the time. It is not easy, however, to employ a camera-person for every occasion, and the scenes captured by a steady camera hardly give us a feeling of the live lecture. It is necessary to control a camera automatically. ACE enables people to do it for taking suitable shots for a distant lecture. Receiving a scene from a camera, ACE analyses it and recognizes the complexion on the lecture. ACE judges what is important in the scene and controls the camera to focus on it. If the sent scenes are most suitable and effective, the educational effect on the students in the distant rooms is as good as that of the students in the room.

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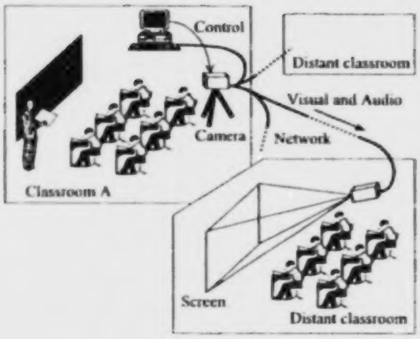

Figure 1: A form of the distant lecture by videoing the normal classroom

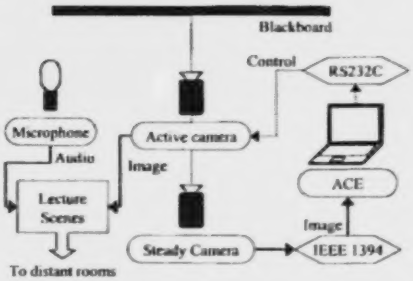

Figure 2: An Overview of ACE

In this paper, section 2 presents design of ACE and our strategy of camera control. Section 3 describes the algorithm to extract the latest object written by a teacher on a blackboard, and section 4 describes an experiment to apply ACE to a real lecture. Finally, concluding remarks are given in section 5.

2 Overview of ACE

2.1 Design

We have designed and implemented ACE, which is an application based on Computer Vision Technique. When we designed it, we assumed the following:

- A teacher teaches his students by using only a blackboard.
- Students aren't reflected in the scenes captured by the camera.
- A teacher isn't required to give the system a special cue.

The first assumption means that the lecture captured by ACE is a traditional one. The teacher writes something on the blackboard, and explains them. Indeed he teaches his students using OHP and/or other visual facilities in the resent years, but many traditional ones are held in many schools.

The second assumption is made to decrease processing costs. If students are reflected in the scenes, ACE always has to distinguish a teacher and them. This processing is complex and take much time. It is easy to satisfy this assumption if we take a scene from the ceiling.

Finally, the third assumption is very important for a teacher. If a teacher gives ACE his special cue such as to press a button of a remote controller, ACE may control a camera more easily. ACE has only to keep waiting his cue in that situation. If the teacher, furthermore, put on a special cloth, on which some color markers are attached, it is easier to detect his position and/or action. The special cue and the special cloth, however, increase the load on the teacher. He may omit to give ACE his cue. He ought to concentrate his attention on his explaining. We decided, consequently, we didn't require him to give ACE his cue.

The overview of ACE is shown in Figure 2. ACE requires two cameras. One is a steady camera and the other is a active one. The steady camera captures a whole blackboard at a constant angle for image processing. The captured image is sent to ACE system running on a PC over an IEEE-1394 protocol. ACE analyzes the image and decide how to control the active camera according to a camera control strategy shown in section 2.2. The control signals are sent to the active camera over an RS-232C. The active camera, hereby, takes suitable shots. The visual and the audio are sent to the distant room. Students in the room watch and listen to them, and take part in the lecture. In our study, we are interested in how to video the lecture held in normal classroom. We are using a known method or product as a way sending the video via the network.

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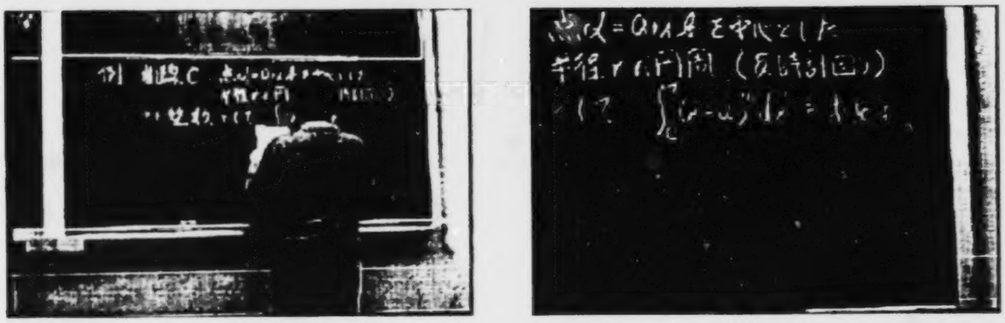

(a) An ordinary shot

(b) A key shot

Figure 3: Sample shots of a lecture scene captured by ACE

2.2 Camera control strategy

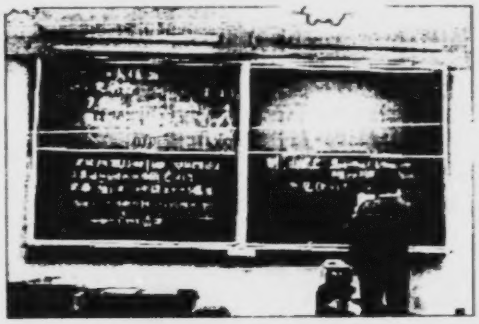

Figure 4: A sample shot captured by a steady camera

What does ACE capture? It is a very important thing for the system such as ACE. One solution is to take the scenes that students want to watch, but in this case many scenes are probably requested by many students at the same time. Although this solution needs the consensus of all students, it is very difficult to make it. We decide, therefore, that ACE captures the most important things from a point of view of a teacher. The most important thing from teacher's point of view is also difficult. We guessed the objects that teacher was explaining were the most important things for all students. When he explains something, he probably wants his students to watch it. He frequently explains the latest object that he have written on the blackboard. We decided consequently that ACE captured the latest object written on the blackboard.

When the lecturing scenes are videoed, both constantly changing shots and over-rendering shots are not suitable. A changeless shots are, if anything, more appropriate than those shots. It is important that students can easily read contents on the blackboard. The shots captured by ACE is shown in Figure 3. ACE usually takes a shot containing the latest object and a region near it in a discernible size. The blackboard often consist of four or six small boards like a picture in Figure 4. A teacher frequently writes relational objects within one board in this case. Now, ACE takes a shot by the small board such as figure 4-(a). On the other hand, ACE takes a shot zoomed in on the latest object after the teacher has written it on the blackboard such as figure 4-(b). After a-few-second zooming, ACE takes an ordinary shot again.

If we take the scene by a steady camera, the shot may be like a shot in Figure 4. In this case the camera must capture the whole blackboard, because the teacher writes something anywhere. The characters in this shot are too small for students to read. The shot of ACE is superior to that of the steady camera.

3 Extracting the latest object

3.1 Background subtraction

We use a background subtraction technique to detect objects on the blackboard. The background subtraction technique is a method to detach the foreground image from the background image. In the method, the background image is captured before opening the lecture. The image contains only the blackboard on which written no object.

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It cannot contain a teacher. We can get some objects on the blackboard and in front of blackboard when we subtract the background from the image captured by the same camera during the lecture.

We adopted a background model[Haritaoglu 1998] in our system. This model is robust against a noise such as a flickered noise and so on. The platform is lightened by fluorescent lamps in a normal classroom. There are usually many noises such as flickered ones in a shot when a video camera captures objects lightened by them. ACE needs a robust method against noises for this reason.

In the original background model, the background image is modeled by representing each pixel by the following values; its maximum ($Max(p)$) and minimum ($Min(p)$) intensity values and the maximum intensity ($D(p)$) difference between two pieces of successive frames observed during capturing the background image. Pixel p is a background pixel if the intensity of pixel p satisfies the following: $Min(p) - I(p) \leq D(p)$ or $I(p) - Max(p) \leq D(p)$. The first inequality represents the lower-bound in order that the pixel belongs to the background, the other represents the upper-bound.

We specialized the method for the lecturing scene. The foreground objects segmented by the technique are something to write on the blackboard, something to erase on it, the teacher and so on. We need only the written object. Their pixels appear only above the upper-bound because the object written on the blackboard is brighter than the blackboard. Our method takes, therefore, no longer the pixel whose brightness is less than the lower-bound. ACE segments the object by using only the above second inequality.

The foreground objects are extracted by thresholding and noise clearing. The objects represent highlighted pixels in the background subtraction image.

3.2 Separating an object from the foreground image

The foreground image almost always includes a teacher. We would like to detect only the written object. If we mask teacher's region, we can get the region correctly. We have to detect, therefore, teacher's region. We assumed that all the moving object is a teacher. A method using a subtraction between a frame and a frame that captured after a short interval is usually used when we want to detect a moving object. ACE calculates the subtraction image and makes moving objects highlight. ACE makes a rectangle circumscribed highlight pixels the temporal teacher's region. After all pixels in teacher's rectangle in the foreground image are changed to dark ones, the remnant highlight pixels are the written objects if teacher's region is segmented correctly enough. ACE makes a rectangle circumscribed the highlight pixels, and deals with it after this processing.

3.3 Remake the background model

We have to distinguish the latest object and others. ACE keeps tracing the latest object written by a teacher from our camera control strategy described by section 2.2. Once the object has been detected as the written object, it doesn't need to be detected more than twice. After detecting the latest object, ACE re-calculates the values of the background model for each pixel in the region of the object. ACE always detects, therefore, only the latest one.

3.4 Timing of zooming in

We cannot control a camera even if we get the region of the latest object. We have to find the timing of zooming in. If ACE zooms in on the written object before a teacher has written, ACE must take a scene occluding the object behind the teacher body. After guessing whether the teacher finished writing, consequently, ACE zooms in on the object written by him at that moment.

The rectangle circumscribed the latest object usually change frame by frame. This main reason is the following:

- The rectangle increases or decreases because the teacher wrote something new or erased something.
- The masked region changes because the teacher moved to write something new. Then the rectangle increases or decreases.

Shortly, the rectangle changes when the teacher is writing something. On the other hand, he usually clears the object to make his students watch it after he has written. ACE take advantage of this feature to guess whether he finished. The rectangle does not change when he cleared the object. ACE counts the number of frames in which the rectangle does not change. If the number is over a threshold, then ACE judges the teacher finished writing, and control a camera to zoom in on the written object.

4 Applying ACE to a real lecture

4.1 Condition

We have developed ACE and done an experiment of applying it to a real lecture. We held two 25-minutes lectures on Mathematics for 85 undergraduates. A teacher taught them by only using a blackboard. One of the authors played the role of the teacher. Although he knows the detecting algorithm of ACE, he taught by usual style. Sort of thing, he behaved as disadvantage for ACE. We videoed the lecture scene by ACE and by a steady camera in order to compare their shots. These shots were recorded on video cassettes and played them in classrooms. We divided 85 students into two groups, each group discretely watched the video lectures projected on a screen. We evaluated ACE in terms of the following:

1. How correctly did the student copy contents from the screen to his note?
2. How good were the shots of ACE by comparison with that of the steady camera?

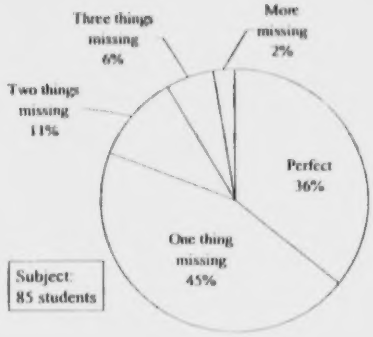

Figure 5: How many things did the student miss copying?

4.2 How correctly did the student copy contents?

We designed ACE to capture the latest object because a teacher often explains it. Is this strategy adequate enough to video a lecture scene? We evaluated the videoing strategy of ACE from a point of view that students could make a note. We made the students make a note for this evaluation. We told the students before the lecture that we would collect their notes after the video lecture and check that they ware made properly. We precomposed a master note and wrote the all contents of it on the blackboard all through the lecture.

After the lecture we collected their notes and compared them with the master note. We counted their missing in each note. The result is shown in Figure 5. 36% of all the students can perfectly copy the contents from the shots captured by ACE. 45% of the students make only one mistake. There are some small characters such as the index of a formula in this lecture scene. Many mistakes are caused by them. Almost all students make not more than three mistakes. Although there was a few students that hardly copied the contents from the screen to their note, this reason was that they sat dawn far from the screen when he took part in the video lecture. As the results of this estimation, almost all students can make a note correctly enough to learn it. The shots seem good enough.

4.3 How good were the shots of ACE?

We asked five questions to the students after each video lecture. They scored each scene captured by ACE and the steady camera, from 1 to 5. The average scores of each question are shown in Table 1. We omitted the third question for the scene captured by the steady camera because it always contains all objects on the blackboard. We used the t-test to compare these scores. Our null hypothesis is *"The scene captured by ACE is as good as the scene captured by the steady camera."*

The score of the scene captured by ACE is better then that of the scene by the steady camera, except the first question. Since ACE focus on the latest object, the scene does not always contain a teacher. Then the first evaluation of ACE is lower than that of the steady camera. On the other hand, a teacher is relatively small because the scene captured by the steady camera contains the whole blackboard. Teacher's action is hard to interpret in the scene. This is why the score of the steady camera is also low. Our null hypothesis, therefore, is not rejected with both 1% and 5% level of significance in this question. The point of the third question is, furthermore, what we abandoned at design of ACE. We were afraid that many students could not watch something to want because ACE zoomed in on the latest object. When they copy the contents, they often miss watching what and when they need, if timings of their watching do not synchronize with that of ACE's zooming in. Sure enough, the score is lowest of all scores of ACE.

Table 1: Questionnaire

Questions	Steady	ACE	Null hypothesis
1. Could you watch the teacher's action well?	3.27	3.19	Accept
2. Could you watch the objects on the blackboard well?	1.58	2.75	Reject
3. Could you watch the object you wanted?	—	2.49	—
4. Were you given a feeling of the live lecture?	2.71	2.86	Accept
5. Could you give the scene a overall score as a lecture one?	2.12	2.49	Reject

(1% level of significance)

Our null hypothesis is rejected with 1% level of significance in the second question and the fifth question. In both of them the scores of ACE are better than that of the steady camera. The evaluation of ACE is, therefore, superior to that of the steady camera. Neither of the scores, however, is high. In this experiment, the quality of the audio of our videos was not so good. Teacher's voice was, especially, hard to hear because we recorded it not by a wireless microphone at his breast but by a standard one on a desk. This is why the magnitudes of the evaluations are not large. If the quality had been better, they would have been larger. Because there were many feedbacks that described the low-quality audio. The shots captured by ACE is, consequently, good enough to video a lecture.

5 Conclusion

We have designed a camera control strategy for videoing a lecture and developed a prototype of ACE. We evaluated, moreover, it with applying it to a real lecture. As a consequence, we make sure that ACE is a useful tool for videoing a traditional lecture.

ACE takes a suitable shot if the teacher explains the object as soon as he writes on the board. It cannot take, however, a suitable shot when he explains something written in past. He usually teaches his students pointing the objects which he wants them to look at. Interpreting teacher's action and/or posture, ACE could capture more suitable scene. We will make ACE interpret it. We assume that a teacher teaches his students with a blackboard. But he sometimes also uses with an OHP. We will also make ACE be applied to such a situation.

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References

[Haritaoglu 1998] I. Haritaoglu, D. Harwood and L. S. Davis, "W^4: Who?When?Where?What? A Real Time System for Detecting and Tracking People," International Conference on Face and Gesture Recognition, pp.14-16, 1998.

[Mine 2000] T. Mine, A. Suganuma, and T. Shoudai, "The Design and Implementation of Automatic Exercise Generator with Tagged Documents based on the Intelligence of Students: AEGIS," Proc. of International Conference on Computers in Education, pp.651–658, 2000.

[Suganuma 1997a] A. Suganuma, S. Kuranari, N. Tsuruta, and R. Taniguchi, "An Automatic Camera System for Distant Lecturing System," Proc. of Conference on Image Processing and Its Applications, Vol.2, pp.566–570, 1997.

[Suganuma 1997b] A. Suganuma, S. Kuranari, N. Tsuruta, and R. Taniguchi, "Examination of an Automatic Camera Control System for Lecturing Scenes with CV Techniques," Proc. of Korea-Japan Joint Workshop on Computer Vision, pp.172–177, 1997.

[Suganuma 2000] A. Suganuma, R. Fujimoto, and Y. Tsutsumi, "An WWW-based Supporting System Realizing Cooperative Environment for Classroom Teaching," Proc. of World Conference on the WWW and Internet, pp.830–831, 2000.

Automatic Generating Appropriate Exercises Based on Dynamic Evaluating both Students' and Questions' Levels

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Abstract: Popularization of computers and the Internet enable people to hold lectures using Web contents as a teaching material. Although teachers have prepared a lot of Web contents, most of them are used so as only to be browsed by students. If we arrange some exercises according to lecture notes and prepare an answering mechanism for the exercises via the Internet, students can attempt the exercises any time. This paper proposes AEGIS (Automatic Exercise Generator based on the Intelligence of Students) that generates exercises of various difficulty levels according to each student's achievement level, marks his/her answers and returns them to him/her. It is necessary for AEGIS to evaluate dynamically both the levels in order that it selects a suitable question for each student. This paper also declares the validity of the method with a simulator.

1 Introduction

As the Internet has come into wide use, WWW environments provide lots of opportunities to various fields. In the educational domain, many Internet technologies enable people to hold lectures using Web contents as a teaching material and even develop new lecture methods using the technologies. Web data are, therefore, being expanded rapidly as useful materials.

We have devoted ourself to develop a Web-based self-teaching system and to build the tools for helping students understand their subjects [Sato 1997, Mine 1998, Fujimoto 1999, Suganuma 2000]. Through our experiences teaching in classes and developing such systems, we recognize the necessity of both a method evaluating students' achievement levels and generating exercises suitable for the students automatically.

For example, in trying to make some exercises for the students in a class, we have to take at least their achievement level into considerations. The well-considered exercises are useful not only to measure the achievement level of the students, but also to improve their performance. Unfortunately, it is not an easy task for any teacher to make exercises with the difficulties suited to their achievement levels. Besides, it is very important to mark their answers to the exercises and return the marked results to them for keeping their learning enthusiasm. These tasks become harder in proportion to the number of the students in a class[Hirokawa 1996].

In this paper, we present the automatic student's achievement level evaluator that generates exercises from tagged documents, presents them to students and marks their answers automatically. We call the system AEGIS (Automatic Exercise Generator based on the Intelligence of Students)[Shoudai 2000, Mine 2000]. AEGIS generates the three question-types from the same tagged data. Guessing the achievement level of each student from his/her trial history, AEGIS selects the most suitable question-type and exercise for him/her according to not only his/her achievement level but also the difficulty level of the exercises. It is necessary for AEGIS to evaluate dynamically both the levels in order that it gives each student a suitable question. Although many CAI systems have been proposed, our system is different from them in the points of re-usability of pre-existing electronic materials and re-estimation of both the levels. We have already proposed the method to re-estimate them[Mine 2000] but have not yet validated it competently. This paper declares the validity with a simulator.

In what follows below, the remainder of this section discusses related works. Section 2 describes the exercise generating process by AEGIS and the specification of the tags designed to generate an exercise. Section 3 describes the algorithm to re-estimate the achievement level of a student and the difficulty level of a question. Section 4 discusses experiments and their results to show the validity of the algorithm described in Section 3, and Section 5 shows the overview of AEGIS. Finally, concluding remarks are given in section 6.

1. **multiple-choice question**

   Complete the sentence. Choose your answer from the following list.

   Data structures need to be studied _____ order to understand the algorithms.

   (1) an (2) in (3) on (4) at (5) by

2. **fill-the-gap question**

   Fill in the blank with the right word.

   Data structures need to be studied _____ order to understand the algorithms.

3. **error-correcting question**

   Right or wrong? Correct the sentence if it is wrong.

   Data structures need to be studied an order to understand the algorithms.

Figure 1: Examples of three question-types

```
(QUESTION SUBJECT="idioms")
Data structures need to be studied
(DEL CAND="an,on,at,by") in (/DEL)
order to understand the algorithms.
(/QUESTION)
```

Figure 2: The tagged data to generate the examples of three question-types shown in Fig. 1

Related Works A lot of automatic quiz generators have been proposed. Browning et al. proposed Tutorial Markup Language(TML for short) to generate questions automatically[Browning 1997, Browning 1998]. TML has a couple of tags to specify a question, a multiple-choice and a message. It requires a correct answer in a multiple-choice tag to mark a student's answer to the question. Carbone et al. proposed CADAL Quiz[Carbone 1997], which generates a multiple-choice quiz from a question database. After marking a student's answer, CADAL Quiz returns the result to him/her and to tutors. Both of them restrict the question type only to a multiple-choice quiz. On the other hand, ClassBuilder[ClassBuilder] generates many kinds of quizzes and grades a student's answer. However, all of them do not mention any effect of making the difficulty level of question-type change according to the students' achievement level. In order to improve their performance and keep their enthusiasm to attempt the quiz for a long time, it is indispensable to consider their performance level for generating their exercise. This point is the difference from other systems. AEGIS makes use of pre-existing electronic documents so as to embed tags in them, generates exercises automatically with tagged documents according to students' achievement levels, and re-estimates both their levels and the difficulty level of the generated question through marking their answers.

2 Automatic Exercise Generating

There can be several types of a question in every subject. Since our aim is to make a computer generate an exercise and mark a student's answer to it, we thus restrict the question-types to the following three: *multiple-choice question*, *fill-the-gap question*, and *error-correcting question*. Figure 1 shows examples of these question-types. All of these question-types can be constructed from a sentence by replacing one or more consecutive words with a blank or a wrong expression. We call the region to be replaced, *hidden region*. We note that these three question-types have different difficulties even though they are constructed from the same *hidden region*.

The exercise generating process from teaching documents is summarized as follows: (1) Setting a *hidden region*, (2) Selecting a paragraph or sentence(s) from teaching documents, and (3) Constructing a candidate list. These three steps are deeply related to the teachers' intentions. It is not easy to extract such intentions automatically from the teaching documents. AEGIS system thus deals with tagged documents including the information such as *hidden regions* and candidate lists.

In order to embed the above three kinds of information in teaching documents, we define the following three tags: QUESTION tag that surrounds a *question region*, DEL tag that indicates a *hidden region*, and LABEL tag that surrounds the relevant sentence/s to the DEL tag. Figure 2 shows the tagged data to be used for generating the examples in Fig. 1. Replacing the word "in" which is located between DEL tags with a blank generates the example of the fill-the-gap question. In addition, the value of CAND "an,on,at,by" constructs the candidate list of the multiple-choice question. On the other hand, replacing the *hidden region* with an element in the value of the CAND generates the error-correcting question. Thus we can generate three question-types from only one *question region* where the above tags are embedded. The additional three attributes of DEL, which contain the information of the difficulty to solve an exercise, are LEVEL, GROUP, and REF. They specify the difficulty of each *hidden*

⟨QUESTION SUBJECT="W_S"⟩ *question region* ⟨/QUESTION⟩
W_S ::= word or symbol, where a backslash (\) must be added just before the symbol if it is a comma(,), double quotes("), or a backslash(\).

⟨DEL CAND="CANDIDATE" LEVEL="PAIR" GROUP="ID" REF="ID"⟩ *hidden region* ⟨/DEL⟩
CANDIDATE ::= W_S | W_S ',' CANDIDATE
W_S ::= word or symbol, where a backslash (\) must be added just before the symbol if it is a comma (,), double quotes ("), or a backslash (\).
PAIR ::= LOW ' ' HIGH
LOW ::= an integer between 1 and 10
HIGH ::= an integer between 1 and 10
ID ::= keyword

⟨LABEL NAME="ID"⟩ sentences ⟨/LABEL⟩
ID ::= keyword

Figure 3: Definition of tags for exercise generation

region, and the connections to other *hidden region*.

Figure 3 shows the definition of the tags described above in BNF. The LEVEL attribute must be provided because AEGIS initializes the difficulty level of the *hidden region* with its value. On the other hand, the others are not essential attributes. When a value of CAND attribute is utilized as a distractor, AEGIS generates only a fill-the-gap question.

3 Re-estimation of Achievement Level and Difficulty Level

It is very important for AEGIS to estimate an achievement level of a student because it generates exercises according to the level. Such a student level fluctuates constantly because AEGIS measures it whenever the student answers a question. The achievement level of student i at time t is calculated with the following formula:

$$s_{i,t} = \begin{cases} s_{i,t-1} + \dfrac{\sum\limits_{j\in Q}(q_{j,t} - s_{i,t-1})\delta_{i,j}}{\sum\limits_{j\in Q}\delta_{i,j}} & \text{if} \sum\limits_{j\in Q}\delta_{i,j} \neq 0 \\ s_{i,t-1} & \text{otherwise} \end{cases}$$

where Q is a set of questions that he/she answered in the recent 30 trials and $q_{j,t}$ stands for the difficulty level of question j at the time when the achievement level $s_{i,t}$ is calculated. The weight value, $\delta_{i,j}$, is 1 if student i correctly answered question j whose difficulty level is more than his/her achievement level $s_{i,t-1}$ or he/she incorrectly answered question j whose level is less than $s_{i,t-1}$, or 0 otherwise. The achievement level of student i is initialized to 1 when he/she tries a question at first time. The student who has continuously answered a lot of questions correctly, obtains a higher achievement level, and can attempt more difficult one. He/she can try more difficult ones if he/she answers them correctly again. On the other hand, the achievement level of the student who answered most of the questions wrongly, becomes lower, he/she comes to attempt easier ones. Continuously answering them correctly, he/she can gradually attempt more difficult questions.

The difficulty level of a question is carefully configured, because AEGIS uses it to calculate the students' achievement level and refers it to generate a suitable question for a student. Since the teachers set it up with the attribute LEVEL of DEL tag, they can assign the upper and lower limits of the difficulty level of a *hidden region*. However, there may be a gap between the difficulty level evaluated by the teachers and that found by the students. A question evaluated by the teachers as an easy one, may not always be answered correctly by lots of students, and vice versa. AEGIS, therefore, utilizes the value of the attribute LEVEL as an initial value of the difficulty level of

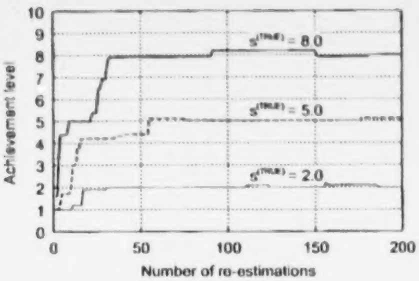

Figure 4: Variance of students' achievement level evaluated by AEGIS in our simulation

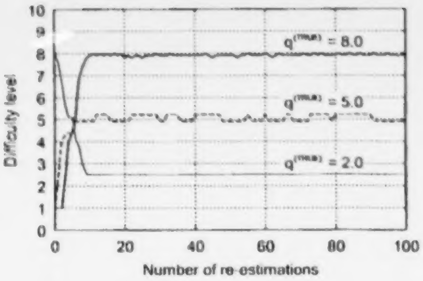

Figure 5: Variance of questions' difficulty level evaluated by AEGIS in our simulation

the ***hidden region***, and calculates the level dynamically at regular intervals with the following formula:

$$q_{j,t} = \begin{cases} q_{j,t-1} + \dfrac{\sum\limits_{i \in S} (s_{i,\tau} - q_{j,t-1}) \xi_{i,j}}{\sum\limits_{i \in S} \xi_{i,j}} & \text{if} \sum\limits_{i \in S} \xi_{i,j} \neq 0 \\ q_{j,t-1} & \text{otherwise} \end{cases}$$

where S is a set of students who answered the question j between time $(t-1)$ and t, $s_{i,\tau}$ is a student's achievement level at time τ $(t-1 \leq \tau < t)$. The weight value, $\xi_{i,j}$, stands for 1 if students whose achievement level is more than the difficulty level $q_{j,t-1}$ of question j answered it wrongly or students whose level is less than $q_{j,t-1}$ answered it correctly, or 0 otherwise. This equation is a recurrence formula, and $q_{j,0}$, which is the initial difficulty level of question j, is given with the attribute LEVEL of DEL tag by teachers.

The above formula calculates a new difficulty level of the question for each question-type. Since the teachers assign the upper and lower limits of the difficulty level of a ***hidden region*** with the attribute LEVEL of DEL tag, AEGIS sets the upper (lower) limit as the initial difficulty level of the question to be generated in the error-correcting question (multiple-choice question). That of the fill-the-gap question is assigned the mean of the upper and lower limits. After calculating the new difficulty levels, AEGIS sets the maximum (minimum) value among the three-question types as the upper (lower) limit of the difficulty level of the ***hidden region***.

4 Evaluation with Simulator

AEGIS estimates dynamically both the achievement level of each student and the difficulty level of each question with the equations defined in Section 3. In order to examine their validity, we investigated the following three things: 1. How does AEGIS estimate the inherent achievement level of a student? 2. How does AEGIS estimate the inherent difficulty level of a question? 3. Can AEGIS provide only questions suitable for a student?

We assumed that the probability that a student answers a question follows the function of both the inherent difficulty level of the question($q^{(TRUE)}$) and his/her inherent achievement level ($s^{(TRUE)}$), and that he/she can correctly answer the question with 50% probability if $q^{(TRUE)}$ is equal to $s^{(TRUE)}$.

1. Re-estimation of the achievement level of a student

   Based on the student's achievement level calculating formula defined in Section 3, we made AEGIS calculate the achievement level ($s^{(AEGIS)}$) of three students whose inherent achievement levels are high ($s^{(TRUE)} = 8$), middle ($s^{(TRUE)} = 5$) and low ($s^{(TRUE)} = 2$). We used 100 questions whose difficulty levels are distributed at the equal interval from 0 to 10.

   Figure 4 shows the variance of $s^{(AEGIS)}$. Since all of their levels, $s^{(AEGIS)}$, are set to 1 at first, the three curves in the graph start from 1. They were gradually separated each other because they answered questions

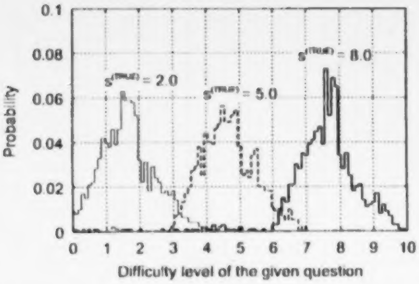

Figure 6: Distribution of the questions that AEGIS gave to students in our simulation

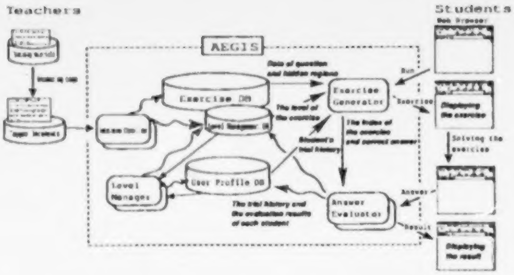
Teachers
AEGIS
Exercise DB
User Profile DB
Level Manager
Exercise Generator
Answer Evaluator
The level of the exercise
Student's trial history
The index of the exercise and correct answer
The trial history and the evaluation results of each student
Students
Web Browser
Run
Exercise
Displaying the exercise
Solving the exercise
Answer
Result
Displaying the result

Figure 7: Overview of AEGIS

correctly or incorrectly based on their inherent achievement level. Each curve of $s^{(AEGIS)}$ in our simulation approximates closely the value of $s^{(TRUE)}$ that we presupposed. AEGIS can consequently distinguish between them.

2. Re-estimation of the difficulty level of a question

   Based on the question's difficulty level calculating formula defined in Section 3, we made AEGIS calculate the difficulty level ($q^{(AEGIS)}$) of three questions whose inherent difficulty levels are high ($q^{(TRUE)} = 8$), middle ($q^{(TRUE)} = 5$) and low ($q^{(TRUE)} = 2$). We at first set $q^{(AEGIS)}$ to a different value far from $q^{(TRUE)}$, that is, $q^{(AEGIS)}$ of the questions whose inherent levels were 5 or 8 was set to 1, and that of question whose inherent level was 2, was set to 8.

   In order to estimate the movement of the difficulty level of these questions, we used the two real distributions, called Class A and Class B, of achievement level of students who were given a lecture by one of the authors. Class A is superior to Class B. We assumed that the distributions did not change during our experiment.

   The curve of $q^{(AEGIS)}$ is shown in Fig. 5 for the data of Class A. Each curve of $q^{(AEGIS)}$ approximately converges to its inherent difficulty level $q^{(TRUE)}$. The students in Class A tried to solve a lot of questions of higher difficulty level. Although we would have expected that the current difficulty level of a question tried by many students would influence the change of the new difficulty level of a question, the result of our experiment on Class B becomes similar to the curve in Fig. 5. We can conclude that our method can well estimate the difficulty level of each question.

3. The difficulty level of questions generated by AEGIS

   We prepared three trial histories each of which belonged to high, middle, and low achievement level students. We applied 1,000 questions of various difficulty levels to these students so as to confirm that AEGIS generates good questions suitable for the students' achievement level. We assume that each 100 questions are uniformly distributed between difficulty levels 0 and 10.

   Figure 6 shows the distributions of the difficulty levels of questions which each student tried to solve. A student of high (resp. middle, low) achievement level tried a lot of questions of high (resp. middle, low) difficulty level. Let (x, y) be a pair of the mean value x and the standard deviation y of each distribution of the curve in Figure 6. (x, y) of each curve is (1.6, 0.78), (4.6, 0.87) and (7.6, 0.96), respectively. The result shows that AEGIS generates questions suitable for the students' achievement level.

5 Overview of AEGIS

The AEGIS system consists of three databases: *Exercise DB* (**EDB** for short), *User Profile DB* (**UPDB** for short) and *Level Management DB* (**LMDB** for short), and three main database managers: *Exercise Generator*, *Answer Evaluator* and *Level Manager*[Mine 2000]. The overview of AEGIS is shown in Fig. 7.

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Teaching documents with the tags are compiled into the **EDB** and **LMDB**. All of the *question regions* are indexed sequentially and each *hidden region* is labeled with its own subindex of the index of each *question region*. The level of a *hidden region*, which is deeply related to the level of the question to be generated from the *hidden region*, is stored in the **LMDB** together with the index of the *hidden region*. The level of each *hidden region* in **LMDB** is reexamined regularly. **UPDB** keeps students' trial histories with their current achievement levels.

6 Conclusion and Future Work

We discussed our new Web-aided system AEGIS. The system is currently implemented in Perl scripts, PostgreSQL and CGI. AEGIS measures the student's achievement level every time he/she answers a question, and regularly re-estimates the difficulty level of questions in order to generate suitable exercises according to his/her achievement level. AEGIS is consequently utilized as not only a system generating exercises but also a tool classifying questions because the re-estimated level keeps close to their real difficulty level.

Experimental results with the simulator showed the effectiveness of the algorithm estimating both the achievement level of a student and the difficulty level of a question as were expected. We have a plan to evaluate this system by applying it to the real courses of Computer Literacy, which are taken by more than 2300 students at Kyushu University. We hope it will work fine as an educational tool for every student and help him/her to understand his/her subjects. Also, we will implement a tagging tool and an algorithm to generate another kind of exercise that allows more than one correct answers.

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References

[Browning 1997] P. Browning, J. Williams, D. Brickley, and H. Missou, "Question Delivery over the Web using TML," http://www.ilrt.bris.ac.uk/netquest/liveserver/qbanks/demos/paul/lboro/ohp1.html, CAA, 1997

[Browning 1998] P. Browning, "TUTORIAL MARKUP LANGUAGE - A CBA SYSTEM," http://www.soton.ac.uk/ ukgec/workshop/5-cba/minutes.htm#TUTORIAL, 1998.

[Carbone 1997] A. Carbone and P. Schendzielorz, "A Web-Based Quiz Generator for Use in Tutorials and Assessment," Global J. of Engng. Educ., vol.1, no.3, 1997, http://www.eng.monash.edu.au/usicee/gjee/vol1no3/paper20.htm.

[ClassBuilder] ClassBuilder GradeBook And Exam Creation Software, http://www.classbuilder.com.

[Fujimoto 1999] R. Fujimoto, A. Suganuma, and T. Mine, "Development of a classroom management system on the web," Proc. Int. Conf. on Computers in Education, ICCE'99, vol. 2, pp.756–759, 1999.

[Hirokawa 1996] S. Hirokawa, T. Miyahara, T. Mine, T. Shoudai, and M. Mori, "Teaching 2300 students with www – practice and experience at kyushu university," Proc. ERI'96, pp.59–63, 1996.

[Mine 1998] T. Mine, D. Nagano, K. Baba, T. Shoudai, and S. Hirokawa, "On-web visualizing a mechanism of a single chip computer for computer literacy courses," Proc. Int. Conf. on Computers in Education, ICCE'98, vol. 2, pp.496–499, 1998.

[Mine 2000] T. Mine, A. Suganuma, and T. Shoudai, "The Design and Implementation of Automatic Exercise Generator with Tagged Documents based on the Intelligence of Students: AEGIS," Proc. Int. Conf. on Computers in Education, pp.651-658, 2000.

[Sato 1997] H. Sato, T. Mine, T. Shoudai, H. Arimura, and S. Hirokawa, "On web visualizing how programs run for teaching 2300 students," Proc. Int. Conf. on Computers in Education, ICCE'97, pp.952–954, 1997.

[Shoudai 2000] T. Shoudai, A. Suganuma, and T. Mine, "AEGIS: Automatic Exercise Generator with Tagged Documents based on the Intelligence of the Students," Proc. Knowledge-Based Software Engineering, pp.311–314, 2000.

[Suganuma 2000] A. Suganuma, R. Fujimoto, and Y. Tsutsumi, "An WWW-based Supporting System Realizing Cooperative Environment for Classroom Teaching," Proc. World Conf. on the WWW and Internet, pp.830-831, 2000.

Instructional Design of Scientific Simulations and Modeling Software to Support Student Construction of Perceptual to Conceptual Bridges

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Abstract: This paper describes the theoretical basis for a constructivist design which can help students develop a set of mental models that increasingly correspond to scientific models that explain or predict scientific phenomena. These student-constructed models can be linked to form perceptual-to-conceptual bridges via two complementary instructional pathways: (1) *interactive multimedia simulations* can enhance the student decision-making process in a learning environment by providing guidance through trail-and-error experiences that culminate in productive experimental outcomes; and (2) *student-generated modeling software* can allow visualization of a simple mechanism, which is shown as perceptual icons which can be combined in a meaningful manner that shows conceptual entities and their interactions. The design of both types of software can support scaffolded student understanding of the connection between a scientific phenomenon (studied in the laboratory) and its underlying scientific principle (studied in lecture).

Introduction

With the help of scaffolded support provided by instructional design, students can begin to generate mental models based upon their interactive experiences with *simulated phenomena* that allow them to visualize scientific principles. Furthermore, modeling software can be designed to help them construct their own *scientific models* which are composed of simpler models that provide a concrete mechanism for them to build more complex models (White 1993, Frederiksen et al. 1999). In other words, simulations and modeling software can serve complementary functions when the former provides a decision-making task that allows student prediction of a phenomenon (i.e., the simulation outcome), while the latter provides an explanation of a phenomenon in terms of its underlying model that drives the simulation.

In the domain of chemistry, several researchers have found that student understanding of chemical principles and phenomena are linked to their ability to visualize the particulate level of matter (Gabel 1993) and then to use this level to connect the more abstract principles to the more concrete phenomena. Thus, it follows that if students use the particulate level to construct their own mental model, then they could use that model to predict the outcome of a simulated phenomenon. This paper features the pedagogic content knowledge needed to begin instructional design for these two forms of learning technology, i.e., simulations and modeling software, that serve complementary functions.

Traditional instruction usually does nothing to help students (Kim et al. 2000) because phenomena and principles are studied in different places (laboratory vs. lecture room) and usually at different times during the semester. Also, it focuses on a passive, information-communicating method of instruction. Conversely, this paper emphasizes the use of technology to provide an active, constructivist approach that is designed to engage students in authentic experiences in scientific thinking and activity (White 1993).

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Goal

The major goal of this paper is to describe how two related types of software can be designed to complement each other: (1) *interactive multimedia simulations* (IMS) can provide opportunities for student decision-making regarding the experimental conditions (parameters) and observation of the consequences of these decisions when their simulation is run; and (2) *student-generated modeling software* (SGM) can allow student construction of their own model within the constraints set by the appropriate scientific models. Thus, the students are generating their own model, which can serve to describe a simple mechanism that explains the underlying abstract features of a scientific phenomenon.

Concrete Level Versus Abstract Level

The abstract level of a scientific principle represents the apex of a hierarchical pyramid that is based on a foundation of concrete-level phenomena. Experts can use these abstractions to explain a wide range of phenomena and to apply them appropriately when solving complex problems. Also, they can use these abstractions to organize information into larger chunks of information, which can reduce the load on working memory. In sharp contrast, novices tend to view these abstractions as information to be memorized or as algorithms to be applied to problems in a very inflexible manner. Thus, they can only engage in constraint-based reasoning that uses abstract principles (e.g. $P V = n R T$) as variables in an equation which they manipulate to find a quantitative answer (Frederiksen et al. 1999). On the other hand, when novices use SGM software they can benefit from a causal-based reasoning strategy that they have learned through their own construction of scientific models. A laboratory setting can give students "hands on" experience with a domain-specific phenomenon; however, they may be so busy manipulating the apparatus that they fail to observe the phenomenon as it occurs in real time. Conversely, an IMS of the same phenomenon replaces the physical manipulation of experimental apparatus with the mental manipulation of the experimental parameters that determine the experimental outcome. Thus students participate in experimental design rather than mimicking a pre-determined procedure that may have little meaning to them.

Intermediate Level of Abstraction

Both IMS and SGM software emphasize an intermediate level of abstraction that connects and gives meaning to concrete-level phenomena and abstract-level symbolic notation systems (mathematical equations or verbal generalizations). This intermediate level usually displays icons (dots for molecules or arrows for vectors) that help students visualize abstract objects (atoms, electrical charges, or biomolecules) and/or processes (chemical reactions, flow through electrical circuits, or cellular metabolism). The icons serve as cybernetic manipulatives (Kaput 1995) that are similar to physical manipulatives (molecular model kits, or wooden counting blocks).

Interactive Multimedia Simulations

An IMS can fully engage the decision-making processes of students while extending the range of phenomena that can be explored. IMS's use models of scientific phenomena and data from real experiments to allow students to determine the experimental parameters and hence to design experiments. Upon running the experiment, they receive feedback about the experimental outcome. If the outcome does not meet their expectations, they can change the experimental conditions (parameter(s) or their values) and rerun the experiment. In addition, an IMS enables the student to create idealized simplifications for scientific systems and to transform abstractions into concrete manipulative representations (White 1993). This transformation allows them to see dynamic representations of phenomena that are connected to more abstract representations. Thus, they can relate and apply their formal knowledge to their everyday situations (White 1993). This "intuitive knowledge" is a flexible and generative type of knowledge (diSessa 2000) that can be used as the building blocks to construct conceptual knowledge.

We plan to illustrate the effectiveness of an IMS with an example that can be found at www.riverdeep.net under the "High School Science Gateways" section and the "Understanding Chemical Equilibrium" subsection. Specifically, an acid/base titration allows the student to explore an animated sequence that shows how acids and bases react during the titration process. The *Logal Express* simulation engine used in this IMS was selected for the following reasons: (1) it is interactive and it provides students with a microscopic visualization of chemical concepts and related graphic representations; (2) it provides a comprehensive content-rich chemistry curriculum, correlated to *National Standards*; and (3) it features a user-friendly interface, a scripting language, and a simulation engine thatallows the authors (and their graduate students) the opportunities to customize and modify existing simulation activities to suit our specific curricular and instructional needs.

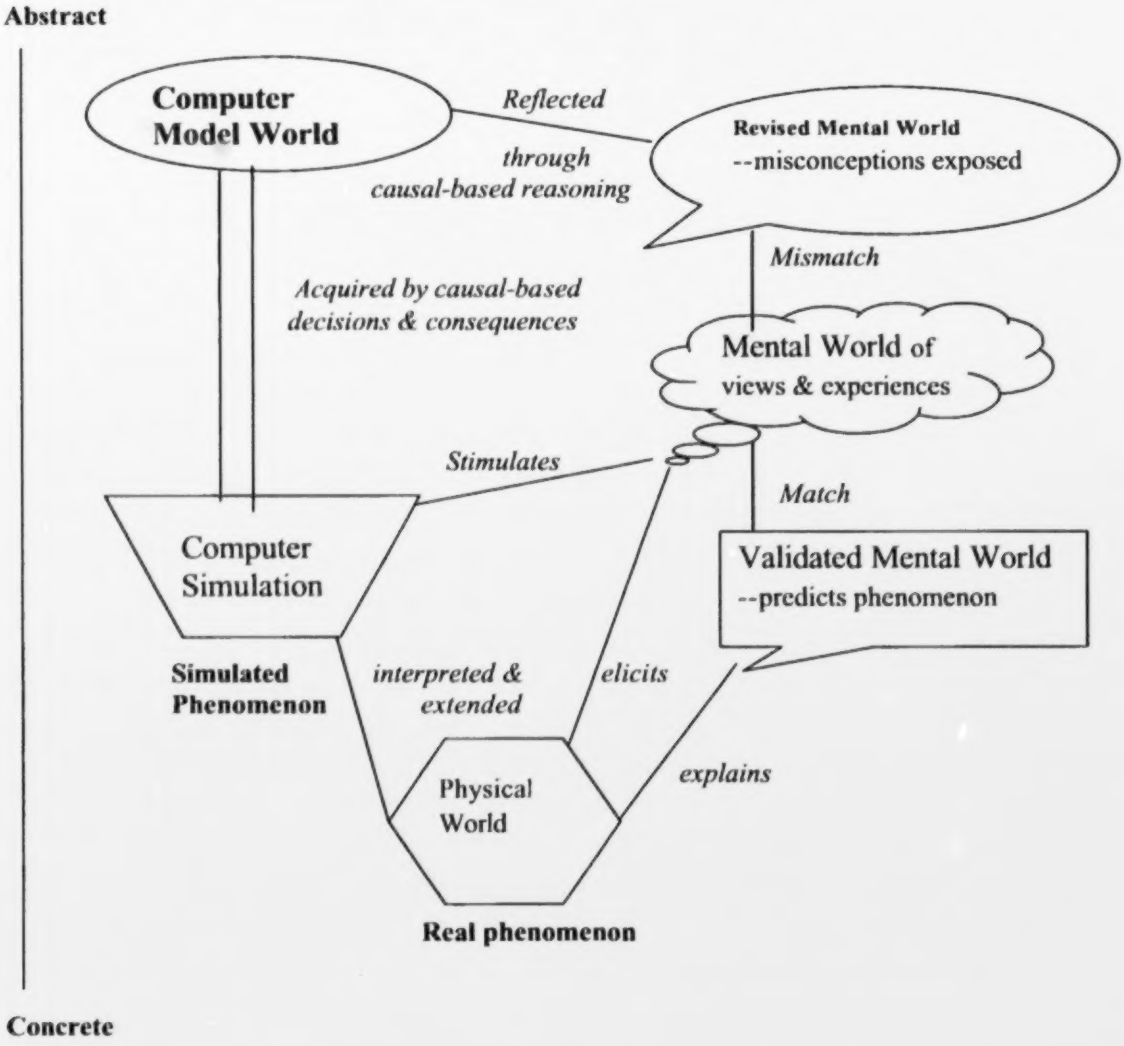
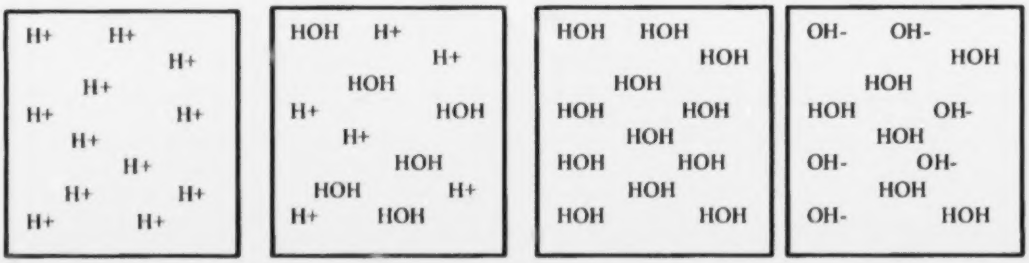

Abstract
Computer Model World
Reflected through causal-based reasoning
Revised Mental World
--misconceptions exposed
Mismatch
Acquired by causal-based decisions & consequences
Mental World of views & experiences
Stimulates
Match
Computer Simulation
Validated Mental World
--predicts phenomenon
Simulated Phenomenon
interpreted & extended
elicits
explains
Physical World
Real phenomenon
Concrete

Figure 1: Student interactions with models, simulations, and phenomena (Diack & Suits 2001, Suits & Hypolite 2002; Originally adapted from Raghavan & Glaser 1995).

Student-Generated Modeling Software

Properly designed SGM software allows student construction of the underlying scientific model that drives the IMS explorations described above. For example, in an SGM-based titration, icons can represent the active part (H+) of an acid molecule (HA, A is a negative ion) and the active part of a base (OH-) from an ionic compound (MOH). The student can select the amount of acid and base to represent four reaction conditions (*Frames*): *(1)* the starting condition in which only acid are present in the receiving flask, *(2)* the "buffered" condition in which H+ predominates over OH-, *(3)* the equivalence point at which the amount (moles) of H+ is equal to OH-, and *(4)* the final condition in which OH- predominates over H+. If a molecular model kit is used, then the student must disassemble each condition (*Frames* 1 to 4) before reassembling the next condition. Thus, it is difficult for novices to understand the causal relationships between the conditions because working memory is limited (Sweller et al. 1998). Conversely, a computer can "run" each condition in the proper order (*Frames* 1 to 4) to show the progression of interactions among chemical species (H+, OH-, and the product H_2O). Thus, the student has created a situation model that serves as an "external memory aid" (Newton 1996) for each condition (*1* to *4*). In addition, the computer can present an "animated filmstrip" (Williamson & Abraham 1995) which can serve as a sequence of discrete causal events that follow a simple mechanism (White 1993).



Frame 1: Initial acid *Frame 2:* Half-titrated with OH- *Frame 3:* Equivalence point *Frame 4:* Overtitrated w/ OH-

Figure 2: Student construction of four situational models (frames) and their links in an animated sequence

In our initial trial with this SGM example, we audio-taped a student as he built the four reaction conditions (*Frames* 1 to 4) described above. The student had just finished his second semester of college general chemistry lecture and a 2-credit hour laboratory techniques course. Prior to his modeling experience, he had done countless calculations involving titration data for his lecture courses, plus physical manipulation of the titration glassware during an acid-base titration experiment in the laboratory. However, it was only during the building of these models (*Frames* 1 to 4) that he "suddenly realized" that mixing acid (H+) and base (OH-) "just made water." In other words, he was able to visualize the essence of an acid-base chemical reaction for the first time despite his more concrete experiences with acids and bases in the laboratory and his more abstract/mathematical calculations performed during his lecture courses. He recommended that this "model building" exercise be used as a pre-laboratory activity for students so that they could understand the titration process before they actually performed the experiment. Currently, we are working to carry out this student's recommendation by designing an appropriate SGM software program on this chemistry topic.

This causal model enables students to envision causal mechanisms that are implicit in an abstraction (e.g., calculations used to solve titration problems). The abstraction, in turn, allows the student to predict and explain a wide range of domain phenomena (White 1993). For example, the students could use the same iconic manipulatives to represent the process of precipitation of a solid when to aqueous solutions of ions are mixed together. Also, this visualization process helps students encode a complex set of information as a simpler knowledge structure (situation model) that can be stored and recalled as needed. They can literally "see" linkages between a set of these structures (Frederiksen et al. 1999) because the "emergent properties" of the lower level model (e.g., each individual condition, 1 to 4) become the primitive elements of the more abstract, derived model (e.g., the sequence of conditions). Overall, two distinctive but complementary mental pathways can provide an intermediate level of abstraction: (a) intuitive knowledge developed from experiences (diSessa 2000), and (b) causal reasoning models (White 1993).

Implications for Instructional Design

The design of IMS and SGM technologies should be most effective when three levels of design are used to make instructional decisions (Lavoie 1995, Suits & Courville 1999, Suits & Lagowski 1981). Briefly, the goal for the primary level of design is to help students solve a scientific problem. Thus, instructional features must be constrained by the structure of the scientific discipline (Suits & Courville 1999). In other words, the nature of the learner's interaction with the simulated phenomena must be authentic with respect to scientific principles. On the secondary level, the goal should be to use instructional design principles as external constraints designed to keep learners "on task" such that the level of task demands roughly matches the student's level of knowledge and skills (Suits & Courville 1999). Finally, on the tertiary design level, the student should be challenged to solve a complex scientific problem (primary level) while being provided with just enough guidance to sustain their progress in solving the problem (secondary level). Guided inquiry (Suits & Lagowski 1981, Zuckerman et al 1998) allows the integration of multiple sources of information without overwhelming the learner's cognitive load capacities (Sweller et al. 1998). This form of instruction is consistent with the constructivist view (Collins 1996) in which students can invent and adapt cultural tools for thinking about scientific ideas (Zuckerman et al 1998). The instructional design of IMS and SGM technologies should help students use sketches and mental pictures (icons) as visual representations (Kozma et al 2000) to build a bridge between the perceptions of the simulated phenomenon (Kleinman et al 1987) and their conceptions of abstract scientific principles (Connell 1998). Thus the purpose of this paper is to illustrate how technologies can scaffold higher-order learning tasks that allow student freedom to explore a phenomenon while constraining student expression towards correct scientific representations.

IMS and SGM technologies can provide the scaffolded support that students need to connect their perceptions of phenomena to the conceptions of abstract scientific principles. Technology, based upon good tutoring practices, should be designed (Roehler & Cantlon 1997) to: (1) offer explanations, (2) elicit active student participation, (3) verify and clarify student understandings, (4) model objects and actions to make thinking visible (Linn 1995), and (5) encourage students to be autonomous learners (Linn 1995) who are responsible for their own learning. Furthermore, scaffolded guidance should be faded as the learner gains the ability to construct and integrate knowledge within a scientific domain. This paper describes the basis for some of the instructional design questions that should be addressed when IMS and SGM are used to provide perceptual-to-conceptual bridges to help students connect phenomena to scientific principles. Instructional design can produce software that initially models a domain at a low level of complexity and employs causal reasoning, which exhibits a simple mechanism at an intermediate level of abstraction (White 1993). This process should supply scaffolded guidance (Roehler & Cantlon 1997) that is faded as the student gains domain-specific competence and confidence in his/her performance. This guidance can help make "thinking visible" when students are aware of their selection and use of problem-solving strategies (Linn 1995).

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References:

Collins, A. (1996). Design issues for learning environments. In S. Vosniadou, E. DeCorte, R. Glaser, & H. Mandle (Eds.) *International Perspectives on the Design of Technology-Supported Learning Environments* (pp. 374-362). Hillsdale, NJ: Erlbaum Associates, Inc.

diSessa, A.A. (2000). *Changing minds: Computers, learning, and literacy.* Cambridge, MA: MIT Press.

Diack, M., PI (Southern University-Baton Rouge), Suits, J.P., co-PI & Project Director (McNeese); NSF-CCLI-A&I Grant, "Collaborative Chemistry Laboratory Model (CCLM): Integrating Microcomputer-Based Laboratory with Interactive Multimedia

Computer Simulations," NSF Proposal # 01-27583; Fully funded for $170,987; 2002 to 2005.

Frederiksen, J.R., White, B.Y., Gutwill, J. (1999). Dynamic mental models in learning science: The importance of constructing derivational linkages among models. *Journal of Research in Science Teaching, 36* (7), 806-836.

Gabel, D. L. (1993). Use of particle nature of matter in developing conceptual understanding. *Journal of Chemical Education, 70,* 193-194.

Kaput, J. J. (1995). Creating cybernetic and psychological ramps from the concrete to the abstract: Examples from multiplicative structures. In D.N. Perkins, J. L. Schwartz, M.M. West, & M. S. Wiske (Eds.) *Software goes to school: Teaching for understanding with new technologies*. New York: Oxford University Press.

Kim, T-K, Jackson, D. F., Yarger, D. N., & Boysen, P. J. (2000). Principles for the design and use of simulations in science learning as exemplified by a prototype microworld. *Journal of Computers in Mathematics and Science Teaching, 19* (3), 237-252.

Kleinman, R.W., Griffin, HC. & Kerner, N.K. (1987). Images in chemistry. *Journal of Chemical Education,64* (9), 766-770.

Kozma, R., Chin, E., Russel, J., & Marx, N. (2000). The roles of representations and tools in the chemistry laboratory and their implications for chemistry learning. *The Journal of the Learning Sciences, 9* (2), 105-143.

Linn, M.C. (1995). Designingcomputer learning environments for engineering and computer science: The scaffolded knowledge integration framework. *Journal of Science Education and Technology, 4* (2), 103-126.

Mathewson, J.H. (1999). Visual-spatial thinking: An aspect of science overlooked by educators. *Science Education, 83,* 33-54.

Newton, D.P. (1996). Causal situations in science: A model for supporting understanding. *Learning and Instruction, 6* (3), 201-217.

Raghavan, K., & Glaser, R. (1995). Model-based analysis and reasoning in science: The MARS curriculum. *Science Education, 79* (1), 37-61.

Riverdeep Homepage. http://www.riverdeep.net

Roehler, L.R. & Cantlon, D.J. (1997). Scaffolding: A powerful tool in social constructivist classrooms. In Hogan, K. & Pressley, M. (Eds.) (1997). *Scaffolding student learning: Instructional approaches and issues*. Albany, NY: Brookline Books, Inc.

Suits, J. P. & Courville, A. A. (1999). Design of interactive multimedia modules to enhance visualization in chemistry courses. In D. A. Thomas (Ed.) *Mathematics/Science Education & Technology 1999,* pp. 531-536. Charlottesville, VA: Association for the Advancement of Computing in Education.

Suits, J.P., & Hypolite, K. L. (2002). Student epistemologies, scientific phenomena, and generative modeling. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans.

Suits, J. P. & Lagowski, J. J., (1981). Design of computer-simulated experiments to enhance the problem-solving abilities of science students; In Diana Harris and Laurie Nelson-Heern, Eds. *Proceedings of the National Educational Computing Conference* (NECC-81), pp. 184 – 189.

Sweller, J. van Merrienboer, J. J. G., & Paas, F.G.W.C. (1998). Cognitive architecture and instructional design. *Educational Psychology Review, 10* (3), 251-296.

White, Barbara Y. (1993). Intermediate causal models: A missing link for successful science education? In Robert Glaser (Ed.) *Advances in instructional psychology,* Vol. 4. (pp. 177-252). Hillsdale, NJ: Lawrence Erlbaum Associates.

Williamson, V.M. & Abraham, M.R. (1995). The effects of computer animation on the particulate mental models of college chemistry students. *Journal of Research in Science Teaching, 32* (5), 521-534.

Zuckerman, G.A., Chudinova, E.V., & Khavkin, E.E. (1998). Inquiry as a pivotal element of knowledge acquisition within the Vygotskian paradigm: Building a science curriculum for the elementary school. *Cognition &Instruction,16* (2), 201-223.

LEARNING THROUGH ONLINE DISCUSSION:
WHERE'S THE BEEF?

MODERATOR: Karen Swan, University at Albany

Asynchronous online discussion, while significantly different from face-to-face communication, seems a significant factor in the success of online courses. In online discussion, all students have a voice and no students can dominate the conversation. Accordingly, many researchers note that students perceive online discussion as more equitable and more democratic than traditional classroom discussions (Harasim, 1990; Levin, Kim & Riel, 1990). Ruberg, Moore and Taylor (1996), for example, found that computer-mediated communication encouraged experimentation, sharing of ideas, and increased and more distributed participation.

Because it is asynchronous, online discussion also affords participants the opportunity to reflect on their classmates' contributions while creating their own, and to reflect on their own writing before posting it. Researchers argue that this creates a certain mindfulness among students and a culture of reflection in an online course (Hiltz, 1994; Poole, 2000). In addition, many researchers familiar with computer-mediated communication have noted what Walther (1994) refers to as the "hyperpersonalness" of the medium. Participants in online discussion seem to project their personalities into it, creating feelings of "immediacy" that build online discourse communities (Gunawardena & Zittle, 1997; Poole, 2000; Rourke, Anderson, Garrison & Archer, 2001).

The question remains, however, as to whether students actually learn anything in online discussion. Hewitt, for example, provides evidence that most threaded online discussions are overwhelmingly divergent and argues that convergence is an important part of knowledge building. Likewise, McLoughlin and Luca (1999) distinguish between knowledge construction and knowledge reproduction, and suggest that we need to develop frameworks for analyzing the negotiation and revision of knowledge.

This panel will explore issues of learning through online discussion. It will ask the questions "Can students learn from online discussions, and if so under what conditions?" and "What might count as evidence of learning through online discussion?" Specific topics to be covered are:

Perceived Learning and Social Presence in Asynchronous Online Courses, Jennifer Richardson, Purdue University.

Research has demonstrated that social presence affects student outcomes as well as student, and possibly instructor, satisfaction with a course (Moore, Masterson, Christophel, and Shea, 1996). Teacher immediacy behaviors and the presence of others are especially important issues for those involved in delivering online education. This presentation will report on a study which used survey data to explore the relationship between students' perceptions of social presence and their perceived learning in online course environments. Implications of the study effect the design and instruction of online courses in terms of students' perceived learning and satisfaction with the instructor. Instructors need to be aware of the impact that their immediacy behaviors and social presence or lack thereof may have on their students' satisfaction, motivation, and learning.

Using the Discussion Board as a Learning Tool: Facilitating Multiple Perspectives. Linda Polhemus, University at Albany

Students learn from online discussions that promote the integration of multiple perspectives. Online learning communities are created when discussion threads are generated. Discussion threads are generated when values and experiences are integrated into messages that promote alternative perspectives. Students from SUNY Learning Network (SLN) participated in interviews, observations and responded to a questionnaire related to knowledge building communities in online learning. Interviews addressed issues of navigation, expectations and beliefs about online learning. Selected students were also video taped when participating in the online discussion using a picture-in-picture device to capture student reactions when 'thinking aloud.' In addition, questionnaires were distributed to students enrolled in graduate level courses and discussion threads were analyzed. Results revealed that when students read and respond in the online discussion, their exposure to multiple perspectives enhanced their perception of knowledge building. Evidence of learning through the online discussion is apparent in the observations where students summarize the messages of others, build upon their ideas and make connections to their own personal experiences. The ability for students to reflect upon the messages of others, navigate the discussion board's interface at a high level, and read and compose messages which are of high quality result in learning engagement at the critical or literate level.

Embedded Formative Evaluation of Student Learning. Michael Danchak, RPI

Current web toolkits such as WebCT and BlackBoard provide tools for quizzing and discussion. However, in order to use these tools one must leave the content. Quizzing and surveys really do not address recitation well. In addition, the bulletin board does not "force" a contribution before the students can see all the postings. I will describe a Java applet based tool we built that allows the instructor to ask either multiple choice or discussion questions. Once answered, the student sees the instructor's answer and may see other students' responses, at the instructor's discretion. The applet can be embedded directly in any html content page and can be used for either synchronous or asynchronous feedback to the student.

Higher-Order Learning Through Computer Conferencing. Liam Rourke, University of Alberta

The educational claims made for computer mediated discussion are largely cognitive in nature—discussion promotes critical thinking, self-reflective thought, higher-order learning—the list is impressive. Yet, researchers in this domain have rarely used techniques developed specifically to investigate cognitive processes. Thus, many of the claims remain speculative, anecdotal, or hyperbolic. Protocol analysis is one technique that has proven to be useful for revealing the mental processes of subjects engaged in a wide variety of tasks. An analysis of students' concurrent verbalizations as they read and respond to messages in a computer conference provides direct evidence of the mental processes in which they are engaged. This presentation summarizes the provisional results of a protocol analysis study involving upper-level, undergraduate humanities students engaged in a computer conference. Eight students were recorded individually as they read and responded to messages that appeared in the computer conference supplement to their face-to-face course. Two distinct sets of cognitive processes appeared to be occurring among the participants—sociocognitive conflict (Doise & Mugny, 1985) and narrative cognition (Bruner, 1990). In the former case, students composed coherent and rhetorical interpretations of course readings, received critical feedback from others, and re-evaluated their original interpretations. In the latter, students embedded their interpretations of course material in autobiographical narratives, and immersed themselves empathetically in the narratives of others. Within these two sets of cognitive processes, there was evidence of many potentially valuable sub-processes including metacognition, internalization of the discourse process, cognitive flexibility, and naturalistic generalization.

Can We Assess the Quality of Learning in Online Conferences? Catherine McLoughlin. Australian Catholic University

While computer-based tools to support asynchronous dialogue and discussion are now part of many on-line units of study, there is a lack of research on how to assess the quality of such interactions, and in particular, how they support learning. Mason (1991: 161) posed the question: 'Are conference interchanges more than merely the outpourings of lonely or loquacious students?' Since then several theorists have provided interaction analysis/content analysis techniques to examine the construction of knowledge in computer conferencing. These are reviewed in the light of constructivist theories of knowledge and the adoption of a socio-cultural model of learning, emphasizing social interaction and dialogue as central to learning. If knowledge construction is to be evaluated rather than knowledge reproduction, we need to assess the processes that support such construction, and consider negotiation and revision of knowledge. For tertiary students, working with others in teams, evaluating others' perspectives and the ability to communicate abstract ideas are recognized and valued educational outcomes. A valid framework for analysis would therefore require a focus on *process* variables, such as how learners negotiate and interact, and *product* variables, such as the content and outcomes of learner interactions. Educators need practical assessment tools to evaluate on-line discussion and show the potential of on-line forums to support collaborative learning and construction of knowledge.

PARTICIPANTS

Michael Danchak is Professor of Computer Science at Rensselaer Polytechnic Institute in Troy, NY. He has been teaching at a distance for more than 10 years and is currently researching tools and techniques for making online courses more interactive.

Jennifer Richardson is an Assistant. Professor of Educational Technology at Purdue University. Jennifer has extensive experience both doing research in the schools in terms of technology as well as conducting evaluations of educational technology programs and products. Her interests include educational technology professional development, social aspects of web-based learning, and integration of technology into educational environments.

Linda Polhemus is currently a doctoral student enrolled in the University at Albany's Educational Theory and Practice program and director of Rensselaer Polytechnic Institute's Online Learning Forum. The Online Learning Forum is a professional development program addressing the needs of k12 teachers. Linda's research interests focus on the integration of instructional technology and distance education.

Liam Rourke is a Ph.D. student in Department of Educational Psychology at the University of Alberta. He has published several papers on the topic of computer conferencing in higher education (www.ualberta.ca/~lrourke/liam.html) and is currently investigating how and what students learn through discussion.

Catherine McLoughlin is an Associate Professor and Head of the School of Education at the Australian Catholic University in Canberra, Australia. She is National President of the Open and Distance Learning Association of Australia. Catherine has researched and published in the area of online teaching and learning, and deigned a range of learning resources for distance learners. Her main research interests are development of innovative assessment practices online, and the evaluation of learning.

Karen Swan is an Associate Professor of Instructional Technology in the School of Education at the University at Albany. She has been teaching online courses for five years and has presented and published on issues of interactivity and social presence in online courses.

REFERENCES

Gunawardena, C. & Zittle, F. (1997) Social presence as a predictor of satisfaction within a computer mediated conferencing environment. *American Journal of Distance Education, 11*, (3), 8-26.

Harasim, L. (1990) *On-line Education: Perspectives on a New Environment.* New York: Praeger.

Hewitt, J. (2001) Beyond threaded Discourse. *International Journal of Educational Telecommunications, 7* (3), 207-221.

Hiltz, S. R. (1994) *The Virtual Classroom: Learning without Limits via Computer Networks.* Norwood, NJ: Ablex.

Levin, J. A., Kim, H. & Riel, M. M. (1990) Analyzing instructional interactions on electronic message networks. In L. Harasim (Ed.), *On-line Education: Perspectives on a New Environment* New York: Praeger.

McLoughlin, C. & Luca, J. (1999) Lonely outpourings or reasoned dialogue? An analysis of text-based conferencing as a tool to support learning. Brisbane, AU: *ASCILITE 99; Proceedings of the 16th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education*, 217-228.

Poole, D. M. (2000) Student participation in a discussion-oriented online course: a case study. *Journal of Research on Computing in Education, 33* (2), 162-177.

Richardson, J. & Swan, K. (2001) An examination of social presence in online learning: students' perceived learning and satisfaction. Seattle, WA: Paper presented at the Annual Meeting of the American Educational Research Association.

Rourke, L., Anderson, T., Garrison, D. R. & Archer, W. (2001) Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education, 14* (2), 50-71.

Ruberg, L. F., Moore, D. M. & Taylor, C. D. (1996) Student participation, interaction, and regulation in a computer-mediated communication environment: a qualitative study. Journal of Educational Computing Research 14 (3), 243-268.

Swan, K., Polhemus, L., Shih, L-F. & Rogers, D. (2001) Building knowledge building communities through asynchronous online course discussion. Seattle, WA: Paper presented at the Annual Meeting of the American Educational Research Association.

Walther, J. (1994) Interpersonal effects in computer mediated interaction. *Communication Research, 21* (4), 460-487.

Situated Professional Development: The CATIE Model

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Abstract

This presentation will describe a qualitative study investigating the Capital Area Technology and Inquiry in Education (CATIE) model of situated professional development for technology integration in schools and classrooms. We call the CATIE model "situated" because it places educational technology experts in schools on an ongoing basis where they collaborate directly with teachers to develop and deliver technology enhanced lessons. Teacher learning about technology integration is thus situated in authentic technology integration activities. What we think is unique about the CATIE model is that mentors work with schools and teachers on a long term, daily basis, that they work to incorporate technology use into existing curricula, and that they work in real classrooms directly with teachers and students. The CATIE program thus tends to reach most of the teachers and administrators in a school, and we can see the results in terms of student learning, technology integration, and changes in school cultures. Findings from data collected to date, including monthly mentor reports, interviews with mentors, teachers, and school administrators, classroom observations, and student artifacts, will be used to support discussion of the model.

Background

Recent large scale studies of computer usage in schools (Panel on Educational Technology, 1997; Educational Testing Service, 1998; Becker, Ravitz & Wong, 1999) have precipitated public debate concerning the efficacy of using computers to support instruction, and have highlighted the need for professional development in this area. While emphasizing the need for professional development and pointing to the relationship between it and more sophisticated uses of technology in schools, these and other studies suggest that our understanding of what sorts of professional development programs impact technology integration at school and classroom levels needs to be improved. What we do know is that the teacher training, "expert model" of professional development (Sparks, 1994) does not work, especially when it comes to learning about educational technologies and their integration across the curriculum. Indeed, teacher lore suggests that traditional inservice teacher education has little impact on teaching practices in general. Smylie (1989), for example, found that teachers ranked inservice training last out of fourteen possible opportunities for learning. What teachers ranked as most important was direct classroom experience. Even exemplary professional development programs find it difficult to maintain support for teachers (Carey & Frechtling, 1997), to encourage sustained discourse among participating teachers (Schlager & Schank, 1997), to "scale up" (Corcoran, 1995) through the inclusions of all teachers, and to develop, test, and disseminate new teaching and learning ideas. Researchers agree that new models of professional development are needed, and that such models must include a focus on the development of local cultures of interest if they are to be sustainable.

Situated Professional Development

Putnam and Borko (2000) relate recent trends in research on professional development to new understandings of the nature of learning and knowing that collectively have been labeled "situative"

(Greeno, 1997). They identify three conceptual themes central to situative perspectives – that cognition is situated in particular physical and social contexts, that it is social in nature, and that knowing is distributed across the individual, others, and tools (p. 4) – which they believe have important implications for professional development. Putnam and Borko argue that how teachers learn new methods of teaching is no different from any learning. If knowledge and learning are indeed situative, then the most effective inservice education will be situated in authentic classroom practice.

To our knowledge, such perspective has not been used to frame either the development of, or research on, professional development programs aimed at technology integration, although a situative perspective is widespread in the research and development of technology-based educational programs. It only makes sense, and yet most professional development programs aimed at technology integration are instructionist, application-driven workshops or summer "institutes" well removed from classroom practice. Some have argued that while not optimal, such approaches are often the only practical solutions to meeting large-scale professional development needs with limited resources (Wilson & Berne, 1999). What little research there is suggests such activities have little impact on the day-to-day integration of computing technologies into classroom teaching and learning (Panel on Educational Technology, 1997; Educational Testing Service, 1998).

The CATIE Program

It is hard to see how approaches that consistently have had little or no effect on classroom-based technology integration can be deemed "practical," thus we decided to try an "impractical" approach. The Capital Area Technology and Inquiry in Education (CATIE) program was established through the Center for Initiatives in Pre-College Education (CIPCE) at Rennselaer Polytechnic Institute as an innovative means for addressing technology-based, constructivist-oriented staff development in elementary schools in the greater Troy (NY) region. This unique program places technology experts in elementary school buildings where they serve as mentors to teachers interested in integrating the use of technology into their day-to-day classroom activities. The school-based mentors provide training to teachers on technology utilization, but, more importantly, the mentors work with teachers to jointly design computer-supported lessons that incorporate technology into existing classroom curricula. Teacher learning about technology integration is thus situated in authentic technology integration activities.

Typically, the mentors first meet with teachers, both individually and in groups, to discuss how technology might be used to enhance learning in planned units on particular topics. Mentors try to avoid planning that is either artificial or focused on specific software applications. They then work with teachers to design computer-supported lessons that are integral parts of larger, classroom-based learning units. They encourage inquiry-based, student-centered, constructivist uses of computing technologies, but they do not insist on them. Often, mentors model best practices in computer-based teaching and learning by taking the lead in implementing jointly created lessons. They then guide teachers in designing and implementing their own computer-based lessons, gradually fading their support as teachers become more confident in the use of electronic technologies.

Mentor support, however, does not just disappear. Each mentor structures his or her schedule according to their school and participating teachers' individual needs. Generally, the mentor is available two or three days each week for a period of two years or more to work with teachers and students on a continuing, as needed basis. Many teachers, having mastered a particular technology tool, return to their mentor for help in utilizing other applications in their teaching. Some teachers just come to share with their mentors the ways in which they are using technology on their own, and some mentors meet regularly with groups of teachers to discuss technology integration. As mentors become a part of the culture of the school, formal and informal conversations of this sort become more common and ongoing, and a discourse community grows up around technology integration.

Methodology

The research design was qualitative. Questions addressed included the impact of the CATIE program on teachers' integration of technology into regular classroom teaching and learning, CATIE's impact on the culture of technology integration in individual schools, and the affordances and constraints on that process across schools. We were also interested in how CATIE mentors viewed their work. Because the nature of technology integration clearly seems to be situated in individual schools (Swan, Jennings & Meier, 2001), we looked at each of the schools in which CATIE mentors worked as a single case within the larger investigation of the CATIE program.

In the 2000/2001 school year, there were ten CATIE mentors working in 14 elementary schools in four school districts in the greater Troy, NY area. The schools in which mentors were placed were all urban, but ranged in size from quite small (12 teachers) to quite large (101 teachers) and varied in ethnic and SES characteristics by neighborhoods. In 2000/2001, CATIE mentors worked with 188 teachers and over 4,000 students. They turned in monthly reports detailing the teachers and students they worked with, lessons jointly developed, and any outstanding successes or problems they encountered. Mentors also met biweekly with the researchers to discuss the same. The researchers visited all schools at least twice, where they observed mentors work with teachers and students and took field notes. They also conducted onsite interviews with mentors, school administrators, and teachers with whom the mentors were working, and collected samples of student work.

Data sources thus included the monthly mentor reports, notes from mentor meetings, transcripts of interviews with mentors, teachers, and school administrators, field notes, and student artifacts. Data analyses consisted of the constant comparison method to look for emergent themes.

Preliminary Findings

Clearly, the CATIE program exhibits the features Putnam and Borko (1997) identify as essential to effective teacher education:

- Teachers involved in the CATIE program are treated as active learners who construct their own learning to meet their own specific professional needs. CATIE mentors serve as facilitators for that learning but follow and respect the directions it takes.
- Thus, teachers in the CATIE program are empowered to use technology in their teaching (through the on-site support of the mentors) and treated as the professionals they are.
- In the CATIE program, teacher learning about technology integration is situated in classroom practice.
- CATIE mentors model constructivist, student-centered teaching with technology in their work with both students and teachers. Mentors thus treat teachers the way they would have them treat students.

Mentors spend the majority of their time working with teachers and students in the computer labs of their participating schools, although they also assisted some classes within their own classrooms. The latter is the goal of the program and is increasing but we are still not satisfied with the lack of classroom usage. This seems to have to do with the availability and quality of equipment in schools and classrooms, but the relationship is complex and interesting. In some cases, for example, classroom usage is hampered by the lack of computers with Internet access in classrooms. However, in several schools CATIE is involved with, there are multiple computers with Internet connections in classrooms that are not well utilized. In these schools, there is also a high quality computer room. In these schools, teachers seem more comfortable with the computer room because it affords each student a computer and so allows teachers to work in more traditional modes. Indeed, the one school in which more use is made of classroom computers the computer room computers are older and incapable of running more complex programs such as Hyperstudio.

A related goal in CATIE is to encourage teachers to look beyond their current uses of technology. This seems to be happening with the more technology-experienced participating teachers, and with teachers involved in their second or third years with the program. The CATIE program has also made significant gains in helping teachers less familiar with educational technology become comfortable in its use. An interesting finding involves what we are calling the "learning by lurking" phenomenon – teachers who have been only peripherally involved in CATIE become involved after the program has been in their school for several years. To date, CATIE mentors have assisted approximately 350 teachers in fourteen schools in four school districts to create and implement lessons that integrate the use of technology into regular classroom activities.

Flexibility and adaptability were found to be central to best practices in mentoring. Mentors' ability to work with variations in teacher learning styles, pedagogical approaches, and prior experiences, as well as with existing school technology resources were found to significantly influence technology integration in schools and classrooms. An unexpected finding regarding mentors was their programmatic focus. The CATIE program's mission is focused on teachers. In interviewing mentors, however, we found that many mentors were at least as concerned with student learning as with teacher learning. The effect of such focus is being investigated.

Teacher perceptions of the CATIE program were overwhelmingly positive. Teachers uniformly reported increased knowledge of computing technologies, greater confidence in using them, and more creative teaching with computers. Positive outcomes for students, including greater independence, heightened self-efficacy, and increased motivation, were also noted by participating teachers. In most of the schools we visited, the CATIE program was seen as a valued part of the school culture, and many teachers noted changes in technology integration school-wide as a result.

Educational Significance

The CATIE program seems to be positively affecting technology integration in the schools in which it is operating. In this its fourth year of operation, its effects are becoming clearer. Most important of these, is the saturation of technology integration into the schools in which CATIE mentors are working. After several years of being present in schools, the CATIE program is reaching most of the teachers in those schools, which in turn seems to be changing their culture to include technology integration. Perhaps the best measure of its success is that one of the CATIE districts is adopting mentoring as the preferred means of technology training. Common sense indicates that the CATIE program is successful because it is reaching out to teachers in the physical and social context of their practice, because it provides ongoing, long-term support for technology integration, and because of the personal relationships mentors are forging with participating teachers within the culture of the schools in which they work. Its success thus supports a situative perspective on teacher learning, especially teacher learning about technology and technology integration.

References

Carey, N. & Frechtling, J. (1997) Best Practice in Action: Follow-up Survey on Teacher Enhancement Programs. Washington, DC: National Science Foundation.

Corcoran, T. B. (1995) Transforming Professional Development for Teachers: A Guide for State Policymakers. Washington, DC: National Governors' Association

Educational Testing Service (1998) Does it Compute? Princeton, NJ: Education Week. http://www.edweek.org/sreports/tc98.html

Panel on Educational Technology. (1997) Report to the President on the Use of Technology to Strengthen K-12 Education in the United States. Washington, DC: President's Committee of Advisors on Science and Technology.

Putnam, R. T. & Borko, H. (1997) Teacher learning: Implications of the new view of cognition. In Bidle, B. J., Good, T. L. & Goodson, I. F. (Eds.) The International Handbook of Teachers and Teaching. Dordrecht, Netherlands: Kluwer.

Putnam, R. T. & Borko, H. (2000) What do new views of knowledge and thinking have to say about research on teacher learning? Educational Researcher, 29 (1), 4-15.

Schlager & Schank, (1997) TAPPED IN: a new online teacher community concept for the next generation of internet technology. Toronto: CSCL '97: The Second International Conference on Computer Support for Collaborative Learning.

Smylie, M. A. (1989) Teachers' views of the effectiveness of sources of learning to teach. Elementary School Journal, 84, 543-558.

Sparks, D. (1994) A paradigm shift in staff development. Journal of Staff Development, 15, (4),26-29.

Wilson, S. M. & Berne, J. (1999) Teacher learning and the acquistion of professional knowledge: An examination of research on contemporary professional development. In Iran-Nejad, A. & Pearson, P. D. (Eds.) Review of Research in Education, 24. Washington, DC: American Educational Research Association, 173-209.

TECHNOLOGY & LITERACY LEARNING: A NATIONAL SURVEY OF CLASSROOM USE

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objectives/purposes

This presentation will report on the Technology Integration Project's work to date documenting the use of technology in middle school English language arts classrooms. The purpose of this ongoing national study is to explore the ways in which middle school English language arts teachers are using electronic technologies to enhance literacy learning in their classrooms. In particular, we are interested in teachers' conceptions of "technology integration," how they frame their uses of technology within a larger curriculum, and how technologies can support teaching strategies that have been shown to enhance learning in the English language arts.

theoretical frameworks/perspectives

This study builds on the work of Henry J. Becker and others at the Center for Research on Information Technology and Organizations (CRITO) that documents teachers' uses of computers (Becker, Ravitz & Wong, 1999), and on the work of researchers at the National Research Center on English Learning and Achievement (CELA) that identifies effective strategies in English language arts teaching and learning (Center on English Learning and Achievement, 2000).

Becker and the CRITO researchers have found that, although it is still true that a majority of teachers use computers very little and that the majority of intensive experiences students have with computers are outside the academic disciplines, a growing number of subject matter teachers do have their students use computers frequently and do so with a new focus on accessing information and improving their writing and general communication skills. First, among these are English language arts teachers. Indeed, at the middle school level, 30% of students' experience using computers takes place in English classes. 75% of the secondary English language arts teachers surveyed used computers at least occasionally in their classes, and 24% used them twenty or more times a year. (Becker, Ravitz & Wong, 1999) The CRITO report gives some insight into what kinds of computer applications English teachers are using and what learning objectives they are focusing their technology use on. It was not intended to tell us, however, how technologies are being used to support literacy learning.

CELA researchers have identified six approaches to English language arts teaching that have been shown to enhance literacy learning across many CELA research investigations. These are:

- using diversity to enhance learning
- increasing the cohesiveness of curriculum and instruction
- raising the level of student engagement in higher order talk and writing
- aligning curriculum with assessment
- scaffolding student performance of new and difficult tasks
- helping struggling readers (Center on English Learning and Achievement, 2000).

What CELA reports to date cannot tell us is how electronic technologies can and are being used to support such approaches.

methodology

To investigate the ways in which English language arts teachers are using technology to support literacy learning, the authors of this paper instituted a national nomination process. English language arts, library, and/or technology coordinators from all states and regional NCTE (National Council of Teachers of English) and RTEC (Regional Technology in Education Consortia) directors were contacted and asked to nominate middle school English language arts teachers who were making extensive and/or interesting use of computers in their classroom teaching. Technology using teachers were also recruited through the

CELA website, school district home pages, recommendations from software publishers and hardware vendors, other researchers, and through formal and informal professional networks.

Nominated teachers were asked to respond to an online survey which requests that they describe two lessons they use that incorporate technology, as well as asking for certain demographic and technology usage information. The survey thus focuses on specific classroom uses of electronic technologies. Survey results are being analyzed not only for technologies and applications used, but for how teachers frame technology-supported lessons and how they support literacy learning. Selected teachers will also be interviewed by phone to further explore these issues.

data sources

The data sources for the study are technology using middle school English language arts teachers. Teachers participating in the study, thus, do not represent average English language arts teachers. Rather they were chosen to provide a sample of what is being done by exceptional technology using teachers in the middle school English language arts areas. The study is national in scope for breadth and to take into account possible regional variations in usage. The middle school domain was chosen not only because it matches the focus of larger CELA projects (Center on English Learning and Achievement, 2000), but because it has been shown to be where technology is most used in English language arts teaching and learning (Becker, Ravitz & Wong, 1999).

results/conclusions

To date, nominations have been solicited, nominated teachers contacted, and 72 online surveys from teachers in 30 states collected. This data is being analyzed in terms of teachers' conceptions of technology use, in terms of how they integrate technology into existing curricula, and in terms of how technology is being used to support the six approaches to English language arts teaching that have been shown to enhance literacy learning (Center on English Learning and Achievement, 2000). We are currently conducting phone interviews with these teachers that additionally probe the above issues as well as issues of assessment and English language arts standards. By the time of the annual meeting, we anticipate having collected and analyzed all the data, including teacher interviews, on which we will report.

Preliminary findings suggest that electronic technologies are indeed being used to support the six approaches identified by CELA as enhancing literacy learning, most particularly using diversity to enhance learning, raising the level of student engagement in higher order talk and writing, and scaffolding student performance of new and difficult tasks. In addition, participating teachers frequently mentioned computer support for what might be termed the development of learning communities. They frequently spoke of more active and authentic learning, motivation, and the use of extended and collaborative projects. Almost all of them stated that students worked better together on computers, and that all students were included in the class work. Teachers also spoke of their role as changing from lecturer to facilitator.

Participating teachers generally used computers at least 30% of the time in their classes, although some used them a good deal more. As the CRITO researchers found, teachers with greater access to computers used them more often. For example, one teacher who had laptops for every student used them 70% of the time. Our survey also confirms the baseline of use that CRITO reports -- word processing and information access using CD ROMs and the Internet. Teachers in this survey, however, went way beyond these uses. They used concept mapping software such as Inspiration to explore their own and others ideas. They used email to communicate with peers and experts around the world. They used multimedia and presentation software, such as PowerPoint and HyperStudio to publish and present their work, and digital cameras, scanners, and graphics packages to illustrate it. Many made and edited digital movies. Some used simulations available on the World Wide Web, such as the virtual tour of Ann Frank's house; others made use of online drill and practice exercises in grammar and comprehension. Interestingly, many used spreadsheets and databases to organize information and create knowledge.

educational significance

Across the nation, schools and school districts are investing heavily in computer hardware and software, often using state and federal grant monies as well as local tax and bond revenues. Yet little or no information is available about the most effective ways to leverage that investment into higher literacy achievement for students. This study is designed to identify the variety of ways middle school English language arts teachers across the country are using electronic technologies to support literacy learning. What we are finding is that computer using English language arts teachers are using a wide variety of software a good deal of the time to support approaches known to enhance literacy learning as they develop learning communities in their classrooms. Their pioneering work can serve as models for school and teachers who would like to integrate technology into English language arts teaching and learning.

references

Becker, H. J., Ravitz, J. L. & Wong, Y-T (1999) Teacher and Teacher-Directed Student Use of Computers and Software; Teaching, Learning, and Computing: 1998 National Survey; Report #3. Irvine, CA: Center for Research on Information Technology and Organizations.

Center for English Learning and Achievement (2000) Partnerships to improve student literacy learning. English Update, Fall, 2000, 1.

Turning terror into discovery: Traditional narrative strategies and interactive educational media

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Abstract: Adapting narrative principles from traditional media lets course developers and writers draw from a rich aural and visual tradition to craft a new language for on-line learning. This paper highlights techniques that may be adapted from traditional media to inform the creation of content, task and navigation for interactive educational media.

In a world of increasing speed, complexity and competition, we must engage learners through meaning that resonates with their sensibilities and experience. The rich, interactive learning environment enabled by computer technology challenges us to engage people in creating their own meaning as a foundation for further learning. Taking up the suggestion by Plowman (1994) to borrow well-known narrative conventions from film to design both structure and interface, this paper highlights narrative strategies fromtraditional media that are adaptable to developing content for interactive educational media.

Narrative strategies from traditional media

That the structure of all narratives, at least in Western society, is the same has created a very stable framework for audiences (Lacey, 2000). The three-act structure, well-defined as early as Aristotelian times and formularized in the Hollywood film, is aptly explained by Hunter (1994) as an introduction (set-up), in which we place our heroes up a tree; a complication (conflict), in which we throw rocks at them; and a resolution (climax) in which we get them back down. Within this framework, many techniques have emerged to engage audiences through traditional media such as theatre, the novel, film, radio and television that are adaptable to educational interactive media.

In considering narrative techniques developed in traditional media, we should consider Lacey's advice that "Narrative does not deal with reality at all[,] but strives to create an illusion of reality by referring to other sign systems" (p. 77). Devices like book covers, film posters, radio theme music, title sequences in film, and, for our purposes, CD-ROM jewel cases and on-line course home pages, give learners cues to the genre, metaphor or interface of the lesson as well as its content.

From dramatic writing comes the need for a premise (Egri, 1960) progressing to a climax, "the pinnacle of concentration of all meaning and emotion… the decisive centre of audience satisfaction" (McKee, 1997, p. 108). Novels immerse us inside characters in a different environment to let us better understand ourselves and our purpose (Wilson, 1990), and furnish narrative genres such as the picaresque, the epistolary and the serial (Hawthorn, 1997), which, like the cues noted above, create shortcuts by drawing on knowledge external to the actual content. Film gives us time-manipulation devices like cutting between scenes and dissolves to flashbacks (Mast, 1976)—although these were criticized by early purists as drawing undue attention to the medium (Salt, 1983)—and the distinction between what we perceive through the characters (diegetic) and beyond their perception (non-diegetic) by way of superimposed music, images or voices (Lacey). Radio reminds us of the power of oral narratives to immerse listeners (Tolan, 2001), and, with television, echoes serial literature in its episodic approach and in offering narrative "arcs" spread over a season (and analogously, over a course). The need to engage audiences through an opening "teaser" and to build to a high point just before cutting away, although motivated by commercial breaks (Miller, 1980), may be applied to modularized interactive media lessons. In fact, writers can draw on tactics from new media itself to hold learners' attention by, for example, leading them through a suspenseful (but lesson-laden) labyrinth known to harbour hidden obstacles or lurking adversaries. This is what Murray would call "achiev[ing] coherent dramatic form by shaping our terror into a pattern of exploration and discovery" (p. 137).

Guidelines

Experiences with narrative in traditional media provide a wealth of lessons for writers seeking to engage learners in constructing their own meaning through interactive educational media. A review of the literature on traditional narrative tools suggests the following guidelines for developing content for interactive educational media:

1. A premise or theme of a lesson, expressed in terms of human behaviour and carried through to a logical conclusion, can create deeper meaning for learners.
2. The three-act structure of introduction, complication and resolution, so well-engrained in Western thought, provides a solid frame for building a lesson.
3. We can engage on-line learners more deeply by casting them in "immersive" roles and allowing them to chart their direction through the narrative.
4. Immersing learners inside other characters, in a different environment, can help them to better understand themselves and their purpose.
5. Using the first person can provide access to a character's innermost thoughts, and multiple points of view. Unreliable narrators can add to the critical skills demanded of the learner.
6. Lessons can be structured along narrative forms well-established by novels and filmic genres, which enrich the lesson and save time by incorporating learners' prior, external knowledge.
7. Further layers of meaning are available through non-diegetic devices such as background music, superimposed images or voice-overs.
8. Time, space and perspective can be illustrated by employing classical filmic techniques such as double exposure, different types of shots and dissolves.
9. Different stories can be linked through a common motif; differences can be lessons, too.
10. Sound, used alone, offers great power to co-opt the audience's imagination. Key points may be delivered, along with other means, by voice-over while freezing or blackening the screen.
11. An episodic approach, with a fixed cast of characters can provide continuity to a series of teaching modules by building on preceding lessons, and referencing prior foundations as refreshers or as needed to understand ensuing points.
12. We can capture learners' interest with a tantalizing opening sequence and hold it through tests or other breaks by building the lesson to a narrative high point just before they occur.

The familiarity and interactivity of narrative structures make them ideally suited to on-line learning. The nascence of interactive media and its educational applications present a tremendous creative challenge for course developers and writers. Adapting, and perhaps even improving on, narrative principles from traditional media allows us to draw from a rich aural and visual tradition, and to help craft a new language for on-line learners who seek to rise to Murray's call to turn their terror into discovery.

References

Egri, L. (1960). *The art of dramatic writing (Revd. ed.).* New York: Simon & Schuster.
Hawthorn, J. (1997). *Studying the novel (3rd ed.).* London: Arnold.
Hunter, L. (1994). *Lew Hunter's Screenwriting 434.* New York: Perigee.
Lacey, N. (2000). *Narrative and genre: Key concepts in media studies.* New York: St. Martin's Press.
Mast, G. (1976). *A short history of the movies.* Indianapolis, IN: Bobbs-Merrill.
McKee, R. (1997). *Story: Substance, structure, style, and the principles of screenwriting.* New York: HarperCollins.
Miller, W. (1980). *Screenwriting for narrative film and television.* New York: Hastings House.
Murray, J. (1997). *Hamlet on the holodeck: The future of narrative in cyberspace.* New York: The Free Press.
Plowman, L. (1994). "The 'primitive mode of representation' and the evolution of interactive multimedia." *Journal of Educational Multimedia and Hypermedia, 3*(3/4), 275-293. Retrieved October 15, 2001 from http://meno.open.ac.uk/Prim_mode_abstract.html
Salt, B. (1983). The early development of film form. In Fell, J. (Ed.), *Film before Griffith* (pp. 284-298). Berkeley, CA: University of California Press.
Tolan, S. (2001). "First-person narratives on radio document historic memory." *Nieman Reports, 55*(3), 19-21. Retrieved December 13, 2001 from the Academic Search Premier database.
Wilson, C. (1990). *The craft of the novel (3rd ed.).* Bath, UK: Ashgrove.

Could oral communication be successfully taught entirely online?

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Abstract: This paper discusses the formative stages of an ongoing study to develop a course in oral communication that can be taught entirely online using chat rooms, bulletin boards and synchronous video-conferencing. It addresses the reasons for the development of the on-campus oral communication course, its structure, pedagogical foundations and its evolution from the face-to-face and distance print-based delivery modes to be taught entirely online. Due to current technical limitations a simulated online course will be developed and conducted under experimental conditions using a Local Area Network. This study will not only assist oral communication instructors, but also instructors developing a wide range of courses for online delivery.

Background to the Study

The need for improved oral communication skills has been expressed by employers, academics and students (Merrier & Dirks, 1997). Oral communication is the top skill sought by employers, however, this skill is lacking in most business graduates. A compulsory 15-hour oral communications course to improve students' oral skills was introduced in 1999 for all business students studying on-campus at a Western Australian university. The course was initially designed for the internal students. It was later developed to include distance students using print-based materials. The challenge now is to develop it for online delivery.

The pedagogical basis for the original course was founded on constructivist principles, collaborative online learning, adult learning and the situated learning model. Particular attention was given to the elements of authentic learning model outlined by Herrington (1997) that is, authentic content and activities, modelling of process by experts, multiple roles and perspectives, collaborative construction of knowledge, reflection and articulation, coaching and scaffolding, and authentic assessment. The course provided opportunities for students to learn and practise communication skills applicable to the business world.

The face-to-face course was structured as a two-hour seminar and a one-hour tutorial repeated five times. A typical seminar, with approximately 50 students, provided the background information for the module through student discussions, activities, question and answer sessions and demonstrations of presentation exercises. Each tutorial, with groups of 10-12 students, was further subdivided into teams of 3 or 4. This structure provided support, a nurturing environment, and time for students to practise and develop the required communication skills. The aim is to replicate as many of theseessential ingredients as practicable via online delivery.

Feedback about the face-to-face course was positive and class members noted their peers' development. Students appeared more confident, readily participated in class discussions, attended regularly, gave positive, objective and encouraging feedback, and provided professional presentations. They considered the skills transferable to other units and general life. The test will be whether these positive evaluations persist when the face-to-face element of the course is removed.

There has been a push from students, governments, tertiary institutions and the workplace for the development of flexible delivery modes. Online learning has quickly become a pervasive study option, offering "anytime-anyplace, one-to-one or one-to-many communication venues. Online learning is a particularly attractive option for meeting the diverse needs of adult learners (Vician & Brown, 2001). Much of the research into online teaching and learning, however, has concentrated on the use of interactive multimedia by an individual, and communications with other students and the lecturer via chat rooms or bulletin boards. Less research has been published on synchronous videoconferencing as a means of communicating with other students and lecturers through computer cameras. Mason (1991) suggested this method offered 4 advantages: It is more motivating for learners by focusing group energy, it helps develop a sense of social presence and group cohesion, provides quick feedback that supports decision making, and provides structure and discipline to encourage students to keep up-to-date. A recent US study (Clark & Jones, 2001) used the Internet to teach oral communication, however, students were required to attend class for the practical component; their actual presentations. While this method may be suited to those students who prefer a different delivery mode, it is not suitable for students (particularly those living in remote locations) who want to complete the entire course off-campus.

Online Oral Communication Experimental Study

A combination of delivery systems will be used in this experimental online study not only to provide a better learning environment (Berge, 2000), but also to replicate the successful face-to-face course. Students will progress through each module by accessing information either online using the software package "Blackboard" or via a CD-Rom. The CD-Rom will contain video clips of examples, demonstrated techniques, past student presentations and key hints from the lecturer. Students will complete "class" activities either individually or with other students via chat rooms and bulletin boards to enhance their learning.

The main oral presentation exercise for each module will be completed via synchronous videoconferencing. This will allow for peer coaching immediately following presentations, a component of the internal course considered essential. Until more advanced technology becomes available there could be problems with voice synchronisation, time delays and computer breakdowns, so the student presentation experience will be simulated using Intranet. Five linked computers, with cameras attached will be set up in separate rooms. For each simulated session the first student will give their individual presentation via the camera, the second student in the team will facilitate the self- and peer-evaluation, and the third student will evaluate. Student roles will be rotated until all students present, provide feedback and facilitate. For the purpose of this study a video camera in the room will record student actions, visible signs of apprehension, and their handling of the program.

Before being given access to the course itself, students will receive individual personal training in using "Blackboard" and be asked to complete a pre-test questionnaire online. This questionnaire will measure levels of communication apprehension (CA), willingness to communicate (WTC), shyness and self-perceived communication competence (SSPC). After the course students will do a post-test to determine any changes. Student satisfaction will be measured by questionnaires, focus groups and interviews.

Summary

This paper has outlined the developmental stage of a work in progress aimed to deliver an oral communication course entirely online. It has highlighted the critical success factors of the existing face-to-face course that would have to be replicated to ensure positive learning outcomes in the proposed online course. Although the new course will be trialed in a simulated experimental setting, it should provide a good indication of the potential for success for such a course when the technology becomes sophisticated enough for complete online delivery. The insights gained from this experiment will be of use to educators involved in development of other online courses, especially those where synchronous feedback would be an asset.

References

Clark, R. A., & Jones, D. (2001). 'A comparison of traditional and online formats in a public speaking course." *Communication Education* 50(2), 109-124.

Herrington, J. (1997). *Authentic learning in interactive multimedia environments.* Perth, WA, Edith Cowan University

Merrier, P., & Dirks, R. (1997). "Student attitudes towards written, oral and e-mail communication." *Business Communication Quarterly*, 60(2), 89-99.

Vician, C., & Brown, S. A. (2001). "Re-engineering participation through on-line learning environments: An examination of communication apprehension, choice and performance." *Journal of Computer Information Systems*, 42(1), 26-36.

Skills Needed for Managing Multimedia Development – Invisible or Visible?

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Abstract: All multimedia project managers strive to have projects delivered on time, on budget and to the required quality. In the quest to achieve this success, much research has been performed and literature written about project management techniques to enhance in this process. Increasingly however, it is being recognised by both employers and researchers that project managers not only need administrative and management skills, but also other skills, which are related to their management style and emotional intelligence. This paper investigates the range of skills needed by a project manager immersed in a multimedia development environment, and are classified in a continuum from "visible" to "invisible". These are compared and contrasted to consider the impact of emotional intelligence on the overall project success, including the team synergy.

Introduction

Collaborative teamwork focused on project work is becoming an increasingly popular process by which companies seek to increase efficiency and effectiveness to increase their profits (Thomas & Pinto, 1999). This is placing pressure on a greater number of "modern day project managers" to act as visionaries, technical experts, negotiators, sales people and so forth. These individuals are required to master the various, sometimes-competing demands of their jobs by striking an effective balance between the roles they undertake. Current research is advocating that successful completion of projects requires project managers and team members to have effective generic skills (Bennett, Dunne, & Carre, 1999; National Board of Employment Education and Training, 1996). This concept is gaining huge support from industry as well as higher education funding authorities, and many reports from around the world are advocating that vocational and higher education institutions need to focus more on improving students generic skills rather than just providing content knowledge (Australian National Training Authority, 1998; Candy, Crebert, & O'Leary, 1994; Dearing, 1997).

According to Wysocki (1995, p.14), project managers need skills in three broad areas: managing/administrating, applying technical skills and using generic skills. The management/administrative and technical skills or "visible skills" such as scheduling, planning, legal issues and costing are well documented and supported by a myriad of training courses. However "Invisible skills" needed by project managers have only just recently been recognised as being important by both academics and industry employers. These are represented in Figure 1 as a continuum, in which technical and management skills such as computer programming, design or authoring skills are easily proven or observable. But hidden or "invisible" skills are not always easy to demonstrate i.e. how can you predict if a candidate has good conflict resolution skills or collaboration skills?

This type of classification is also supported by Belassi & Oya (1996) who developed a framework, based on a wide literature review, for predicting project success factors. In their classification, they also recognise the importance of project manager and team member attributes as critical success/failure factors for project development. They grouped four factors that can potentially affect the success of a project:

- Project manager and team member factors - such as ability to delegate authority, ability to coordinate, perception of role and responsibilities, communication skills, technical background and commitment;
- Overall project factors - such as size and value, uniqueness of the project activities, urgency, density of project and life cycle;
- Organization factors - such as support from management and project organisational structure; and
- Environment factors - such as politics, economics, technology, client issues, competition and sub-contractors.

Figure 1 illustrates these broad skill sets as a continuum, showing technical and administration skills on the "visible" side of the scale and generic skills and emotional intelligence on the "invisible" side. This paper contends that each of these four broad skills are needed for successful project management. However, the main

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focus of this paper will be on emotional intelligence and it's relationship and impact on successful project management.

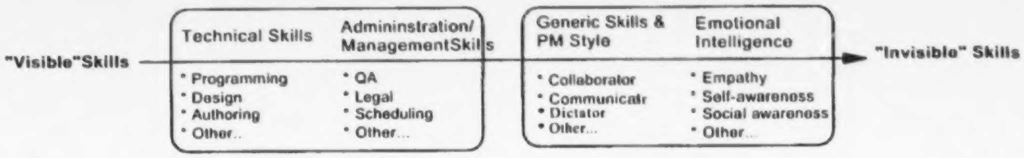
"Visible"Skills
Technical Skills
Admininstration/ ManagementSkills
Generic Skills & PM Style
Emotional Intelligence
"Invisible" Skills
• Programming
• Design
• Authoring
• Other..
• QA
• Legal
• Scheduling
• Other...
• Collaborator
• Communicatr
• Dictator
• Other...
• Empathy
• Self-awareness
• Social awareness
• Other...

Figure 1: A spectrum of project management skills

Skills Needed for Multimedia Project Management

In the field of multimedia development, project managers must "juggle" a range of team, business, administrative and production aspects, as shown in Figure 2. These aspects have a direct affect on profit, delivery time and final product quality(Department of Industry Science and Technology, 1995). Clearly, project managers must have skills and experience in these areas to help create successful products, which are a mixture of administrative, management and technical understanding of the media.

Increasingly however, it is being recognised that the "visible" skill set shown in Figure 2 is not enough for success. Generic skills and the individual's management style are increasingly being promoted as being a critical component in having successful outcomes. Employers now actively seek employees with problem solving, collaboration and communication skills. These skills are considered important for both project managers as well as all other team members to help promote the development of successful projects.

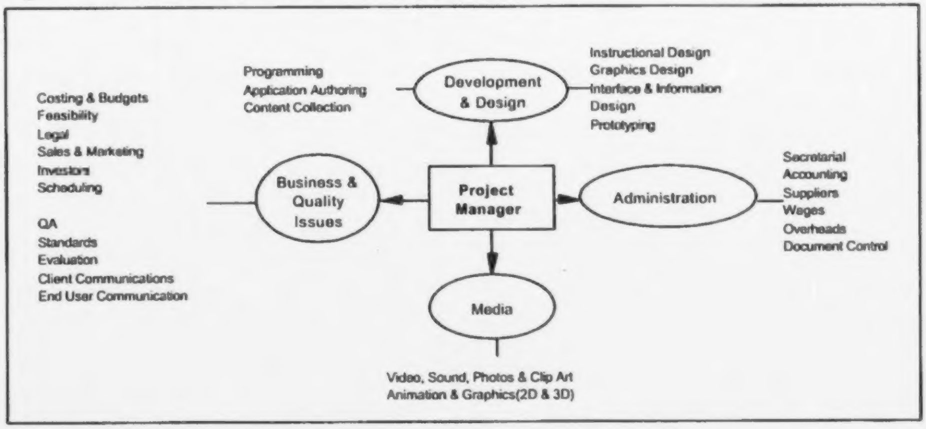
Programming
Application Authoring
Content Collection
Development & Design
Instructional Design
Graphics Design
Interface & Information Design
Prototyping
Costing & Budgets
Feasibility
Legal
Sales & Marketing
Investors
Scheduling
QA
Standards
Evaluation
Client Communications
End User Communication
Business & Quality Issues
Project Manager
Administration
Secretarial
Accounting
Suppliers
Wages
Overheads
Document Control
Media
Video, Sound, Photos & Clip Art
Animation & Graphics(2D & 3D)

Figure 2: "Visible" project management skills

Another factor that can also influence project management success is the management style used by the project manager. The traditional "command-and-control" method is becoming increasingly redundant in a market that strives to empower and not direct team members (Dodgson, 1999). Team members need to feel motivated, enthusiastic and trusted by the project manager to make correct decisions. Through the review of literature a link will be identified between successful project management and emotional intelligence. The relationship between emotional intelligence and project management is discussed in the following section.

What is emotional intelligence?

The concept of emotional intelligence and its impact on project management, team management and overall project success, especially in multimedia design and development is relatively new. Salovey and Mayer (1990) initially conceived the concept and coined the term Emotional Intelligence. This concept was derived from Gardner's (1983) theory of multiple intelligences. The notion that there is not one intelligence, but several intelligences, forms the basis of multiple intelligence theory. Gardner (1983) identified seven intelligences -

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musical intelligence, bodily-kinesthetic intelligence, logical-mathematical intelligence, linguistic intelligence, spatial intelligence, interpersonal intelligence and intrapersonal intelligence.

Intrapersonal and interpersonal intelligences were used by Salovey (1990) to form the basis of the initial comprehensive theory of emotional intelligence (Goleman, 1995; Yost & Tucker, 2000). Personal intelligences or the initial idea of emotional intelligence, though essentially derived from Gardner's multiple intelligences, does not explore feelings but focuses primarily on the cognitive aspects of feeling (Goleman, 1995). Salovey and Mayer (1990) used this as a basis for their definition of emotional intelligence, which they define as the "ability to monitor and regulate one's own and other's feelings, and to use feelings to guide one's thinking and action" (p.189). This definition identified five main domains: knowing one's emotions, managing emotions, motivating oneself, recognising emotions in others and handling relationships.

Goleman (1998b) adapted Salovey and Mayer's model as a basis for his discussion of the theory of emotional intelligence and it's implications for everyday life including the world of work. The model includes five emotional and social competencies: self-awareness, self-regulation, motivation, empathy and social skills. These are each discussed below.

Self-Awareness

Self-awareness is the ability to understand and interpret one's own feelings through internal reflection. The ability to be critical about thoughts and make changes to behaviour can lead to an in-depth understanding about one's self, which leads to a better understanding of others. Lanser (2000) places a strong emphasise on the importance of self-awareness in guiding and perfecting job performance, including interactions with colleagues and in the establishment of positive and productive leadership and teamwork skills. Leaders and managers need to be especially aware of their feelings as they may allow uncontrolled emotions to impact on the dynamics and culture of the workplace or team. Overt expressions of negative emotions rather than controlled self-awareness of one's own emotions can lead to conflict and can create an unpleasant working environment. Cherniss (1998) emphasises that effective leaders are self-confident, which is reflective of their own emotional self-awareness, and ability to control their emotions.

Self-Regulation

Self-awareness of emotions enables managers to then practice self-regulation, which is the ability to use emotions to facilitate the progress of the task or the project (Goleman, 1998b; Lanser, 2000). Being able to regulate emotions especially during conflict, pressure, stress and deadlines facilitates the smooth progress of the project and promotes positive, effective working relationships with team members and clients. Goleman (1998b) explains that handling emotions and putting the task first rather than emotions aids in the attainment of the required goal. Through self-awareness, project managers need to be able to self-regulate their emotions, and then facilitate the attainment of the project goals through positive, productive relationships with colleagues in a team environment.

Motivation

Being able to motivate team members into contributing their best is very powerful. Workers are discretionary in their application to a project – they will only give if they feel they are being supported, nurtured and inspired. Managers need to create an environment that stimulates, enhances and empowers team members to become motivated and apply themselves fully to the project (Grossman, 2000). Successful leadership requires intrinsic motivation, persistence and vision (Cherniss, 1998). Project managers are not only responsible for their own motivation but are also play a key role in motivating the team and colleagues. Goleman (1998b) and Lanser (2000) propose that motivation is an essential element of emotional intelligence that pushes us forward through the positive and negative aspects of working life by showing initiative, perseverance and dedication, as well as being goal orientated, focussed and proactive. Grossman (2000, p. 19) explains that the managers and leaders with high emotional intelligence "can motivate members of an organization to work more effectively and efficiently – in short, produce a better product" (p. 19).

Empathy

Goleman (1998b) contends that empathy is understanding and interpreting colleagues' feelings and being able to identify with their feelings on issues through understanding their perspective and cultivating rapport with people from different 'walks of life'. Empathic project managers have an awareness of the diversity of personalities and are accepting of the diversity of people and the impact culture can have on interactions within a team environment. (Book, 2000), defines empathy as the "capacity to see the world from another person's perspective" (p. 45). This skill allows project managers to understand other peoples' behaviour without commenting its appropriateness or inappropriateness, which has the potential to turn adversarial relationships into collaborative alliances.

Social Skills

Social skills are essential for the development of positive, effective relationships with colleagues and the ability to interact with team members to deter conflict, be aware of, ease and dissipate underlying tensions that can accumulate and have a negative impact on working relationships and project success. Project managers need to be able to stimulate cooperation, collaboration and teamwork through well-developed social skills (Goleman, 1998b).

It's not hard to think of examples of managers or team members that don't have these skills. Often, these people are referred to as "abrasive", "cold", "unfeeling", "self-centred", "inflexible" or "boring" and are usually hard to work with. The following section describes how emotional intelligence plays an important role in project management.

Emotional Intelligence and Project Management

Grossman (2000) believes that there is "more to management than a keen intellect and grasp of technical knowledge. The difference between success and mediocrity most often can be attributed to a leader's mastery of softer skills– abilities and approaches grounded in emotional intelligence" (p.18). This is also supported by Tucker (2000), who contends that successful project management requires strong technical and theoretical knowledge as well as emotional intelligence. Project failure generally does not occur because of lack of technical knowledge, but more often because the project manager has a deficit of emotional intelligence, which is essential for project success and team cohesiveness and effectiveness.

Book (2000) explains that emotional intelligence is more important than theoretical and technical skills. He considers self-awareness, self-regard, self-actualisation, flexibility, social skills and open communication as essential attributes for successful project management. Project managers should "feel comfortable with themselves to acknowledge their mistakes and flaws…and have the capacity to tolerate not knowing all the answers" (p. 45).

Emotional intelligence is also reflected in management styles. Carlos & Taborda (2000) promote that new management styles are needed in the industry, which focus on team orientation strategies and empowerment, rather than the traditional command and control paradigm. This type of management style places an emphasis on organic commitment and involves everybody in decision making with participative approaches to problem solving. They contend that this management style encourages employee initiative and an atmosphere of "high-expectations, appreciation, and excitement" (p. 42).

The value of empowering team members, and providing a supportive project environment (rather than goal-directed) is supported through a study performed by Tampoe & Thurloway (1993). From the responses of a range of knowledge workers in different organisations, they determined that many of the respondents' drives to succeed were adversely affected by approaches that focus on deliverables rather than the empowerment of teams. They concluded that the trend towards flattening hierarchies, multi-skilling and team working result in increased effectiveness as well as motivation.

The review of the literature promotes that project managers must create an environment that fosters emotional intelligence and encourages team members to contribute. Some organizations are not flexible enough and don't allow or recognise the potential for team members to contribute beyond the expectations of the job. However, by leading through example, fostering creativity and imaginative thinking and allowing others to provide an input into the development of the project can promote greater project and team success. In order to promote positive, progressive, effective working environments, project managers need to have a combination of technical knowledge and well-developed emotional intelligence including self-awareness, empathy, social awareness and be highly motivated and be able to inspire and motivate team members.

Based on Goleman's (1998a) work, Table 1 has been developed which identifies attributes of each emotional intelligence competency. Through the literature we have identified representative examples of each competency that relate to project management.

We have shown that management and technical competencies need to be complemented with behavioural or affective competencies in order to promote the development of successful projects. In summary, Martin (1993), through a synthesis of literature, reinforces the legitimacy and wisdom of recognising an affective dimension in decision-making. The dimension reflects sensitivity to feelings, emotions and the plight of employees, customers and others by listening to the "voices of the heart". He suggests that managers should avoid making decisions, which are based solely on the cognitive domain, that are based solely on rational and analytical reasoning, and proposes that quality business decisions are based on both cognitive and affective understanding (Figure 3).

	Definition	Relationship to PM
Self-Awareness	• The ability to recognise and understand your moods, emotions, and drives, as well as their effect on others	• having positive and productive leadership and teamwork skills • controlling emotions and understand the impact of emotions on the team • being self-confident
Self-Regulation	• The ability to control or redirect disruptive impulses and moods • The propensity to suspend judgement – to think before acting	• being self-aware of emotions to enable self-regulation • handling emotions and putting the task first • using emotions to facilitate the progress of the project • regulating emotions during conflict, pressure, stress and deadlines • facilitating the smooth progress of the project and promoting positive, working relationships with team members and clients
Motivation	• A passion to work for reasons that go beyond money or status • Pursuing goals with energy and persistence	• motivating team members into contributing their best • creating an environment that stimulates, enhances and empowers team members to become motivated and apply themselves fully • showing initiative, perseverance and dedication, goal orientation & focus
Empathy	• The ability to understand the emotionalmakeup of other people • Treating people according to their emotions	• understanding, and identifying with colleagues' feelings • cultivating rapport with people from different 'walks of life' • Having awareness off, and accepting of the diversity of personalities and cultures • Turning adversarial relationships into collaborative alliances
Social Skill	• Proficiency in managing relationships and building networks • An ability to find common ground and build rapport	• developing of positive, effective relationships with colleagues • having the ability to interact with team members and deter conflict, be aware of, ease and dissipate underlying tensions • being able to stimulate cooperation, collaboration and teamwork through well-developed social skills

Table 1: Emotional Intelligence & PM Competencies (modified fromGoleman, 1998a)

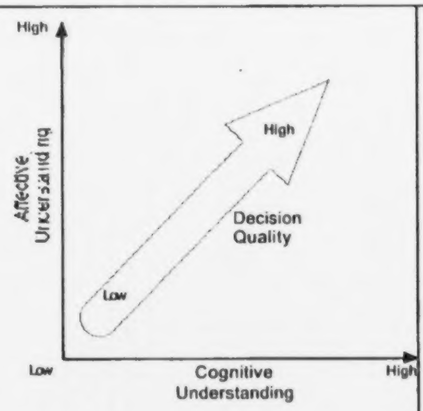

Figure 3: Dual dimensions of decision making (Martin, 1993)

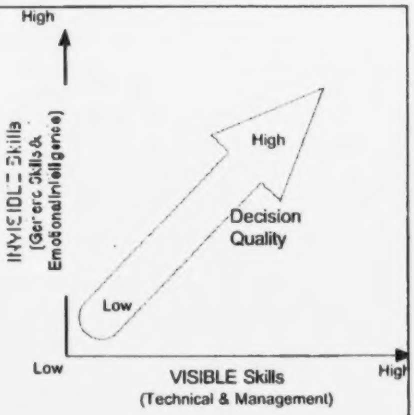

Figure 4: Skills Needed for Effective Project Management

Likewise, Goleman (1998a) contends that emotional intelligence is twice as important for leaders than technical skills and intellect. Excellence in performance relies on emotional intelligence as a major ingredient for success. As managers "move up the ladder", higher levels of emotional intelligence are needed than at levels where technical skills are essential. In recruiting project managers, employers should be aware of emotional intelligence requirements, as outlined in Table 1. Martin's decision making dimensions of affective understanding and cognitive understanding have been adapted, as illustrated in Figure 4, to reflect our belief, based on the literature, that the combination of "invisible" and "visible" skills affect decision making quality and have a direct impact on effective project management and project success.

Conclusion

Project managers need to consider not just technical and management skills for successful project management, but also generic skills and emotional intelligence at the "invisible" end of the scale. As illustrated in this paper, emotional intelligence is clearly an important skill for successful project management, team management and helps promote project success and quality decision making. Project management courses should therefore focus not only on the "visible" skills but also on "invisible" skills. Project managers would gain immensely from courses that provide them with an understanding of the impact of generic skills and emotional intelligence on overall project success and team synergy. We suggest that developing these "invisible" skills should be part of any project management course.

References

Australian National Training Authority. (1998). *Australia's National Strategy for Vocational Education and Training 1998-2003.* Canberra: Commonwealth of Australia.

Belassi, W., & Tukel, O. I. (1996). A new framework for determing critical success/failure factors of projects. *International Journal of Project Management, 14*(3), 141-151.

Bennett, N., Dunne, E., & Carre, C. (1999). Patterns of core and generic skill provision in higher education. *Higher Education, 37*(1), 71-93.

Book, H. E. (2000). One Big Happy Family - the Emotionally Intelligent Organization. *IVEY Business Journal,*(Sept/Oct), 44-47.

Candy, P., Crebert, G., & O'Leary, J. (1994). *Developing Lifelong Learners through Undergraduate Education.* Canberra: Australian Government Publishing Service.

Carlos, G., & Taborda, M. (2000). Leadership, Teamwork, and Empowerment: Future Management Trends. *Cost Engineering, 42*(10), 41-44.

Cherniss, C. (1998). Social and Emotional Learning for Leaders. *Educational Leadership, 55*(7), 26-28.

Dearing. (1997). *Higher education in the Learning Society.* London: HMSO.

Department of Industry Science and Technology. (1995). *Excellence in Content.* Commonwealth of Australia.

Dodgson, M. (1999). What role for management in science? *Technology Analysis & Strategic Management, 11*(2), 133-141.

Gardner, H. (1983). *Frames of Mind: The theory of multiple intelligences*. New York: Basic Books.

Goleman, D. (1995). *Emotional Intelligence.* New York: Bantam Books.

Goleman, D. (1998a). What makes a leader? *Harvard Business Review, 76*, 93-102.

Goleman, D. (1998b). *Working with emotional intelligence*. New York: Bantam Books.

Grossman, R. J. (2000). Emotions at Work. *Health Forum Journal,*(Sept/Oct), 18-22.

Lanser, E. G. (2000). Why you should care about your emotional intelligence. *Healthcare Executive,*(Nov/Dec), 6-11.

Martin, C. L. (1993). Feelings, Emotional Empathy and Decision Making: Listening to the Voices of the Heart. *Journal of Management Development, 12*(5), 33-45.

National Board of Employment Education and Training. (1996). *Changing Context, Moving Skills: Generic skills in the Context of Credit Transfer and the Recognition of Prior Learning*. Canberra: Australian Government Publishing Service.

Salovey, P., & Mayer, J. (1990). Emotional Intelligence. *Imagination, Cognition & Personality, 9*(3), 185-211.

Tampoe, M., & Thurloway, L. (1993). Project management: the use and abuse of techniques and teams (reflections from a motivation and environment study). *International Journal of Project Management, 11*(4), 245-250.

Thomas, P., & Pinto, J. K. (1999). Project Leadership: A Question of Timing. *Project Management Journal, 30*(1), 19-26.

Tucker, M. L., Sojka, J., Barone, F., & McCarthy, A. M. (2000). Training Tomorrow's Leaders: Enhancing the Emotional Intelligence of Business Graduates. *Journal of Education for Business, 75*(6), 331-337.

Wysocki, R. K., Beck, R., & Crane, D. B. (1995). *Effective Project Management. How to Plan, Manage, and Deliver Projects on Time and Within Budget*. New York: John Wiley & Sons, Inc.

Yost, C. A., & Tucker, M. L. (2000). Are Effective Teams More Emotionally Intelligent? Confirming the Importance of Effective Communication in Teams. *Delta Pi Epsilon Journal, 42*(2), 101-109.

Construction of Web-based Japanese Listening Program and the results of its Preliminary Experimental Results

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<Abstract>
In this paper we present the overall framework and the content of a web-based Japanese listening program and itspreliminary experimental results. The program is basically designed not only to help learners of basic level Japanese to develop their perceptional skills of Japanese sounds but also to be used as a remedial course for higher levels of students who still have problems of discerning segments of Japanese sounds and syllables. We believe that the listening for perception is an area which can fully take advantage of multimedia as it enables us to make interactive and interesting exercises and serves learners with a dynamic learning environment where they can learn at their own pace, irrespective of their abilities or learning preferences. The rate of achievements and participation of each student are automatically recorded and the students can see their own process of progress in both histogram and numerical charts. The evaluation of the program was performed by means of a questionnaire and comparing the results of pre- and post treatment tests. In the preliminary experiment we could observe a positive response towards the program.

Keywords: Japanese Education, Listening for Perception, Sound Segments, Syllables, Accent Patterns, Management System

1. Introduction

Since 1999, the Language and Culture Department at Dokkyo University has started to admit foreign students without any previous knowledge of Japanese. In order to let them acquire enough knowledge and skills in Japanese in two years and educate them to be ready for studying specialized subjects in Japanese, we have organized four levels of Japanese courses which amount to approximately 1,100 hours of study in total. The schedule and the contents are very tight and demanding. Under these circumstances, it is necessary for us to prepare as much efficient and interesting teaching materials as possible. Generally, studies for developing sound recognition skills are time consuming and tedious, and the students tend to loose interests and do not pay enough attention to the listening for perception. One way to solve this problem and to use time more efficiently is to construct a CALL listening program which provides students with interactive and interesting exercises, namely, a dynamic learning environment where they can learn at their own pace, irrespective of their abilities or learning.

2. Content of Listening and the Purposes

The content of listening can be divided into "listening for perception" and "listening for comprehension." The studies on comprehension process have demonstrated various aspects of listening activities, not to mention the roles of supra-segmental characteristics of the input, those of background knowledge and context have been duly emphasized. While listening, students are encouraged to use their background knowledge and the contextual information so that they can predict and understand the forthcoming information. They are instructed to listen for purpose and the meaning, but not to pay too much attention to an individual sound. While the latter type of listening has been emphasized, the former type, namely, "listening for perception" seems to be less emphasized in the recent classroom activities. Considering that students should practice both types of listening exercises from the beginning, we have decided to construct the program consisting of two types of listening with equal emphasis, and will investigate the relationship between these. Few of the Japanese listening programs demonstrate data on its implementation as a part of classroom activities. Here we also present a preliminary evaluation of the program after having used it for forty days on the basic level of students at Dokkyo University.

3. Framework of the Listening Program

A number of interesting pronunciation and listening exercise texts have been developed (1). Most of them, however, are not internet-based (2). What is new about our program is that it is internet-based and thus can provide a dynamic learning environment where any learners who are interested in developing their listening skills can learn at their own pace, abilities and preferences. Unlike traditional listening materials introduced above and diso-based training, this interactive program on the web ensures learners a control of the learning process, which is expected to help students maintain their motivation for learning. .

The program consists of two parts: Part One centers around various sound recognition exercises and Part Two with different types of listening comprehension exercises. Part One is further arranged to cover three main areas: 1) "recognition of individual sounds, " 2) "discerning syllabic structures" and 3) "recognition of accent patterns." Since the difficulties in learning Japanese sound system lie not only in distinguishing individual sounds, but also in recognizing a syllabic structure of words and accent patterns, we have decided to choose these topics as the first step to develop Japanese listening CALL materials on the web. The top page of the program (Fig.1) functions as an index page, from which students can jump to any one of these exercises by clicking the exercise number.

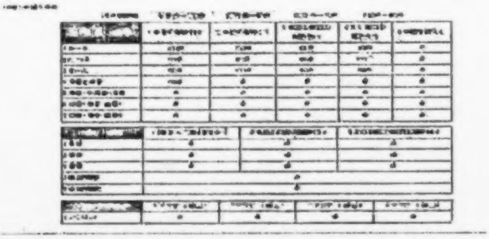

Fig. 1 Top and Index Pager

4. Part I – Sound recognition exercises

Sound recognition exercises consist of five stages: 1) recognition of one syllable, 2) recognition of words, 3) discrimination of two similar words, 4) discrimination of two similar short sentences and 5) extracting the words in long sentences. Students can jump from one exercise to the other if they want to, but in the classroom situation, the instructor encouraged them to go through from stage 1) to stage 5). Figure 2. shows an example of a sound recognition exercise in which students click the corresponding "hiragana" (a Japanese alphabet) on the screen upon having heard the "alphabet." Since Japanese is a syllabic language, the number of syllables is limited. Thus it is possible to let the learners discern each syllabic sound as a basic part of listening exercises by means of minimal pair. The order of the recorded "hiraganas," as in an Exercize 1) ,"recognition of one syllable," is constructed to alter automatically whenever they start working on the exercises from the beginning. This device has been arranged so that the students will not find the task boring and ineffective. Neither can they rely on the route memorization of the order of the sounds. However, in case learners want to do other exercises, they can jump back to the index page and choose any exercises they prefer to do.

Figure 3 presents another type of sound recognition exercise. In this exercises students listen to the word and write the word by dragging down the appropriate "kana" syllable out of the chart on the screen. When the answer is correct, the "OK" mark and the illustration, which depicts the meaning of the word, appear on the screen and confirm that the answer is correct. This kind of visual information can not only help them understand the meaning of the word but also serves them to enjoy the program. In order to make these exercises more interesting, the illustrations are sometimes constructed to move.

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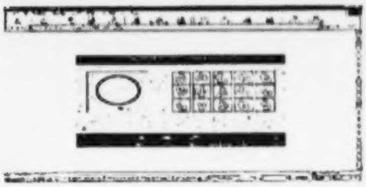

Fig. 2 Sound recognition exercise

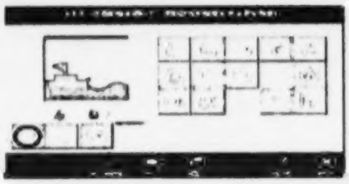

Fig 3. Word recognition exercise

4-1. Exercises on syllabic structure

In addition to the exercises introduced above, where the students should recognize segmental sounds, we have exercises designed to let learners pay attention to the number of syllables and syllabic structure. Even though Japanese is frequently cited as an example of a language with relatively simple syllabic structure, it is not easy for non-Japanese students to recognize the syllabic structure and count the number of syllables in any given word. The Japanese syllable is defined fundamentally in terms of the number of syllables in the word and each syllable holds isochoronous duration. What is particularly difficult is to recognize consonant clusters such as /tt, kk, ss/ , and a syllabic nasal /N/ as one syllable, especially so to the learners whose languages do not admit such consonant clusters and a nasal segment as one syllable. There is one more problem we have to deal with; that is the treatment of long vowels, namely /aa, ii, ee, uu, oo/. These long vowels should be basically pronounced with the length of two isochronous durations, while short vowels with one. For example, the [ba] of the word "obasan" [obasaN] is a short vowel and the [baa] of the word [obaasaN] is a long vowel. The first one has four durations and means "aunt", and the second one has five durations and means "grandmother." Since there are basically no striking quality differences between long and short vowels in Japanese, it is very difficult for learners of Japanese to discern them. These do not only impose problems in listening but also in writing and in speaking. Considering that errors in these area are carried forward even after many years of study, exercises in three areas are extensively presented in the program (Fig. 4).

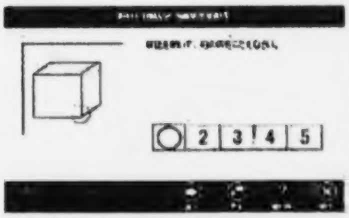

Fig. 4 Number of syllables

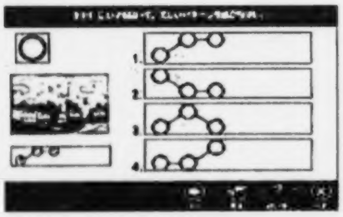

Fig. 5 Accent Pattern

5. Exercises on accent patterns

In addition to those mentioned above, we have prepared the exercises in which learners are trained to recognize word accent patterns. In English, for example, accented syllables are pronounced louder, longer and more clearly than unaccented syllables. In Japanese, accent has nothing to do with them, but it rather involves changes in voice pitch. The words with the same phonetic segments but with different location of accented syllable often signify totally different referents in Japanese. For example, the words "Ame" with the first syllable accented, and "aME" with the second syllable accented mean "rain" and "a candy" respectively. Accordingly, to be able to discern the accent pattern is also another important task for the learners of Japanese. In this area, we also provide various types of exercises with different ways of carrying out the tasks such as "to click the correct answer out of multiple choices," "to answer whether the accent patterns of the two words they hear are the same or not," and "to make up accent patterns on their own" by clicking the circles as shown in Figure 5.

6. Listening Comprehension Exercises

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Part Two consists of various listening comprehension exercises whose contents are closely related to certain topics, situations, grammar points and communicative functions. In preparation for these exercises, we have tried to incorporate the aspect of interactions between the learners and the program. Our intention is supposed to some extent be reflected in the various manners of answering the questions and doing the exercises. In this program other than multiple types of exercises, we have designed exercises in which the system lets learners draw pictures by cutting and pasting the items given on the screen and make up answers on their own. Figure 6 is an example where this "cut–drag-paste" manipulation is used. The task is to put the clothes, bags, shoes, and ribbons on the bear while listening to the story. Upon completing the task, they click the answer bottom, and the picture of the bear appears next to the one made up by the student. Fig.7 is another type of manipulation adopted in Part Two. The task is to indicate the way to arrive at the destination. While listening to the directions, such as, "Go straight and turn right at the corner of a flower shop…" students have to click a number of squares which consist of roads. The color of these squares changes when they click them like a red carpet is gradually spread. When students click the answer key, the black ball starts roll down the road which leads to the correct destination.

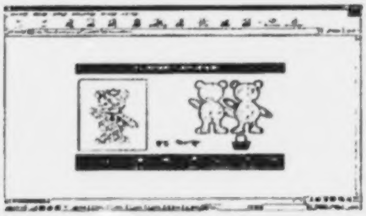

Fig.6 Let's try a coat on the bear -

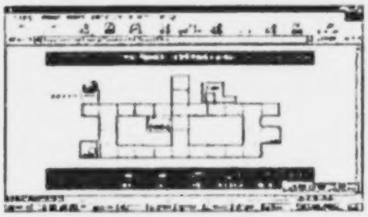

Fig. 7 Let's go to the restaurant - "cut-drag-paste" type

7. Management System

All of these exercises are equipped with a Managing System which is constructed by using Perl. As shown in Fig.8, the teacher who takes a role of administrator registers students in the Server. At the moment, only the students who give their registered ID and password can gain access to the program. Upon completing each exercise, a percentage of correct answers is automatically calculated and presented on the screen (Fig.9).

Even though in the preliminary experiment, we used the program in the classroom situation, our objective is to let the students use this computer assisted listening program as a part of homework or as an extra training on individual basis. Accordingly, dates and degree of participation are recorded and sent to the instructor's homepage linked to this program. From administrative point of view, as its being an internet based system, this program can provide efficient time-saving method of keeping track of each learner's progress and can also record each learner with the items of tests' scores as shown in Figure 10. Not only the instructor can look into the development of studies achieved by each one of the learners but also the learners themselves are able to get into their own page and look into the process of their own achievement.

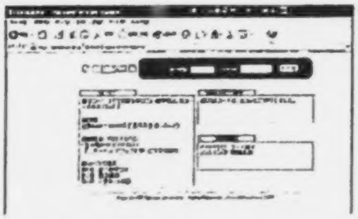

Fig.8 Registration

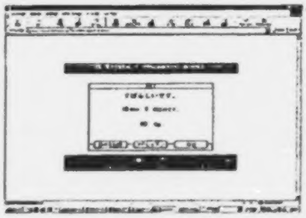

Fig.9 Grading

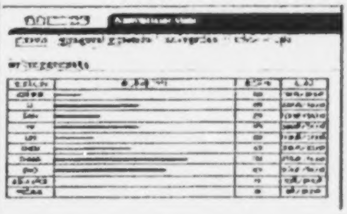

Fig.10 Scores of individual students

Other than these automatic feedback, students can receive messages from the instructor. Naturally, whenever they have

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any problems, they can ask for a help by e-mail.

8. Preliminary Experiments

8-1 Results of Questionnaire on the program

One of the main purpose of this preliminary experiment was to find out how they would react to the computer-assisted listening learning and to see what should be done to make the program easy to handle for them. In order to confirm their reactions, we carried out a questionnaire after a 40 days period of session consisting of three hours of classroom activities and individual studies in their free time. Objectively speaking, the part of the sound recognition exercises, even though we have designed it to be interesting and varied, is rather monotonous. Thanks to the advantages of computer's being multi as well as student-centered media, however, the students did not get bored but become very much involved in the activities and expressed their wish to participate in this listening program. Table 1 shows the results of the evaluation given by the students. The scale of evaluation was from number 5 to 0 and the number 5 stands for the highest score.

WBT(Wav Based Training)	Ave.	SD
WBTis interesting and fun	4.71	0.38
My listening skill has greatly improved	3.86	0.49
Want to continue WBT	4.86	0.38
User Interface	Ave.	SD
Easy to use	4.86	0.38
Easy to understand "icons"	4.86	0.38
Video is helpful	4.57	0.43
Speech sound is very clear	4.14	0.38
Grading system	Ave.	SD
Grading system is easy to understand	3.14	1.07
Easy to see which exercises or sections should be redone	4.33	0.38
Easy to see the rate of achievement	3.36	0.43

Table 1 Results of Questionnaire – Evaluation of the Program by the Students

As seen in the table, their overall reactions towards the CALL learning were very positive. Many of them expressed their wish to continue this type of studies.

8-2 Quantitative evaluation of the program

During the experimental period, regular class activities were conducted as normal to cover the course syllabus. The students were recommended to access the materials until they would complete all the exercises with final score of 90 points or better. How long and how much they would study was up to them. With the help of the Management System we could monitor their learning progress and confirm that all of the students had fulfilled the task. At the end of the designated period of time, we conducted a listening test for perception. The quantitative evaluation of the program was performed by comparing the results of pre- and post treatment tests. The mean score of the test before the implementation was 82.3, and the score after the implementation was 85.4, and the overall rate of progress was 18.6%. Taking into consideration that the regular class activities were conducted during the period and the rate of the improvement was rather slight, it might be difficult to claim that the improvement in their listening skills was achieved solely by the program. Also there are still many issues to be considered to obtain reliable data to judge the efficiency of the program including the number of the participants and the content of the test.

Even though a concrete analysis of the results is to be performed in due course, we can say that the results of the tests indicate that the program could help them improve their listening skills to some extent.

9. Conclusion and Future Plan

As for the content of the listening program, there are two important tasks that remain to be fulfilled. One is to prepare exercises to instruct super-segmental aspects of the Japanese sound system: rhythm, prominence and intonation and the other is to complete Part Two - Listening for Comprehension. Another task is to carry out an extensive experiment to evaluate the effectiveness of this listening program. The content of the test should be examined and a large number of subjects should be involved to get a reliable data. The method of experiment should be also reconsidered. For example, we will divide students into two groups. The first group studies Japanese sounds using this program, and the other group studies the exactly same contents using a conventional means of study: namely, a paper and tape recorder. If the group of students who use the computer make more progress than those who use a conventional method of learning; namely, a tape recorder, we will be able to ascertain effectiveness of the CALL materials. However, this kind of experiments is not easy to carry out without collaboration from other universities or institutes. Speaking of quantitative measurements in general, we also have to keep in mind that there are many variables to be considered, such as students' motivation, aptitude, and affective conditions. Accordingly, the results may not be straightforward and distinctive in quantitative terms (3). We believe that to figure out how these variables affect the learning process on Web is also an important area to be studied in the future.

Finally, we would like to confirm that the preliminary study of our CALL program has proved its usefulness to improve students' listening skill. More significantly, it had indicated that the program could provide a learning environment where the students were able to actively engage in the learning of Japanese sounds and to maintain their motivations.

Note:

(1) For example: "Introduction to Japanese Pronunciation, Theory and Practice" by ShinichiTanaka, etc. al Kuroshio Shupan (1999), "Instructions Prosody to Japanese Learners" by H. Matsuzaki presented at University of Hiroshima(2000)

(2) "Nala-u (Nihongo Accent Learning Aid – Universal)" by Yukihiro Nishinuma. This is one of a very few multimedia programs on speech sound education in Japanese.

(3) There have been a few research on developing a CALL listening program, but few of them have systematically covered the various aspects of the listening activities and have been actually used as a part of classroom activities and proved its efficiency (Mizumachi et al, 2001)

References

[1] Alessi, S.M. & Trollip, S.R.: Computer-Based Instruction: Methods and Development, Englewood Cliffs: Prentice Hall, 1991

[2]Aoki, Nobuyuki & Watanabe,Chie: "Computer- Assisted Intensive English Training Program: Implementaion and Results". Hiroshima Journal of International Studies Volume 6. (2000.8).

[3]Murphy, Kare L.: "A Constructivist Look at Interaction and Collaboration via Computer Conferencing" International Jl. of Educational Telecommunications 4 (2/3). (1998.11)

[4]Mizumachi, I., Tawata, S., & Yamanaka, E. "Discussion for the dvelopment of Japanese CALL Listening Comprehension Materials" Bulletin of the Department of Teaching Japanese as a Second Language, Hiroshima University No.12 (2002, 3)

[5]Nakanishi, Yaeko. "Images of Japan - Collaborative Learning System for Japanese and Japanese Culture" Dokkyo University Shogaku Kenkyuu. Vol.2. No.2. (1999.3).

[6]Tatsuta, Rumi, et.al: "Images of Japan" – "Collaborative Learning System for Japanese and Japanese Culture" Proceedings of ICCE98 Global Education on the Net Japanese Learning System. (1998.10).

Modeling of Courses through Workflow using the standard SVG/XML

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Abstract: This brief paper describes the implementation of one tool for modeling of workflows of authoring courses through of one graphic editor based on SVG technology.

Introduction

Workflow modeling techniques can express in the form of a graphic, a flow of activities as the collaborative authoring of courses through WWW, even so, the implementation of these models is one of the main difficulties found in the use of workflow technologies. Seeking to facilitate this implementation the project "Conception of Cooperative Environment for Editing Multimedia Documents with Workflow Technology" (CEMT) proposed the creation of an graphic workflow editor with base in the software Amaya (Vatton, 2001), the Amaya Workflow (AW). The objective of AW is to facilitate the determination and implementation of workflows for courses, for that it generates through a graphic interface based on standard SVG (SVG, 2001) a XML file with the instructions of a workflow that it specifies the authoring or execution of a course. After the files have been generated they can be sent for a workflow machine that will interpret and to execute the projected workflow.

The environment

The software Amaya is the official Browser/Editor of W3C, now is being developed in INRIA, this software have among other resources a support for technologies XML and SVG. SVG is a pattern of graphs representation official's of the W3C, Amaya hold an editor of graphs that follows this pattern and have as base this editor the project CEMT made the implementation of AW, that is an editor graph of the technique of workflow modeling "Workflow Process Model " developed by Casati/Ceri (WIDE, 1997).

With this editor a user can define a workflow graphically conform the model of Casati/Ceri. Paralleling with the generation of graphic SVG the AW generates a file XML that contains all data about the workflow that is being modeled, for this, the project CEMT needed to define a DTD of Workflow, the files XML that follow this DTD are capable to store information that can recompose the flow of the model and the necessary information for its execution.

The objective of AW is to facilitate the determination and implementation of workflows for courses in the WEB, for that it generates through a graphic interface a file XML with the instructions of a workflow that specifies the authory or execution of a course. The files are generated so that after they are interpreted and executed by a workflow machine.

Implementation

The AW (Amaya Workflow) is a workflow editor/browser with any features that facilitates the graphic edition of documents that express a workflow in accord with the symbols and semantics of the modeling technique Workflow Process Model.

The user can edit the document using a graphic tool added to the software Amaya, this graphic tool consists of a palette with symbols of the modeling technique Workflow Process Model.

With a palette of symbols the user add workflow elements (that visually are geometric graphics) in the document, conform the symbols are added, the workflow is structured with its tasks, super tasks, forks, joins and connections, generating in this way the files that describe graphically the logical flow of the activities and in the format XML the logical structure of the workflow.

Each element have a list of attributes where information about the workflow that is being modeled are stored. Many attributes are automatically set for the system conform is made the graphic distribution of the elements. Other attributes should be set for the users, to fill and to edit these attributes the user needs to select the element in that want to add attributes and soon after to fill or to alter a form where the referring data should be inserted.

For each document edited in AW two types of files are generated:

· A file that follows the standard SVG that can show the graphic drawing of the workflow in any application that interprets standard SVG.

· A XML file that follows the DTD of Workflow, this file will have only information related with the Workflow, no graphic information will be contained in him although these information be extracted of the graphic distribution of the elements and of its attributes. As this file have all the information of a workflow, a workflow machine can read, to interpret and to set up this workflow.

Future works

The AW is just a part of the project CEMT, and its use, evaluation and adaptation to the remaining of the project are some of the future important works related to this editor. Concisely the project CEMT tell that: A specialist in workflow should project in AW a workflow for the authoring of a course, the files XML generated by editor AW about this project will be sent to a workflow machine that will interpret the files and with base in this files will build, will execute and will coordinate a cooperative environment for the authoring of a course in the Web, and the content of this course can be multimedia, hypermedia resources like SMIL. In this context the AW would serve as a tool that would generate a file XML with instructions for a workflow machine in an agile way, for this the AW still needs to be correctly adapted to the CEMT project.

Conclusions

The editor can be considered with a resource that can help in the interaction Human-machine because (1) of an agile and efficient way, it help in the construction and visualization of workflows, facilitating the interaction and human interpretation of the models and (2) it generates automatically SVG files with the data graphs of the workflow and XML files with information about the logic of the workflow facilitating the interpretation and the processing of these models for computer systems as Workflow Machines.

References

SVG (2001) . Scalable Vector Graphics (SVG) 1.0 Specification. Avaliable in <http://www.w3.org/TR/2001/REC-SVG-20010904/ > . Access: Dez, 2001

Vatton, I.(2001). Welcome to Amaya. Available in <http://www.w3.org/Amaya/ >. Access: Dez, 2001.

WIDE .(1997). The WIDE Workflow Modeling Language. Available at: <http://dis.sema.es/projects/WIDE/Documents/4080-2.pdf>. Access: Dez, 2001

LOMster: Peer-to-peer Learning Object Metadata

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Abstract: This paper reports on the development of a peer-to-peer based tool to share and reuse learning objects, by making it easy to publish and search over their metadata [5]. The goal of this work is to leverage the popularity of file sharing applications such as gnutella [3] and napster [4] in the context of learning content.

1. Introduction

The evolution in peer-to-peer (P2P) networking [9], inspired us to examine the possibilities of P2P in the scope of share and reuse of learning objects. We report on the first outcomes of this work here. There are many infrastructures that rely on LOM, most notably ARIADNE [6,8].

2. Peer-to-peer

Peer-to-peer networks are networks in which every computer performs the same task. This approach can be contrasted with a client/server based architecture, where the server provides dedicated services and clients access the services offered by the server to implement a meaningful interaction with the end user. In a peer-to-peer environment, every peer publishes its own information. When a peer goes offline, only the information stored in that peer becomes unavailable. When performing a query, a peer queries its own information and sends the query to other peers, which perform the same task. The partial results from the different peers are merged and the result of the query is returned to the sender. In a peer-to-peer network, all hosts interact as equals. There is no need for a central server which needs a lot of maintenance costs. As a consequence, a great advantage of a P2P approach is that the system becomes much more robust. When a peer gets disconnected from the network, only the information it manages itself becomes unavailable.

3. LOMster

LOMster is a project that adresses sharing of learning objects on a P2P base with the following functionalities.

Publishing

1. First of all, a user can select the learning objects he wants to share with other users, by dragging and dropping. The idea is that users may find this a more natural way to make their material available for share and reuse than uploading it to a central server.
2. When the user adds a file to the system, the tool should generate as much metadata as possible [10]. In our current prototype, only file size and file name are taken into account. The user can add additional metadata manually.

Searching

1. A user can formulate boolean combinations of search criteria over LOM fields. LOMster sends its query to all other known peers. Replies from peers include the full LOM description of the results. Relevant learning objects can then be downloaded in the next phase.
2. Finally, a user can inspect the state of the current downloads and uploads.

To store the metadata on a peer, we could not use an RDBMS as that would impose too heavy a load on the typically rather simple user stations that LOMster is intended to run on. Rather we store all metadata in an XML file. To implement LOMster, we relied on the JXTA [2] P2P Framework. LOMster search-messages in JXTA have 3 fields (fig. 1) :

```
<search>
      <peerid>peer-id</peerid>
      <qid>query-id</qid>
      <query>query</query>
<search>
```

Figure 1: structure of search-message

1. In the peerid-field a search-message indicates to which peer the answer needs to be sent.
2. The query identifier distinguishes different queries from the same peer.
3. Finally, the query-field contains the search

conditions expressed in XSLT.

When another LOMster peer receives the search message, it processes the query. For each relevant learning object, it generates an answer-message structured as in fig. 2.

1. The first field contains the peer-identifier of the peer that generated the answer.
2. The qid-field defines the query being answered.
3. The last field contains the metadata of the relevant learning objects.

```
<answer>
        <peerid>peer-id</peerid>
        <qid>query-id</qid>
        <lom>
                <general>
                . . .
                </general>
                . . .

        </lom>
</answer>
```

Figure 2: structure of answer-message

4. Related Work

The Edutella project also addresses the share and reuse of learning objects. This open source project also uses the JXTA framework. Instead of an XML binding, Edutella relies on an RDF binding of LOM. This project seems to have a slightly more mature status than LOMster, as more extensive field trials are already well developed.

5. Future Work

As we mentioned above, users often find it cumbersome to insert new material in a client-server based repository. We are exploring whether LOMster-like approach may help in overcoming this problem: contributing new material now simply entails dropping the relevant files in the shared directory. Although this approach may lower the effort for making new material available, it also results in rather poor and limited metadata, unless the user still spends considerable effort on the detailed description of the learning objects involved. One way to tackle this problem is the (semi-)automatic generation of learning object metadata. We are currently investigating how such techniques can be integrated in LOMster, as well as in our more conventional client server based metadata environment [10].

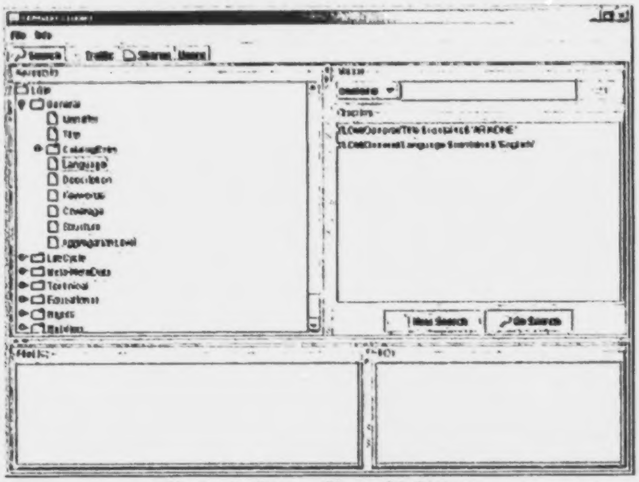

Figure 3: Screen Shot of LOMster

6. References

1. http://ltsc.ieee.org/wg12/
2. http://www.jxta.org/
3. http://www.gnutella.com/
4. http://www.napster.com/
5. Duval Erik. *Standardized Metadata for Education: a Status Report*. Proceedings of EdMedia2000, Tampere-Finland, pp. 458-463
6. Verhoeven Bart, Cardinaels Kris, Van Durm Rafaël, Duval Erik and Olivié Henk. *Experiences with the ARIADNE pedagogical document repository*. Proceedings of EdMedia2000, 26 June-1 July 2001, Tampere-Finland, pp. 1949-1954.
7. Heidrun Allert, Changtao Qu, Wolfgang Nejdl. *Konzeptionelle Ideen des P2P Systems Edutella.* Workshop Standardisierung im Elearning, April 2002, Frankfurt-Germany, pp. 25-27.
8. Duval Erik, Forte Eddy, Cardinaels Kris, Verhoeven Bart, Van Durm Rafaël, Hendrikx Koen, Wentland Forte Maria, Ebel Norbert, Macowicz Maciej, Warkentyne Ken, and Haenni Florence. *The ARIADNE Knowledge Pool System.* Communications of the ACM, May 2001, 44 (5), pp.73-78.
9. Clark David. *Industry Trends: Face-to-Face with Peer-to-Peer Networking*. Computer, January 2001, 34(1), pp. 18-21.
10. Cardinaels, K. (2002). *A Classification of Document Reuse in Web-based Learning Environments.* EdMedia2002, Denver-Colorado, Accepted

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Mental Models: Do they exist, how are they are taught, can they be measured? Preliminary research findings using computer based systems.

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This paper will be a synthesis of the author's research into methods for teaching and measuring mental models. The presentation will be organized as answers to the three most pressing questions about mental models.

Do mental models exist? Possibly.

Although the "mental models" learning objective have been widely discussed in design literature, there have been no construct validation studies to establish it as a distinct learning outcome. Sheehan and Tessmer (2000) conducted a construct validity study of the mental models construct to determine if it was distinct from related learning outcomes of concepts and problem solving. To conduct the study, 112 US Navy engineering students were given five types of computer-based tests following a minicourse on electrical circuits: memory of definitions (to test for verbal information learning), circuit identification (concept learning), calculation (rule learning) troubleshooting (mental models and problem solving), and inference (mental models). A factor analysis of test results indicated that mental models measures indicated there might be a construct that is distinct from verbal information and has concept learning as one of its subcomponents. However, inference test results did not indicate that the construct is different from its component outcome, problem solving. Further validation studies are needed to indicate that mental models are in fact different from problem solving.

How do you teach mental models? Answer 1: have students build an expert system using a computer based authoring system.

Students acquire a mental model when they learn the proper place and relationship of its component parts. Consequent with constructionist and constructivist learning theories, students may best acquire a model by building the model itself. This building can be accomplished through two concurrent student learning activities:

1) Arranging the system components into their proper spatial or conceptual space within the model. This is the mental map of the system. For example, learning a mental model of a house by knowing the arrangement of the roof, roof trusses, walls, subfloor, etc.

2) Indicating the relationship between the model components. Knowing how one component interacts with other components is what distinguishes mental model learning from mental map learning. For example, knowing that the roof trusses support the roof.

One way to enable these two learning activities is to have students construct an expert system of the system to be learned, to have them program the components and relations while building an expert system advisor. A recent study by Mason and Tessmer (2000) indicated that this mental models strategy might be both effective and engaging.

Study Description. In an experiment conducted by Mason and Tessmer (2000) students used an online expert system to develop an expert system advisor on a brake system. Students had to input the relations between brake system components and their relationship to system malfunctions. The learning assumption behind this experiment was that students might construct an effective mental model of a system if they have to build the system itself. This model building not only requires that they put the system components in their proper relationship to one another (a necessary but not sufficient condition for learning a mental model) but that they also describe the functional relationship between the components: how they affect one another (another necessary condition).

Method. 28 adults were recruited to learn about automobile brake systems. Students' pretests indicated little or no brake system knowledge. Students had their brake system knowledge tested before they read a two-page text about the brake system, adapted from the World Book Encyclopedia. They were tested immediately afterward, using troubleshooting and inference questions as measures of mental models learning. Following the test students had to build an expert system of the brake system, one that would advise users on brake system problems. Students were tested again after the expert system task, using more troubleshooting and inference measures. Students also answered an email questionnaire about their learning experience.

Results. Students exhibited no significant mental models learning gains after they read the brake system text but indicated significant and substantial learning gains after they completed the expert system task. Moreover, students indicated that the expert system task was engaging and enjoyable, even though they had never constructed an expert system. The results indicate that expert systems are worth consideration as mental models learning strategy for adult learners.

How do you teach mental models? Answer 2: have students build an expert system by assembling a graphic representation of one using a CBT system.

Expert systems have students learn a model by helping system users troubleshoot the problems the system may have. As such the model activity focuses upon learning the rules for system component interactions. Another strategy is to have students build a complete visual model of the system, arranging model components and their functional relations into a "big picture" model of the system as a whole. Such graphic representations can be done for abstract systems (e.g., the stock market, how a bill becomes a law) as well as concrete ones (brake systems, houses).

Method. In this study a CBT construction activity was developed using Macromedia's Authorware multimedia authoring system. Using such a CBT system enables a learner to pull model components and relations into place and to receive contextual feedback when they are put into the correct and incorrect locations. The model constructed was about the internet; how messages are received and transmitted. Students pulled internet components into their locations on the screen (router, server, home computer) and pulled over functional statements about the relations between the components (e.g., "directs message to the proper server"). Pulling the wrong component into place resulted in feedback cues ("no, this is where messages are sorted"). Students were then tested on internet system troubleshooting.

Results. At present only pilot test groups of 12 or less have been used to test the system, so there are no statistically significant results to speak of. However, preliminary test results (Bland and Tessmer, 1999) have indicated that students find the system building activity engaging and profitable. In this presentation the Authorware model-building learning activity will be demonstrated.

How to you measure mental models learning? Multiple measures are advisable.

As a relatively new and unproven construct (Sheehan and Tessmer, 2000), there is still some debate about the proper ways to assess it. One of the more popular methods has been through the use of modeling software, specifically PCKnot and KnotMac (Schvaneveldt, et al, 1993). This software builds a model of a student's conceptual map and compares it to the conceptual map of one or more experts, providing a numerical measure of the strength of correlation. Tessmer and Perrin (1998) tested the reliability of this measure and found it to be questionable, while other popular measures (troubleshooting, inference) remain unexamined. The current prescription is to use multiple mental models measures at the same time, not only to achieve a more accurate measure of mental model learning but also to assess the soundness of the measures themselves.

In this presentation a five-page minipaper will be distributed, complete with research results and references. Each type of computer-based strategy and measure (the expert system, the Authorware system, the online concept-mapping test) will be demonstrated.

Teachers, Identity, Psychological Capital and Electronically Mediated Representations of Cultural Consciousness

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Abstract: This paper documents key issues in electronic mediated visual representations of social identity, based on the teacher's psychological capital in computer mediated communication (CMC). Psychological capital is beliefs, perceptions, attitudes and thoughts. The origin of psychological capital is related to cultural consciousness. Cultural consciousness is defined as the part of an individual, which is derived from the amount of transmitted cultural mores, values, ethics, worldviews and ways of being that is expressed in the behaviors of everyday practices. In short psychological capital and cultural consciousness is how teachers talk about classroom teaching and learning in CMC. This paper further sought to capture ways which teachers talked about their communities of practice in their classroom environments.

Introduction

What is identity? What does it mean to document keys issues in electronic mediated visual representations of social identity? This paper will define visual representations, psychological capital and cultural consciousness.

This paper introduces a new model for analyzing teachers' conversations in computer mediated communication (CMC) environments. This conceptual paradigm seeks to capture ways in which teachers talk about their communities of practice in their intercultural and cross-cultural classroom environments by looking through the lenses of social identity. Social identity is "a combination of those social categories which defined his or her place in society and which had been internalized to define the self, together with their value and emotional significance attached to that membership" (Tajfel, 1982, p.255). Specifically, my goal is not to capture the actual events of teacher behaviors in a teacher's classroom, but to capture ways in which the teachers talk about their identities (this includes behaviors, as well as other aspects of identity), and how their identities can emerge from the actual talk that occur in CMC. By using CMC, the goal is to unmask psychological capital to arrive at a better understanding of cultural consciousness that is embedded in social identity. While considering prior research, this model seeks to engage educators in dialogue that can allow them to capture and construct textual images of their psychological capital through (CMC) so that we may better understand cultural consciousness as it relates to teaching and learning in intercultural, multicultural and cross cultural classrooms.

Psychological capital and cultural consciousness is different from Bourdieu's definition of social and cultural capital (1977; 1986). In short, Bourdieu's approach focused on the distributions of power in relationships within group memberships and social networks; However, this conceptual paradigm focuses on collective utterances from individuals (teachers) that are grounded in social historical meaning (Bahktin, 1981; 1986).

My goal is to create the constructs, psychological capital and cultural consciousness. I sought to develop new conceptual tools that could better define teacher's thoughts, perceptions, beliefs and attitudes that are situated in their social identities. I use the construct psychological capital to refer to the collective of the later. Cultural consciousness defined, is the part of an individual, which is derived from the amount of transmitted cultural mores, values, ethics, worldviews and ways of being that are expressed in the behaviors of everyday practices based on social identity. The construct psychological capital is related to cultural consciousness. Psychological capital is how teachers think, believe, act, know, and cultural consciousness is what teachers do when they interact with themselves and others socially.

Social science is influenced by society's values and ideologies, by the social and cultural background of its practitioners (Turner, 1996). The practitioners, in this case, are teachers and other educators. Some important questions that arise are: What do teachers think when interacting with students from different groups? How do they feel when they experience intercultural, cross cultural and multicultural classrooms? What do teachers experience when they enter the door of a classroom of 30 students from Hispanic cultures? A teacher's psychological capital may be limited for Hispanic groups. If their psychological capital is limited, then what happens within their cultural consciousness as they approach the students?

Conclusions

In conclusion, the constructs of psychological capital, social identity and cultural consciousness embedded in electronic visual representations of voice are new and recent phenomena (Kress, 1998). Visual representations are very important for teachers because the visual/textual representations represent voice of voices that are associated with experiences, memories, attitudes, beliefs and practices in an Internet/WWW environment. This conceptual paradigm seeks to further to capture ways in which teachers talk about their communities of practice in their multicultural, intercultural and cross-cultural classroom environments. The constructs of psychological capital, dialogue, speech genres and social identity embedded in an online or web based environment through CMC can result in what we refer to as electronically mediated cultural consciousness. If the visual text as a mode of representation is systemic, rule governed, as well as simultaneously an effect of the values of the culture and social identity in which it is used, then it may be possible for teachers and other educators to know and make meaning of their own and other's social identity by visual representations (text) to construct images of their multiple voices in electronically online mediated environments (Kress, 1998).

This conceptual paradigm seeks to provide a means for teachers from diverse backgrounds, where they can engage in communities of dialogue, using CMC, regarding their social identity and about their experiences teaching in a cross-cultural or multicultural classroom. By examining social identity and intergroup dialogue of teachers, I hope to add to the current research a better understanding of teachers' social identity, psychological capital and cultural consciousness towards intergroup relations. CMC structured forums will allow teachers to structure their inquiries where they may feel comfortable. It will enable them to dialogue in inter-cultural virtual communities so that they can engage in discussions that may assist with modifying their psychological capital. Through their own unmasking of their identities and psychological development they could be better prepared to teach children from diverse backgrounds and interact with families from diverse backgrounds.

Computer mediated communication (CMC) empowers teachers to engage in conversations about their teaching philosophies and practice. It allows educators to better understand how talk, based on psychological capital, is culturally embedded. It also allows freedom of voice using textual representations, to facilitate volatile issues teachers face in intercultural, cross cultural classroom environments and multicultural environments

CMC provides a means to express multiple voices and notions of self. Many times when we experience courses and others in formal academic environments our multiple voices and identities are suppressed. This can be self-imposed or directly imposed by others. Our psychological capital and cultural consciousness are freed through binary systems of matter (wires, numbers, etc.). In many cases we have to step outside the community to view the other self.

References

Bakhtin, M.M. (1981) The dialogic imagination. Four essays by M.M. Bakhtin, (ed.) Michael Holquist, trans. Caryl Emerson and Michael Holquist. Austin: University of Texas Press.

Bakhtin, M.M. (1986) Speech genres and other late essays, (ed). Caryl Emerson. Minneapolis: University of Minnesota Press.

Bourdieu, P. & Passeron, J.C. (1977). Reproduction: In Education, Society and Culture. (trans. Richard Nice). London: Sage Publications.

Bourdieu, Pierre, (1986). The Forms of Capital. In John G. Richardson (ed.) Handbook of Theory and Research for the Sociology of Education. New York: Greenwood Press.

Kress, G.R. (1998) In G.R Kress (Ed.) Communication and Culture. Kensington, Australia: New South Wales University Press.
Tajfel, H. (1982) Social Identity and Intergroup Relations. Cambridge: Cambridge University Press.

Turner, J.C. (1996). Henri Tajfel: An Introduction. In W. Peter Robinson (Ed.) Social Groups and Identities: Developing the Legacy of Henri Tajfel. Oxford: Butterworth-Heinemann.

A Brief Overview of An Instructor Facilitated Instructional Chat System (IFICS)

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Abstract: The authors have designed and developed a theory-based chat system. The text-based chat system is designed to reduce the cognitive load experienced by students in text-based chat rooms that are used for instructional purposes. This brief paper describes the major features of the chat system.

Purpose of the Paper

The confusion and overlapping conversations that occur in text-based chat rooms (Thirunarayanan, 2000; and Thirunarayanan and Perez-Prado, 2001) are two of several factors that contribute to students' "cognitive load" in chat rooms. The purpose of this paper is to provide an overview of a chat system that is designed to reduce the cognitive load that students experience in text-based chat rooms.

A Brief Definition of Cognitive Load

According to Cooper (1998), "Cognitive load refers to the total amount of mental activity imposed on working memory at an instance in time." He (Cooper, 1998) goes on to state "The major factor that contributes to cognitive load is the number of elements that need to be attended to."

In text-based chat rooms, there are many things that compete for students' attention. Messages from different sources, the quantity of textual information appearing and scrolling off the chat window, and the mental energy expended in composing their own messages, are some of the many factors that increase the cognitive load experienced by students.

Major Features of the Instructor Facilitated Instructional Chat System (IFICS)

A theory-based chat system named "Instructor Facilitated Instructional Chat System" (IFICS) has been developed to reduce students' cognitive load. By enabling the instructor to act as a facilitator, the chat system reduces the confusion and overlap that students experience in many real-time text-based chat systems. Instructors who log into the chat system see two windows on their monitor, unlike students who are presented with only one window. When students type and submit their comments, their comments first appear on a part of one of the instructor's windows and also in a part of the window that is visible only to the student who typed the comment. The instructor can read all the comments typed and submitted by the students, and can select and send appropriate comments that then appear in a part of the window that is visible to all students.

The instructor can facilitate discussions by first reading, selecting and then sending appropriate comments that are submitted by students, to the chat area that is visible to all students. The instructor can also send comments to all students and these appear in a separate part of the window that is visible to all students.

The instructor has the following four choices when it comes to dealing with the comments submitted by students as they discuss course content with each other:

1. Approve the comments made by one or more students after selecting them.
2. Disapprove a student's comment after selecting the same.
3. Disapprove a selected comment and also provide a reason to the student for not selecting the comment.
4. Ignore the comment for the time being and send it to the end of the list of comments that have been submitted by students. Such comments can be considered again at a later time.

Another major feature is one that gives instructors the opportunity to type and save up to four comments before a chat session begins. For example, one of these comments could be "Consider the topic under discussion from another point of view" or "What are some other perspectives that can shed light on the topic being discussed?". When the situation warrants, the instructor can, at the click of the mouse, select and send one of these four pre-saved comments to a part of the window that is visible to all students. This is another way that the IFICS enables instructors to facilitate discussions in text-based chat rooms.

Conclusions

Separating the window that is visible to all students into four parts enables students to focus on the content without having to try to mentally separate the content from the instructions and other messages that are extraneous to the content being discussed. The initial development of IFICS is complete and the system is currently being field-tested. Research will soon begin to determine if the system indeed accomplishes the purpose it was designed for, namely reducing students' cognitive load in text-based chat rooms.

References

Cooper, Graham. (1998). *Research into cognitive load theory and instructional design at UNSW.* Retrieved from the World Wide Web: http://www.arts.unsw.edu.au/education/CLT_NET_Aug_97.HTML

Thirunarayanan, M.O. (2000). Cutting down on chat confusion. *Ubiquity, 1*(38), *(November 28 - December 5, 2000)*. Retrieved from the World Wide Web: http://www.acm.org/ubiquity/views/m_thirunarayanan_1.html

Thirunarayanan, M.O., and Perez-Prado, Aixa. (2001). Structured chat. *Ubiquity, 1*(45), (January 23 - 29, 2001). Retrieved from the World Wide Web: http://www.acm.org/ubiquity/views/m_thirunarayanan_2.html.

On the Effectiveness of a Programming Coach in a Distance Learning Environment

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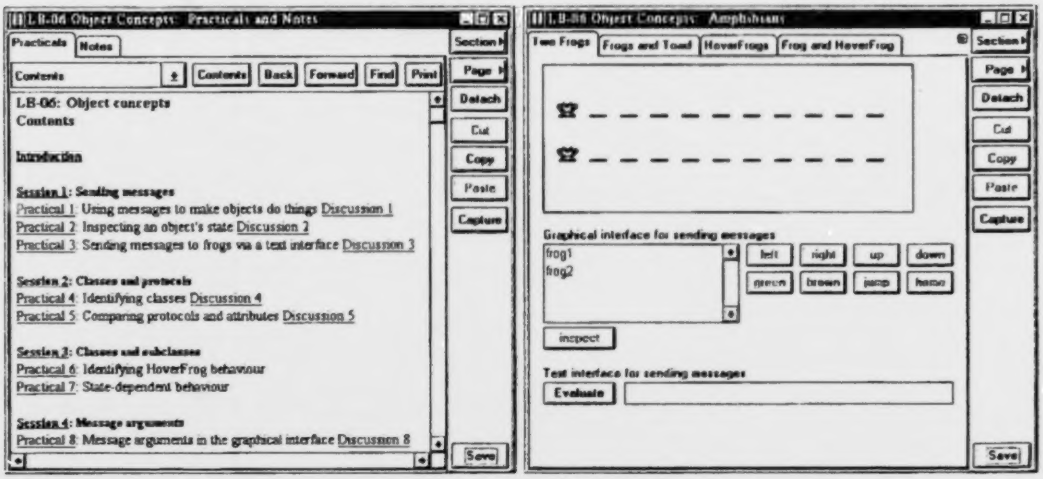
Abstract

Previous research into the behaviour of students while learning to program by automatically recording their actions has revealed that such recordings contains a wealth of information that can be collected together into a diagnostic tool that can support students' learning. The first step has been to construct the Coach, a software component that can be invoked on demand to provide a variety of support based on students' previous experiences. The Coach has undergone an initial stage of usability and usefulness testing to determine its effectiveness in practice. This paper describes the design of the Coach and reports on a small-scale experiment to assess its effectiveness with two groups of students. It was found that students did indeed turn to the Coach for help and that the control group also searched for help, but had to get it elsewhere. The paper also reports on other differences in behaviour between the two groups.

Introduction

Students on the Open University introductory course in computing M206, *Computing: An Object Oriented Approach* (M206 2000), are taught the OO paradigm using Smalltalk. The students, of which there are approximately 5000 per presentation, are taught at a distance. The teaching is supported by a series of practical activities performed with the LearningWorks system (Goldberg, Abell et al. 1997). The LearningWorks environment consists of over 30 LearningBooks, each one of which contains a set of practical activities. The structure of a LearningBook is based on the paradigm of a book in that the student can read through some pages of material that describe practical activities which have to be carried out in other pages of the book (Woodman, Griffiths et al. 1999). The early programming exercises ask students to interact with a series of micro-worlds in which they observe the effects of small portions of Smalltalk code; later exercises ask the students to construct their own code.

The left-hand side of Figure 1 shows the contents list of LearningBook 06, LB-06. All LearningBooks are divided into a sequence of sessions. A session is designed to be studied in one continuous interaction with the computer. Each session comprises a sequence of practicals, and each practical has an associated discussion page. Thus, students are encouraged to attempt a practical and then examine the discussion where the outcomes of the practical are examined.



LB-06: Object concepts
Contents

Introduction

Session 1: Sending messages
Practical 1: Using messages to make objects do things Discussion 1
Practical 2: Inspecting an object's state Discussion 2
Practical 3: Sending messages to frogs via a text interface Discussion 3

Session 2: Classes and protocols
Practical 4: Identifying classes Discussion 4
Practical 5: Comparing protocols and attributes Discussion 5

Session 3: Classes and subclasses
Practical 6: Identifying HoverFrog behaviour
Practical 7: State-dependent behaviour

Session 4: Message arguments
Practical 8: Message arguments in the graphical interface Discussion 8

Figure 1 The interface of a typical LearningBook

On the right-hand side of Figure 1 is a page from LB-06 shown detached from the LearningBook containing the Amphibians micro-world. This micro-world is intended to support the learning of message sending. The Amphibians page also contains an evaluation text area in which students can enter small sections of Smalltalk code for the system to

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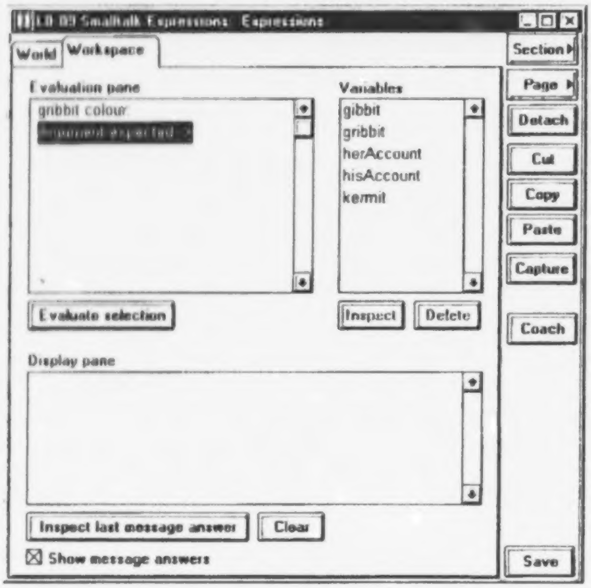
evaluate. In later LearningBooks, the idea of a workspace is introduced where students can enter significantly larger pieces of code and investigate their execution (see Figure 2).

Given this novel approach to the teaching of programming, we were interested to know how effective it would be. Therefore, we set up a significant research project (Thomas, Macgregor et al. 1998) to investigate how students learn to program in this environment. Our first step was to develop a student Observatory – an electronic system for recording the actions that students take when interacting with LearningBooks (AESOP 2001). An analysis of the recordings (Thomas and Paine 2000) showed a variety of student behaviours, particularly when dealing with errors (Logan and Thomas 2001). Therefore, we set about adapting the observatory software to provide additional support for error message comprehension and error correction – the Coach (Paine 2001). This approach opens up the question of how effective the Coach would be. There are two aspects to this question. First, how easy would students find the system to use and second, how useful would students find the system? The effectiveness of the Coach would be ascertained by examining the extent to which students used it to solve problems. In this paper we shall discuss the effectiveness of the Coach; the usability issues are discussed in (Thomas, Paine et al. 2000).

The Coach

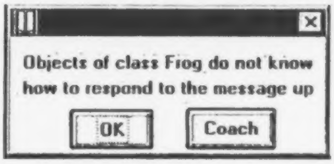
Whenever the LearningWorks system detects an error in an item of Smalltalk code, it issues an error report. Figures 2 and 3 show two kinds of report. In Figure 2, the error report is shown highlighted. To obtain help with this error the student can invoke the Coach by clicking on the appropriate button. In Figure 3, the report appears in a modal dialog box that would normally be cleared by clicking on the OK button. However, in the modified system, the student has the option of invoking the Coach. The result of clicking on the Coach button is a new window similar to the one shown in Figure 4.



```
gribbit colour
argument expected ->
```

```
gibbit
gribbit
herAccount
hisAccount
kermit
```

Figure 2 The LearningBook interface



Objects of class Frog do not know how to respond to the message up

Figure 3 A typical error report

The prototype Coach window has two main areas. At the top of the window is a tabbed area labelled 'Actions' which enables the student to scroll through a history of their actions. This uses the Observatory's recording of the student's actions throughout the LearningBook. The error report is shown highlighted and, in Figure 4, is a textual representation of the contents of a dialog box similar to the one shown in Figure 3 (the DIALOG is the error report and the CHOICES are the buttons that appear in the box). The second tabbed area that occupies most of the window shows a series of hints, the first of which is headed MEANING and contains an expanded explanation of the error that has been detected. The remaining items on the Hints page are possible reasons, given contextually, for the occurrence of the error. The hints contain hyperlinks to the Glossary containing definitions of the terms used in the descriptions. The remaining tabs give access to possibly useful materials such as the main teaching texts (Chapters), links to related web sites (Links) and a graphical Smalltalk syntax analyser (Precedence).

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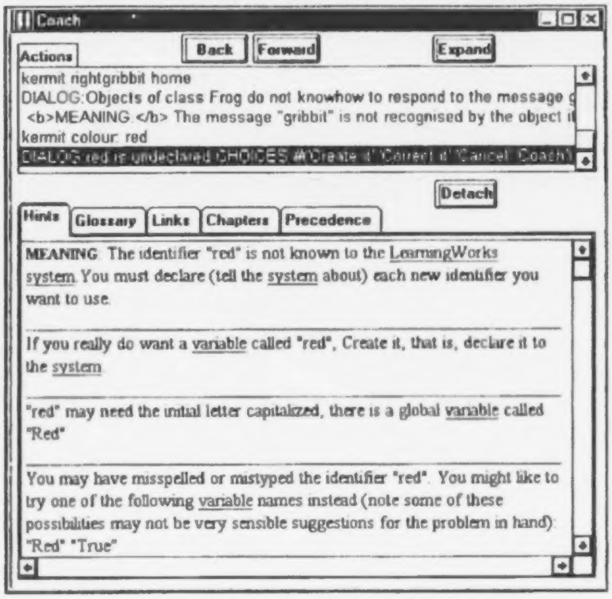

```
kermit rightgribbit home
DIALOG:Objects of class Frog do not knowhow to respond to the message g
 <b>MEANING </b> The message "gribbit" is not recognised by the object i
kermit colour: red
DIALOG:red is undeclared CHOICES #('Create it' 'Correct it' 'Cancel' 'Coach'
```

MEANING The identifier "red" is not known to the LearningWorks system. You must declare (tell the system about) each new identifier you want to use.

If you really do want a variable called "red", Create it, that is, declare it to the system.

"red" may need the initial letter capitalized, there is a global variable called "Red"

You may have misspelled or mistyped the identifier "red". You might like to try one of the following variable names instead (note some of these possibilities may not be very sensible suggestions for the problem in hand): "Red" "True"

Figure 4 The Coach interface

Effectiveness experiment

In a small experiment designed primarily to investigate usability issues, we took the opportunity to study the effectiveness of the Coach. 14 student volunteers were provided with two additional LearningBooks, each containing a small number of practical exercises related to the work of LearningBooks 09 and 10. The practicals asked the student to evaluate a number of simple expressions, each of which resulted in an error, and to attempt to rectify the errors. Those with the Coach were told of its purpose, but were not required to use it to solve the problems.

The experiment used an independent samples design to compare the actions of students who used the Coach with those who did not (Siemer and Angelides 1998; Budgen and Pohthong 1999). Students were divided into two groups, providing us with 2 conditions. In condition 1, students were provided with the additional LearningBooks, the AESOP Recorder and Coach software. In condition 2, students were given the additional LearningBooks and the AESOP Recorder software (i.e., they did not receive the Coach software). Students were assigned to a condition on the basis of a pre-experiment questionnaire aimed at controlling variables related to gender and age. This resulted in 8 students being assigned to condition 1 group and 6 to condition 2 group. Having completed the test exercises, the students e-mailed their recording to us for analysis.

Post-Questionnaire

Once they had finished the tests, all students were asked to complete a questionnaire designed to assess usability and usefulness issues. When asked to rate the ease of completing the tests on a scale of 1 (difficult) to 5 (easy), on average students without the Coach rated the practicals as easier (4.4) than students with the Coach (3.75). Generally, students who used the Coach found the amount of information on its interface slightly distracting. When asked about the likelihood of using the Coach in other LearningBooks on a scale of 1 (unlikely) to 5 (likely), on average they said 3.25.

The following comment from one student summarises experiences with the Coach: "The information in the Coach was useful, although it was a little difficult to home in on the appropriate comments for the problems I had. When I went back to using LearningWorks I found myself looking for it in my next LB and on a couple of occasions wishing it was there. Sometimes the Smalltalk error messages are difficult to interpret and I think the Coach would help."

Analyses of LB Test-09 Coach Recordings

Of the 8 students with the Coach, 7 used it 'for real'. One student did not open the Coach at any point during either test LearningBook. All 8 students attempted all of the practicals. Figure 5 shows the percentage of students who used the Coach on each practical activity: it only includes those students who used the Coach to help them attempt to solve the practical i.e. not those who simply opened the Coach to look at it. It shows that, for each practical, some students felt the need to use the Coach.

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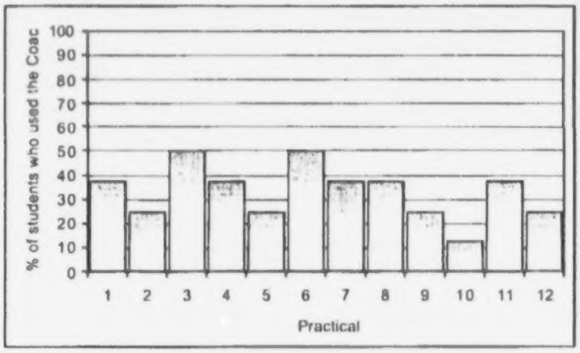

Figure 5 The percentage of students who used the Coach in each practical

With the exception of 1 student in one practical, *all* students with the Coach who solved the problem in a practical did so *without* looking at the discussion pages. However those students without the Coach who solved a practical sometimes looked at the discussion page before the solving the problem, as shown in Table 1. A few students without the Coach software also looked at the discussion page but did not solve the practical. We concluded that some students in each group needed additional support to solve the problems.

	No. of students who:	
Practical	**Solved practical**	**Looked at Discussion page**
1	6	1
2	6	0
3	5	1
5	5	2
8	6	2
10	6	1
11	6	5
12	5	0

Table 1: Students without the Coach who looked at the discussion before solving each practical

Figure 6 shows the percentage of students who correctly solved the problems that had a single specific solution. There were students in each group who failed to solve some problems. In three out of these four cases, more students without the Coach succeeded in solving the problems. Nevertheless, in practicals 1, 8 and 11, some students without the Coach tried the practicals only after having read the discussion, so one might conjecture that not all students in this group would have successfully completed these exercises. However, the results of the post-questionnaire indicates that the group with the Coach were weaker. This is confirmed by the number of student errors (other than those mandated by the practical activities) in which those without the Coach made on average 18.83 errors each, whereas those with the Coach made 23 errors each on average.

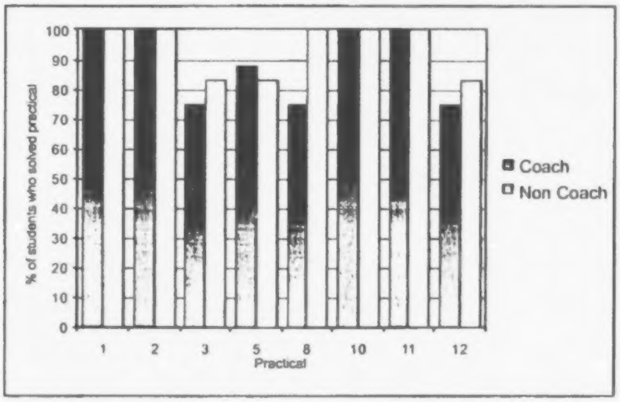

Figure 6 The percentage of students with and without the Coach who solved each problem

A summary of the data extracted from the recordings for LB Test-09 from students with and without the Coach software is shown in Table 2.

		Average number of:				
	Time spent	**Open**	**Close**	**Hyperlinks**	**Evaluations**	**Dialogs / Notifiers**
With	48 mins	2.63	9.75	39.25	35.75	35.00
Without	20 mins	1.33	4.50	22.50	32.83	30.83

Table 2 A summary of LB Test-09 recordings.

From Table 2 it can be seen that students with the Coach spent, on average, over twice as long in LearningBook Test-09 than students without the Coach.

Students with the Coach appear to do LB Test-09 in more sittings that student without the Coach (shown by the higher number of 'Open' events). Students with the Coach also on average accessed more hyperlinks than students without the Coach. This is to be expected as students with the Coach have access to the Coach Links, Chapters and Glossary pages which all contain a number of hyperlinks.

We analysed the results of the second test (LB Test-10) in a similar way. The difference between the two groups of students was less marked particularly in the amount of time spent solving the problems. This is to be expected as students get used to using the Coach software. This gives us confidence that using the Coach need not be a significant overhead, especially when it is clear that some students look for additional support to solve some problems.

Future work

We have implemented a revised Coach interface and slightly amended the two test LearningBooks so that we can repeat this experiment during the 2002 presentation of the course but with a much larger sample of students.

The next major step in the development process is to utilize the data contained in the student recordings to improve the feedback given by the Coach based on actual student experiences. Figure 7 shows the architecture of the system as envisaged. The basic idea is that the Coach obtains its data from a database on a student's machine (downloaded with the Coach). The local database is augmented with additional data based on the student's interactions with the LearningBooks (using the Events Analszer component). The recordings are sent to a central recordings database as with the present system. The recordings will contain all the events that occurred in each LearningBook, including those related to the use of the Coach since it is a LearningBook, too. The complete set of all students' recordings are analysed to update a central database of Coach data. Students will be able to update their local database with revised Coach data as and when they wish. In this way we hope to be able to adapt the Coach in the light of all students' experiences.

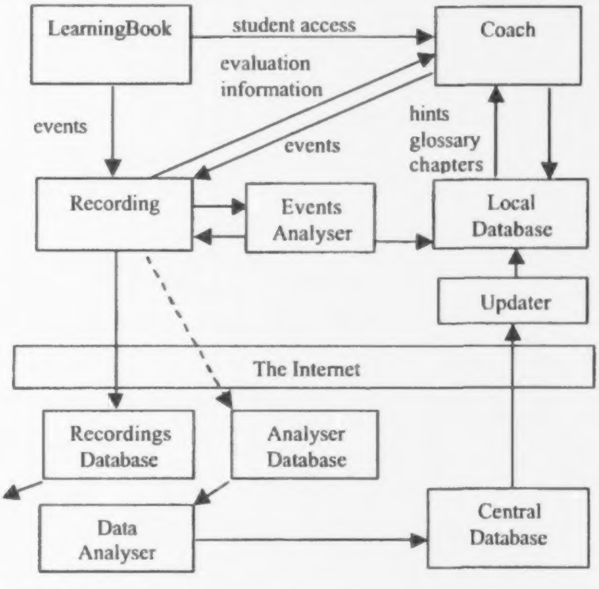

Figure 7 The Coach System

A third avenue for exploration is to follow up on a discussion of models of intelligent tutoring in (Gertner, A. & VanLehn, K (2000)) by using the Coach to provide a model of how a given problem should be solved. This will be

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based on work in another area [Thomas, 2001] for which we are developing mechanisms for specifying tasks and identifying attempts at solving them. We want to see how these mechanisms might be used to create a model of how a problem is to be solved and to detect student attempts at the solution. As the student tries to solve the problem, his/her actions are compared to those that the model would make. If the student's actions diverge sufficiently from the model, the Coach would offer the student some advice or feedback.

Conclusions

Overall, the majority of students who used the Coach found it useful. However, the prototype interface was found to be distracting and students found it difficult to home in on the appropriate hint. We obtained useful feedback on the interface and have simplified it. On balance, the Coach seems to offer a beneficial tool that some students found attractive.

We believe that the Coach is effective and that it is worth investing further effort to improve it. In particular, we can see ways of adapting the Coach to individual student needs. We also believe that it will be possble to provide further help through the idea of a model solution and comparing it with student attempts at solving programming problems.

References

AESOP (2001). http://mcs.open.ac.uk/aesop

Budgen, D. and A. Pohthong (1999). Component Reuse in Software Design: An Observational Study, Software Technology and Engineering Practice (STEP), Pittsburgh, PA.

Biggs, J. (1999). Teaching for quality learning at university: what the student does. Buckingham: Open University Press.

Gertner, A. & VanLehn, K (2000). Andes: A Coached Problem Solving Environment for Physics. (pp. 131-142) In Gauthier, G., Frasson, C. & VanLehn, K. (Eds) *Intelligent Tutoring Systems: 5th International Conference, ITS 2000*, Berlin: Springer.

Goldberg, A., S. Abell, et al. (1997). The LearningWorks Delivery and Development Framework. CACM **40**(10): 78-81.

Goodyear, P (1999). Environments for lifelong learning: ergonomics, architecture and the practice of educational technology. CSALT Document 99111. http://csalt.lancs.ac.uk/jisc

Kivi, M.R., Gronfors, T. and Koponen, A. (1998). MOTHER: System for continuous capturing of display stream. Behaviour and Information technology, 17 (3) pp152-154.

Logan, K. and P. G. Thomas (2001). Observations of student working practices in an online distance education learning environment in relation to time. 13th Annual Workshop of the Psychology of Programming Interest Group, Bournemouth, UK.

M206 (2000). Computing: An object-oriented approach. Milton Keynes, UK, The Open University Press.

MacGregor, M., Thomas, P.G. & Woodman, M. (1999). Recording and Analysing User Actions in a Smalltalk Programming Environment, Proceedings of Technology of Object-Oriented Languages and Systems, Santa Barbara, USA, August 1999.

Paine, C. (2001). The Coach - Supporting students in the area of error reports, 13th Annual Workshop of the Psychology of Programming Interest Group, Bournemouth, UK.

Siemer, J. and M. C. Angelides (1998). A Comprehensive Method for the Evaluation of Complete Intelligent Tutoring Systems. Decision Support Systems **22**: 85-102.

Thomas, P.G. and C. Paine (2002). Monitoring distance education students' practical programming activities, Educational Technology & Society, special issue, to appear July 2002. http://ifets.ieee.org/periodical

Thomas, P.G. (2001). The Coach: Supporting students as they learn to program. Proceedings of the 6th Annual Conference on Innovation and technology in Computer Science Education. ITiCSE (2001), Canterbury, UK, June 2001.

Thomas, P. G. and C. Paine (2000). Tools for Observing Study Behaviour. 12th Annual Workshop of the Psychology of Programming Interest Group Calabro, Italy.

Thomas, P. G., C. Paine, et al. (2000). The Coach: Overview. Computing Department Research Report 2000/07, Open University.

Woodman, M., R. Griffiths, et al. (1999). Exploiting Smalltalk Modules In A Customisable Programming Environment. *Proceedings of ICSE 21, International Conference on Software Engineering*, Los Angeles.

The Computer, The Discipline and the Classroom: Two Perspectives

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Abstract: The authors present two case studies in the use of computers in the classroom, one involving an introductory computer science class, the other an upper division literature class. After describing each case, the differences are discussed, showing that pedagogical models developed for one discipline may not transfer to another, and that the discipline itself, beyond instructor's preferences or institutional policies, may determine what works and what doesn't.

Introduction

Our goal in this paper is twofold. First, we'll indicate that the successful use of information technology in the classroom depends more on the synergy between teacher, student and the learning context than on the technology itself. The use of technology — as the primary vehicle for teaching (distance learning) or as an adjunct to the more traditional classroom — is effective only insofar as it addresses this synergy. Second, we will maintain that one under-appreciated factor influencing teachers, students and learning contexts is the discipline itself, in a way that goes beyond simply paying appropriate attention to learning (or teaching) styles. We offer two case studies, one drawn from an introductory computer science course, the other from an upper division literature course, in support of these claims.

Enthusiasm for online learning is of course high for students who live in areas not easily served by the traditional classroom, and courses accessible anytime and anyplace can provide valuable learning experiences for mature students who work full time and take courses when schedules permit. But the use of online learning tools *within* traditional campus-based course delivery structures has become popular as well [1]. James Duderstadt, President Emeritus and Professor of Science and Engineering at the University of Michigan, suggests that universities must themselves take a leadership role in remodeling the universities of the 21st century, and that new information and communication technology tools will play a key role in that mission, suggesting that universities will continue to have a physical existence, whatever their virtual roles may become[2]. This is not a completely uncontroversial claim; in a New York Times article, John Chambers, then Chief Executive Officer for Cisco Systems, asserts that "the next big killer application for the Internet is going to be education. Education over the Internet is going to be so big it is going to make e-mail usage look like a rounding error." [3].

As the situation has developed, however, and as other researchers have begun to look at what now seem to be inflated claims, online education has emerged as one aspect of a larger picture. Prosser and Trigwell [4] argue that both teachers and students benefit from an increased awareness of their own personal experiences, approaches and perceptions of the learning process and that this awareness facilitates positive learning outcomes. In particular, they emphasize that "good teaching involves an awareness of students' perceptions of teaching technologies (including information technology) used in teaching" and that these perceptions can significantly impact the learning experience either positively or negatively. Given their results, the successful use of information technology in the classroom is clearly more dependent on interactions between teachers, students and learning contexts than on the technology; it may even indicate that there are some things technology cannot appropriately do, a point to which we shall return.

On the other hand, learning opportunities newly available through the use of technology can support desired learning outcomes—provided (our second claim) those outcomes, as defined not simply by the instructor or the institution but by the discipline *itself*, are congruent with what the technology can provide.

Astin's comprehensive study of student development characteristics in various higher institutional settings [5] points out that active engagement of students in interdisciplinary courses, course with discussions, debates, and class presentations strongly correlates with critical thinking skills.To the extent that technology can facilitate (or at least create the opportunity to provide) such active learning strategies, the effort will not only increase student involvement in the course, but also increase understanding of course concepts by relating them to independent inquiry and debate.

The question is whether available technology can actually do that.

Case Studies and Examples

Our first case study involves an introductory computer science class. Pope's goal in implementing web-based tools the course was to increase opportunities for communication and participation. The class was small (approximately 25), but there was a considerable amount of material to cover and the topics that dominate the headlines -- Microsoft Antitrust litigation, Privacy in Cyberspace – provide fertile ground for discussion. He began using WebCT as a tool both for distributing informational materials and for on-line testing. In doing this, he relied on the students to read on their own time; his discussion/lecture now addresses related but different concepts in supplementing the text. Making the quizzes available online provided more opportunity for group and class discussion.

Students were positive; they could find their grades, course syllabus, assignments and topic notes in one central location.

In designing this kind of structure Pope was of course not alone. The University of Central Florida, for example, adopted a similar approach to improve its course in American National Government. There, the goals of the restructuring were practical as well as mission-oriented. The course enrolled over 2000 students in sections of 80-100 students. Classroom space was in critical short supply; increasing the number of sections was not a viable option. But the course also had a retention problem and surveys indicated that partially web-based sections had somewhat higher retention rates. Building on this, the department designed a web-based asynchronous learning environment based on web-based modules to encourage student participation. Class meeting time was reduced by two thirds. Bruce Wilson reports "students are, by necessity, more actively involved in the learning process. And instructional technology can also enhance students' critical thinking skills. ... The use of the Internet in teaching Political Science gives instructors more opportunities to design activities that involve students' direct participation and to follow clearly set instructional goals." [6]

Herman D. Lujan [7] alludes to the tendency of many faculty to "narrowly define 'good' teaching and learning as something that occurs in a time-bound, synchronous classroom setting." Pope believes that students in his computer science course benefit not only from in-class – 'synchronous'– discussions and demonstrations but also from the ability afforded by new online tools to communicate and learn using the tools that promote asynchronous learning opportunities.

Unlike Lujan, however, Pope is not convinced online learning fits in every teaching and learning context. It fits in this course because much of the material and the broad topics under review can be organized in a modular fashion and students can easily take part in discussions outside of the class context using WebCT. Fine for an introductory class, not so fine for an upper division, seminar-style class in advanced topics in mathematics.

This class meets twice a week – once in a regular classroom and once in a hands-on computer lab. But based on his experience Pope has come to believe that hands-on access is a more critical component of the instructional paradigm than the web-based asynchronous tools. This is a rather tame observation in 2002 – the case for instructional computing labs in science and computing education was made by the mid 1980s; nevertheless, the classroom context heavily influences teaching methodology. Without the lab, there'd hardly be time, and fewer topics, for discussion! The point is that successful teaching requires the clear evaluation of the goals of the course [derived from the discipline], the context in which the teaching and learning takes place [the classroom itself], and finally the learning strategies that best fit both.

Finally, Pope also viewed the electronic interface as an opportunity to evaluate his own teaching. In any implementation of electronic technology in the classroom, a major evaluation of course objectives and teaching strategy is required, and he found this to be a welcome necessity. Drawbacks were a lengthy development and the availability of trained support staff.

Thurber, teaching an upper division class in English literature, had a different experience. It was not obvious to him that the standard distributed education model was appropriate, given both the mission of the university and his actual task, which was to investigate, in this case, the work of the English poet William Blake. He does not give quizzes as such, although short exercises related to that moment's discussion do take place; there is no "lecture" and therefore no lecture notes. The course itself, in addition, was already as "interactive" as he (and his 24 students) could stand. Instead, the goal was to use the Web to investigate the nature of hypermedia, particularly as the poet in question, Blake, had done an 18th century version of the same thing. His goals, therefore, were far more specific to the actual material—more contingent, more dependent on the actual poetry than on any idea about how to teach poetry.

He created, therefore, a course website (www.sandiego.edu/~thurber/CyberBlake) and asked the students to create their *own* hypermedia websites in lieu of the traditional paper—the rationale being, once again, not simply that hypermedia may be worth investigating on its own, which it may be, but that, given this poet's practice, hypermedia are an appropriate, perhaps the most appropriate, response. The student's response was positive, in each case suggesting that the course be given again. Typical remarks included "It's about time English Departments did this," "an English course that is actually practical," and "I feel like I'm a writer too, doing something a little bit like Blake."

The course model that evolved, however, has almost nothing in common with Pope's. There was a course discussion board; very few students used it, feeling that opportunities for interaction were already sufficient; a few found it intimidating, while others viewed it as just another course assignment. (Participation in the discussion board was optional. Thurber wanted to see what would happen if it was not required.) There were electronic office hours; no one ever showed up, as students uniformly felt either that they already had sufficient access to the instructor, or that personal interaction was preferable. The emphasis was on the student's ownership and exploration of an electronic medium, the Web, rather than on using the Web to enhance communication or provide additional course materials.

Observations and Conclusions

It is about the differences between these two course structures that we would like now to reflect. Crucial to Pope's model was the use of the Web in the transferal of information from the instructor to the student. Indeed, he viewed, as is common, class sessions as adjuncts or supplements to information provided online.

But this is already not a model that transfers readily to an upper division literature class. Advocates of distributed learning have traditionally emphasized that the use of electronic communications present opportunities for teacher-student interaction that effectively shift the educational focus from "teacher-centered" to "student-centered," away from the traditional lecture format and towards distributed learning. But is the "transmission" of information, by itself, what college courses are for? If so, never mind the traditional lecture; colleges have been masquerading as libraries or, now that the technology is available, web sites. As far as the humanities are concerned the "transmission" of information is only one function college courses serve, and in some respects the least important.

While we acknowledge that modern educational philosophy mandates the critical importance of engaging the student in interactions that will impact his or her mastery of the subject matter, it does not then follow that the hallmark of student-centered learning is the use of computers in the classroom. Particularly if, as at our university, classes are small and instructors, on the whole, couldn't lecture if they wanted to. Is the give and take in small, discussion-centered, quasi-seminar situations comparable to what we can do in online discussion groups, even with real-time audio and video? If it isn't, what are the differences, and what is the educational impact of those differences? In the absence of hard answers to those questions, we wonder what's really at stake. What is being transmitted, pre-eminently in literature classes but in the humanities generally, is not the "information" we possess about, for example, Shakespeare, which is trivial, but the nature and kind of conversations we have and have had about his work. Knowledge in the humanities is both a process (not a result) and always contingent, socially constructed and crucially dependent on the context in which it is acquired. (The French Revolution in the eyes of post-1848 Europe was one thing; to Woodrow Wilson it was another; to ourselves it is yet something different.) From this perspective the transmission of information via the web is a non-sequitur. It isn't the Web that's the problem; it's the word "transmission."

Using computers according to the first model, therefore, at least interferes with and may even negate the goals and methods of the humanities—not because humanities instructors are Luddites (some are), but because the pedagogical model such approaches embody originated in one discipline, or set of disciplines, and don't readily transfer to another. Using computers according to Pope's model would deny Thurber and his students the chance to do what they want to do, which is both to learn what a writer actually did and to forge a response, together, to what she actually did. Here is where the under-appreciated difference between disciplines-- world views, at some point-- comes into play. There is no, and there had better not be, any such thing as socially constructed knowledge in the sciences. (Actually this is a matter of current debate. What physicists thought about the significance of Maxwell's equations in 1890 was a different than what Einstein thought fifteen years later.) In the humanities, on the other hand, and particularly in literature, there is no knowledge *except* what has been socially constructed – beginning with the fact that literature is made of language, the most social of all constructions, and including the fact that no writer, no matter how august, is a writer unless someone, somewhere, chooses to read her. The artist has an intent, to be sure, but that intent is only one of many variables connected to our mutual investigation of what a work actually is. Reader-response theory, as a matter of fact, would have us believe, in general, that readers are actually as responsible for what a work does as the author is -- maybe more so, in some constructions. Whether that is true or not, none of us reads or could read Shakespeare as Shakespeare did; but we still read Shakespeare! What's that, then? Shakespeare is Shakespeare but he's also us reading Shakespeare, in ways that he could not have foreseen but which are, still, what Shakespeare "is." For now. Meanings change; there are no "laws" in the sense that there are for the hard sciences.

Thus when Pope says, for example, that it's a good thing that online discussions can happen any time, that it frees people from the constraints of time and space so that they can say anything from anywhere, Thurber's response is -- why is that good? It would depend on the crucial insight that online discussion is the same as or better than the kinds of discussions his students and he have in real time, with their real bodies and their real minds in a real place, zoned into a writer they want to try to understand. Is virtual discussion discussion? (We know, for example, that people write and talk differently, and that they behave differently on- or off-camera. What are the differences, are they significant, and are virtual discussions better than, the same as, or worse than virtual discussions? And for what ends? There has been surprisingly little research in these areas, particularly as different disciplines are involved.)

Even, Thurber notices, Britain's Open University, one of the oldest and most successful implementations of computer-based instruction (http://www.open.ac.uk), supplements online material with local study centers (and tutors) at learning centers around the world. On this model, the discussion, always specific, always local, and always the joint product of the persons present on that occasion, is preserved, together with ancillary electronic material and the opportunity, which he welcomes for his classes, for students to write back at the sea of electronic media they are surrounded by, owning the web by helping, in a small way, to create it.

Thurber makes one further point, however. Crucial to his thinking about the use of computers in the classroom is what he has taken to be the centrality of hypertext (and hypermedia) in the classroom. As things have developed, however, he is beginning to wonder whether hypertext —at least as it was once envisaged—has failed. If it has, the use of computers—any computers at all -- in his classroom becomes problematic.

In one sense, of course, it is absurd to say that hypertext has failed—the Web itself is evidence that it has not-- not to mention media-rich computer programs, whether or not they live on the web. Hypertext, and more generally hypermedia, are the cornerstone upon which contemporary electronic communications stand, the cornerstone as well of the new IT economy, with its multiple and still evolving political, social, and psychological impacts. Hypermedia used creatively, moreover, as a medium of expression with its own aesthetics, continues to be produced, if in small quantities. It was this last area—the possibility that interactive technologies could be the means by which student author-readers could create new kinds of texts— that most interested and excited Thurber.

But in this context the early promise of hypermedia has not been realized. We do not go to see interactive movies, though attempts have been made, nor, on any meaningful scale, do we find ourselves reading interactive novels. Hypermedia on the web and elsewhere have developed as economic, more than literary or artistic, engines. Interactive games are arguably interactive fiction-- but games more than fiction, image more than text; but text —language-- is at the heart of Thurber's commitment to his own discipline.

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It is true that interactive textuality continues to be investigated in the academy—notably at Brown University, MIT, the University of Texas at Austin—but these attempts too have failed to generate impact beyond those who are already persuaded. Hypertext has not swept away text; hypertext fictions bear approximately the same relationship to fiction that performance art bears to drama—marginal, contingent, rather that the revolution many of us thought was coming.

But whether or not this is true, our conclusion is that each of us is still *en route* to a full understanding of the implications of electronic technologies for higher education. We would emphasize, however, that our different disciplines seem to require different choices, different ways of using those technologies or reasons for not using them. One size does not fit all!

References

[1] "Wiring the Ivory Tower;" Kathleen Morris; *Business Week*, August 9, 1999; also at http://www.businessweek.com/1999/99_32/b3641119.htm

[2] "A Choice of Transformations for the 21st Century University;" James J. Duderstadt; *Chronicle of Higher Education*; February 4, 2000.

[3]Thomas Friedman, Next: "It's Education;" November 17, 1999; *New York Times.*

[4] *Understanding Learning and Teaching*; Prosser, Michael And Trigwell, Keith; Bury St. Edmonds, Suffolk: St Edmundsbury Press Ltd., 1999.

[5]*What Matters in College, Four Critical Years Revisited*, Astin, A. W., San Francisco: Jossey-Bass, 1993.

[6] "Best of Both Worlds? Web-Enhanced or Traditional Instruction in American National Government." Bruce Wilson, Phillip Pollock, Kerstin Harmann, *Political Chronicle*, v. 12, no. 2, Fall 2000.

[7] "Commonsense Ideas from an Online Survivor", *Educause Review*, March-April, 2002, pp. 29-330.

Students' Epistemological Beliefs and the Learning of Introductory Computing Concepts

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Abstract: Epistemological beliefs have been shown to influence cognition and learning, motivation, persistence in problem solving and navigational strategies in software use. Brownlee, Purdie and Boulton-Lewis (2001) have also been shown that learning environments can influence students' epistemological beliefs. Observations of students in a first year undergraduate introductory Information Systems course at the University of New South Wales, Australia revealed learning approaches and behaviours that suggest simple epistemological beliefs. Results of a survey of students' epistemological beliefs support these observations, leading to a reconsideration of pedagogical approaches adopted in teaching the course that might lead to the development of more complex epistemological beliefs. The motivations for the redesign of the core information systems course and the resulting restructure to include web-supported independent activities and lecturer facilitated workshops are described in this paper. Results from the first implementation of the course revision in early 2002 will be presented to Ed-Media 2002 conference delegates.

Epistemological beliefs are those concerning the nature of knowledge and learning: beliefs about how individuals come to know, how knowledge is constructed and how knowledge is evaluated.

'Epistemological beliefs' is an area that is increasingly seen as influencing learning and cognition, and an area of investigation afforded greater attention by the research community in recent times. Beliefs about knowledge have been shown to influence factors such as student's motivation, persistence or problem solving approach (Kardash and Scholes,1996; Schommer, 1994b; Jacobson and Spiro, 1995). Kardash and Scholes (1996) draw attention to 'A growing body of evidence (that) suggests individuals' epistemological beliefs play a critical role in strategic learning in general and higher-order thinking and problem solving in particular' (p261). Schommer (1994b) suggests that '... epistemological beliefs affect the degree to which individuals (a) actively engage in learning, (b) persist in difficult tasks, (c) comprehend written material, and (d) cope with ill-structured domains. In each of these areas, the evidence suggests that epistemological beliefs may either help or hinder learning' (p302). In a summing up the same article Schommer concludes that '... there is enough evidence to suggest epistemological beliefs are critical to the learning process' (p315).

Jacobson and Spiro (1995) identify '...*epistemic cognition* as a relatively recent area of cognitive enquiry of potential relevance to hypertext investigators' (p305). They identify students epistemic beliefs as being associated with '... such learning problems as the failure to integrate new knowledge with prior knowledge, use of rigid criteria for monitoring reading comprehension, and poor performance on comprehension measures' (p306). Based on the work of Spiro, Coulson, Feltovich and Coulson (1988) they also suggest that '... over simplification of complex and ill-structured knowledge contribute to the formation of conceptual misunderstandings at post-introductory stages of learning' (p306). As a result of their 1995 study Jacobson and Spiro describe preliminary evidence which suggests that students holding a simple set of epistemic beliefs were less able to learn and apply their knowledge after using a hypertext system than students who possessed a more complex set of epistemic beliefs. It is apparent that epistemological beliefs are not only important to learning generally, but also to learning with computer-based materials.

Epistemology is an area with its roots in philosophy that is generating increasing interest (Belenky, Clinchy, Goldberger & Tarule, 1997; Brownlee, Purdie and Boulton-Lewis, 2001; Hofer, 2000; Hofer & Pintrich, 1997; Jacobson, Maouri, Mishra & Kolar, 1996; Schommer, 1990; Schommer, 1994a; Schommer & Walker, 1997; Spiro et al., 1988). Initial work in the area in the form of a number of longitudinal studies involving mostly young American men at college was undertaken by Perry (1970) who suggested a model based on nine developmental stages in intellectual and ethical development as the results of. Perry's work came under attack in the late 1970s due to its focus on an 'elite male sample', with Belenky, Clinchy, Goldberger and Tarule responding with a study focusing on American female subjects from academic institutions and from human services agencies (1986). Belenky et.al. proposed a model based on '... a set of epistemological perspectives from which women know and view the world' (p15). Kuhn (1991), Baxter Magolda (1992), and King and Kitchener (1994) have also suggested alternative developmental models, Kuhn with levels of 'argumentative reasoning', Baxter Magolda with four different 'ways of knowing' and King and Kitchener with three 'reflective judgement' stages.

A recent prolific researcher in the area of epistemological beliefs, Marlene Schommer, suggests that epistemological beliefs are far to complex to be captured in one dimension of developmental stages and has proposed instead of a set of five independent epistemological dimensions, each having a range of possible values. These dimensions include *certainty* of knowledge (absolute to tentative), *structure* of knowledge (simple to complex), *source* of knowledge (handed down by authority to derived through reason), *control* of knowledge acquisition (ability to learn is fixed at birth to ability to learn can be changed), and *speed* of knowledge acquisition (knowledge is acquired quickly or not-at-all to knowledge is acquired gradually). Schommer (1994a) proposes these dimensions as a starting point to the line of investigation of dimensions of epistemic beliefs, as she suggests that the five dimensions are unlikely to encompass all possible aspects of epistemological beliefs. Hofer's (2000) investigations in the area of personal epistemology have shown that epistemological beliefs are not unrelated to the discipline of study being undertaken, and are not 'domain general' as suggested by Schommer.

Consistent with the work of Jacobson and Spiro (1995), Tolhurst and Debus (2000, and 2002 in press) found that the navigational strategies and learning approaches adopted by students' using complex software may be influenced by their epistemological beliefs. Dimensions of Schommer's epistemological beliefs were found to be relevant to this study were those of certainty of knowledge, structure of knowledge, source of knowledge and speed of knowledge acquisition. It was found that if students possess naive beliefs of knowledge, such as belief that knowledge is absolute, is simple, is handed down by authority and is acquired quickly or not-at-all, then this is likely to affect the way that they use software to seek information. With less sophisticated beliefs students were likely believe that there is one answer to be found, and it will be found quickly if the software is authoritative or it will not be found at all. With such beliefs, students were not likely to persist in information seeking beyond the situation in which they locate any information they believe satisfactorily answers a question, on in the event that they do not find an answer relatively quickly. Conversely, with more sophisticated beliefs students, were be more likely to seek additional information to that first identified and persist in the event of being unsuccessful at first.

Of particular significance to the work discussed in this paper is the research by Brownlee, Purdie and Boulton-Lewis (2001). Brownlee et.al conducted a study with Australian tertiary students at the University of Queensland that show it is possible to significantly influence students' epistemological beliefs and produce positive learning outcomes. Brownlee et.al. measured students beliefs before and after a course of study in which two groups of students experienced a year-long of study in which one group was required to reflect on their epistemological beliefs using personal diaries. They found that the group involved in reflective practice experienced a statistically significant shift to more complex epistemological beliefs that those students who did not. They conclude that student epistemological beliefs are able to be influenced, and that this has implications for how educators develop learning environments.

Based on the work of Brownlee et. al. that epistemological beliefs can be influenced, a study in-progress is discussed in this paper which seeks to determine whether changing established learning environments might encourage in students more complex epistemological beliefs, and hence encourage more appropriate study approaches in tertiary students.

Research Study In-progress

Background

After evaluating course outcomes, staff teaching first-year undergraduate students introductory courses in the School of Information Systems, Technology and Management (SISTM) at the University of New South Wales (UNSW) have begun questioning the pedagogical approaches practiced in teaching. Observations of student behaviour have identified attitudes and practices that are of concern to staff, in that many students: rely strongly on teaching staff to provide content and guidance on assignments; rely on a single source of information (often the internet) rather than consulting a range of sources; tend to quote large sections of text from sources with little attempt to 'paraphrase' material or integrate ideas from different sources. The results of an epistemological beliefs questionnaire provide support for the impressions that staff hold, indicating that in the main students possess naive epistemological beliefs.

Epistemological Beliefs of Current Student Group

In first session of 2001 the Epistemological Beliefs Questionnaire (Schommer, 1998) was completed by 201 students studying the first undergraduate Information Systems course. Table 1 shows the results of that survey.

From the data presented in Table 1 it is apparent that the epistemological beliefs of the majority of our students are consistent with the study practices observed by staff. The subscales (range of 1 to 5, 5 represents strong agreement) with the highest mean values small standard deviations suggest that students in the main: seek single answers (mean=3.17, sd=.35), depend on authority (mean=3.21, sd=.58), and avoid ambiguity (mean=3.17, sd=.55). Other values also support evidence of simple epistemological beliefs in the majority of the students, in particular: concentrated effort is a waste of time (mean=2.70, sd=.7), knowledge is certain (mean=2.76, sd=.49) avoid integration (mean=2.70, sd=.41), and ability to learn is innate (mean=2.71, sd=.7). It would seem that the current course structure (2x1-hour lecture and one hour tutorial/laboratory per week) does not support more complex epistemological beliefs in students that are associated with more desirable learning approaches and outcomes.

Scales, Subscales and sample items	Student responses	
	M	SD
Quick Learning		
Learning is quick 1. If you are ever going to understand something, it will make sense to you the first time you hear it.	2.53 (n=199)	0.58
Learn first time 20. Going over and over a difficult textbook chapter usually won't help you to understand it.	2.55 (n=198)	0.68
Concentrated effort is a waste of time 53. If a person tries too hard to understand a problem, they will most likely just end up getting confused.	2.70 (n=201)	0.70
Certain Knowledge		
Avoid ambiguity 27. If lecturers would stuck more to the facts and do less theorising, one could get more out of University.	3.17 (n=198)	0.55
Knowledge is certain 12. If scientists try hard enough, they can find the truth to almost anything.	2.76 (n=193)	0.49
Avoid integration 54. Being a good student generally involves memorising facts.	2.70 (n=198)	0.41

Innate Ability		
Cannot learn how to learn 15. The most successful people have discovered how to improve their ability to learn (negative item).	2.37 (n=199)	0.55
Success unrelated to hard work 49. The really smart students don't have to work hard to do well at university.	2.32 (n=197)	0.66
Ability to learn is innate 55. Students who are 'average' in school will remain 'average' for the rest of their life.	2.71 (n=194)	0.70
Omniscient Authority		
Depend on authority 5. How much a person gets out of university depends on the quality of their teacher.	3.21 (n=200)	0.58
Don't criticise authority 3. For success at university it is best not to ask too many questions.	2.37 (n=199)	0.53
Simple Knowledge		
Seek single answers 59. The best thing about science courses is that most problems have only one right answer.	3.17 (n=197)	0.35
Avoid integration 54. Being a good student generally involves memorising facts.	2.70 (n=198)	0.41

Table 1. Results of Schommer's Epistemological Beliefs Questionnaire for first year undergraduate students studying the first core Information Systems course in Session 1 2001

Note: M = mean, SD= Standard Deviation, Subscale range is 1 to 5, 5 represents strong agreement.

Changes in Course Structure for 2002

In an attempt to address the problems identified, the first year core undergraduate course in Information Systems is being restructured in a way that minimises formal lectures where content is provided by an 'authority'. In place of the formal lectures students will spend half of their structured course work undertaking web-supported independent work in preparation for workshop sessions in which experienced staff facilitate learning activities. The workshops will be classes of no more than 30, in place of participation in lectures of up to 250 students. Rather than be passive learners in lectures, students will be required to be actively involved in their-own learning in both the independent web-supported activities and workshops. They will be required to undertake guided and independent research from multiple sources (on-line, computer-based and non-computer based), involve themselves in group discussions, case studies, project work, debates, design activities, software activities, role plays and peer evaluations. It is expected that the work that they undertake will challenge any tendency to settle for 'simple', quick' or 'first' answers, single sources, and the seeking of information from the lecturer as an 'authority'.

Anticipated Outcomes

It is expected that the changes to the course structure to be implemented for the first time in 2002 will foster a more desirable 'academic' approach to learning in our students, encouraging greater student independence and supporting more sophisticated epistemological beliefs. By developing more complex epistemological beliefs it is anticipated that students will be more likely to appreciate the complexity of knowledge, seek information from multiple sources and integrate the ideas they find from these sources and rely less on the 'authority' of the lecturer. It is anticipated that in their computer-based research work that students will be willing to persist in information seeking beyond the situation in which they first locate any information they believe satisfactorily answers a question, on in the event that they do not find an answer relatively quickly.

By June 2002, the date of the ED-Media conference, quantitative results from Schommer's Epistemological Beliefs Questionnaire (1998) and qualitative results from student interviews following the first teaching of the newly structured course will be available for presentation to delegates.

References

1. Baxter Magolda, M. B. (1992). *Knowing and Reasoning in College: Gender-related Patterns in Student's Intellectual Development*. San Francisco: Jossey Bass.
2. Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's Ways of Knowing: the Development of Self, Voice and Mind*. New York: BasicBooks, Inc.
3. Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1997). *Women's Ways of Knowing: the Development of Self, Voice and Mind*. (Tenth Anniversary ed.). New York: BasicBooks, Inc.
4. Brownlee, J., Purdie, N. and Boulton-Lewis, G. (2001) Changing epistemological beliefs in pre-service teacher education students. *Teaching in Higher education*. 6 (2), 247-268.
5. Hofer, B. K. (2000) Dimensionality and Disciplinary differences in personal epistemology. *Contemporary Educational Psychology*. 25, 378-405.
6. Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67(1), 88-140.
7. Jacobson, M. J., Maouri, C., Mishra, P., & Kolar, C. (1996). Learning with hypertext learning environments: theory, design and research. *Journal of Educational Multimedia and Hypermedia*, 5(3/4), 239-281.
8. Jacobson, M. J., & Spiro, R. J. (1995). Hypertext learning environments, cognitive flexibility, and the transfer of complex knowledge: an empirical investigation. *Journal of Educational Computing Research*, 12(5), 301-333.
9. Kardash, C. M., & Scholes, R. J. (1996). Effects of preexisting beliefs, epistemological beliefs, and need for cognition on interpretation of controversial issues. *Journal of Educational Psychology*, 88(2), 260-271.
10. King, P. M., & Kitchener, K. S. (1994). *Developing Reflective Judgement: Understanding and Promoting Intellectual Growth and Critical Thinking in Adolescents and Adults*. San Francisco: Jossey Bass.
11. Kuhn, D. (1991). *The Skills of Argument*. Cambridge, England: Cambridge University Press.
12. Perry, W. G. (1970). *Forms of Intellectual and Ethical Development in the College Years: A Scheme*. New York: Holt, Reinhart and Winston.
13. Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology*, 82(3), 498-504.
14. Schommer, M. (1993). Epistemological development and academic performance among secondary students. *Journal of Educational Psychology*, 85(3), 406-411.
15. Schommer, M. (1994a). An emerging conceptualisation of epistemological beliefs and their role in learning. In R. Garner & P. A. Alexander (Eds.), *Beliefs About Text and Instruction with Text*, . Hillsdale, New Jersey: Lawrence Erlbaum Associates, Publishers.
16. Schommer, M. (1994b). Synthesising epistemological belief research: tentative understandings and provocative confusions. *Educational Psychology Review*, 6(4), 293-319.
17. Schommer, M. (1998). The influence of age and education on epistemological beliefs. *British Journal of Educational Psychology*, 68, 551-562.
18. Schommer, M., & Dunnell, P. A. (1994). A comparison of epistemological beliefs between gifted and non-gifted high school students. *Roeper Review*, 16, 207-210.
19. Schommer, M., & Walker, K. (1997). Epistemological beliefs and valuing school: considerations for college admissions and retention. *Research in Higher Education*, 38(2), 173-186.
20. Spiro, R. J., Coulson, R. L., Feltovich, P. J., & Anderson, D. K. (1988). Cognitive flexibility theory: advanced knowledge acquisition in ill-structured domains. In V. L. P. a. G. J. Groen (Ed.), *The Tenth Annual Conference of the Cognitive Science Society*, (pp. 375-383). Hillsdale, New Jersey: Lawrence Erlbaum Associates.
21. Tolhurst, D. and Debus, R. L. (in press, Vol. 26 due out early 2002, The Influence of Prior Knowledge, Attitude, Ability and Activity Structure on Students' Learning and Use of Software. *Journal of Educational Computing Research*.

22. Tolhurst, D. and Debus, R.L. (2000) *The emergence of 'School' as a factor influencing patterns of navigational choices in hypermedia.* Proceedings of ED-MEDIA 2000 World Conference of Educational Multimedia and Hypermedia. Montreal Canada, June 26 - July 1, 2000. pp1497-1498.

International Education Online: Project THRO

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Abstract: Active learning, case based teaching, and simulations have become increasingly popular tools for international education. In order to realize the full potential of Internet2, Teaching Human Rights Online at http://oz.uc.edu/thro provides: 1) interactive cases that give students immediate feedback at any hour they answer questions online; 2) collaborative problem solving exercises for multi-national teams; 3) structured formats for real world cases and hypothetical scenarios to focus on critical international issues; and 4) internet videoconferencing for students around the world to confront their differences. TV news broadcasts routinely feature a split screen conversation between international reporters in different countries. As internet connections improve, students from different countries will have similar opportunities to meet face to face online. Rather than dehumanize learning, new technology should mediate direct communication between diverse groups whose members may never travel abroad to meet in person.

Introduction

New technology creates extraordinary opportunities for global learning communities but also threatens to dehumanize higher education. Teaching Human Rights Online (THRO) is an interdisciplinary, multi-campus project begun in 1997 that employs interactive cases and internet conferencing to foster critical thinking and normative reasoning through collaborative interaction. Six THRO exercises apply information age technology to the type of problem based instruction found in the classical works of Sophocles and Thucydides. *Antigone* encourages students to decide whether an individual may invoke natural law to defy a ruler who demands obedience in order to avert anarchy. (Cranston, 1983) The Melian Dialogue confronts students with enduring questions of power politics and universal justice. How can technology improve on the personal interplay of student and teacher realized in classic drama, historic debate, and Socratic dialogue? In its first four years, Project THRO published six contemporary teaching cases as issues of an electronic journal that will continue to solicit and disseminate interactive exercises for internet conferences.

Project Partners

Political Science professor Howard Tolley initiated THRO in association with the University of Cincinnati Law School's Morgan Institute of Human Rights and with College of Education professor Dan Wheeler. THRO faculty associates in the U.C. Colleges of Education, Arts and Sciences, Law, Business, and University College collaborated in preparing interactive problems online as a supplement to traditional assigned readings, class lectures, and discussion. External grants from the U.S. Institute of Peace and the Ohio Learning Network supported instructional technology professional development workshops in September 1999 and March 2001 as well as follow-up distance education courses at the graduate and undergraduate level. The two faculty development workshops brought 100 faculty from eight countries and ten states to the U.C. campus for sessions on asynchronous and synchronous internet conferencing with text, audio, and video (with Polycom ViaVideo). The training identified the best applications for low bandwidth connections as well as for Internet2 high speed access.

As a result of the workshops, THRO-Net now lists eighty-five associates including faculty in Australia, Bulgaria, India, South Africa, and Turkey. Email discussion groups with minimal technical requirements enable THRO to reach the widest audience for text chat interactions. U.C. makes the case materials available online at no cost to individuals as well as to instructors who use the problems either as a course assignment or for structured exchange with classes at other institutions. English speaking teachers and students anywhere in cyberspace may use the exercises both as individuals and in organized interaction between classes at different campuses. Each THRO case has a teaching note for course instructors.

THRO promotes three distinct cross-disciplinary collaborative relationships:

- Case-writing Associates led by Political Scientist Howard Tolley develop teaching problems. During academic year 2002-03 a political scientist on sabbatical from Earlham College will work on a THRO case as a scholar in residence at the Morgan Institute.
- Project Associates led by Education Professor Dan Wheeler adapt, evaluate, and train others to use instructional technology. In support of its major information technology initiative, U.C. was a founding member of the Internet2 consortium, received a $328,000 NSF grant to support connections to the Next Generation Internet, and belongs to the ITEC-Ohio consortium with eight university and two corporate partners. Wide bandwidth connections now provide acceptable quality audio and video streaming between U.C. and other Internet2 institutions.
- Teaching Associates registered on THRO-Net assign the cases to students and may arrange online text or videoconferences with others in the network.

Goals and Methods

THRO envisions a third dimension of "IT" beyond "information" and "instructional" technology to accomplish an "interpersonal" objective. Online simulations with classes in different countries can provide to more students at less cost Model U.N. type learning opportunities enriched by multinational participation. Traditionally each school participating in a simulation represents a different state's delegation. With the latest technology, students from a U.S. class might join different multi-national work groups online, collaborating electronically with students of other countries to prepare for a videoconference simulation or seminar. Students in multiple locations working together on international human rights cases realize several important advantages:

- Increasing the diversity of the participants. Students in a single classroom are often quite homogenous and tend to assume that their own notion of rights is universal. Interaction with students from others countries develops a better understanding of cultural relativism.
- Increasing the realism of simulation. When one of the educational goals is to teach students to work with people from other countries, having participants who are actually from different countries adds greatly to the value of the role-playing exercises.
- Providing an independent audience. Students are motivated to take their work more seriously when there is an audience beyond their own classroom.
- Promoting collaborative learning. When classes work together via telecommunications, they must collaborate to make the exercise work. This is in addition to the collaboration that is directly involved in the case-based exercise.

For over fifty years proponents of the Universal Declaration of Human Rights have challenged advocates of cultural relativism in philosophy, history, law, international relations, and education. (Renteln, 1990. Gewirth, 1982) The United Nations proclaimed 1995-2004 as a Decade for Human Rights Education. Students in law, business, or the social sciences begin a THRO case with individual activity by using a personal computer to access materials needed to answer online questions about a human rights dilemma. At any hour students can answer multiple choice and short essay questions online and receive immediate feedback identifying errors and offering model answers. (Haladyna, 1997, Wiggins, 1998.) Analysis of student responses enables case authors to design improved items that measure and promote higher order thinking—analysis, application, problem solving, and evaluation. The student writes short advocacy arguments in support of rival claimants before reaching a balanced judgment in a concluding synthesis. THRO cases involve actual rather than hypothetical situations. Case updates keep online material current with active links to relevant web sites. The multidisciplinary human rights cases not only require critical thinking about political and legal decisions but also pose moral dilemmas that demand ethical reasoning.

Prior Work

Active learning, case based teaching, and simulations online have become increasingly popular tools for international education. First generation education initiatives on the internet have not realized the full potential for personal interaction online. Some hardcopy cases on international issues published by Harvard, Georgetown, and the University of Washington's Electronic Hallway (www.hallway.org) can now be downloaded off the web. Case instructors exchange email and post messages to share teaching ideas, but students derive little added value for costly instructional technology. Business cases at*www.i-Case.com* add audio and video streaming to standard text without engaging students in active problem solving or collaborative learning.

Several efforts to arrange multi-campus simulated Model U.N. activities online have been short lived. The costs of televideo ISDN or satellite transmissions have been prohibitive. International text conferences on the internet have provided a low tech alternative. Business faculty in Association Global View (www.globalview.org) create hypothetical scenarios for student management teams in different countries to negotiate contracts and trade agreements. Since the 1970s Project ICONS of the University of Maryland (Starkey, 1996; www.icons.umd.edu) has sponsored online negotiation simulations employing text exchange rather than videoconference technology. THRO seeks to have greater impact by bringing together students from different cultures in structured videoconferences that examine their distinct approaches to ethical reasoning.

A Unique Approach

THRO is unique in adding interactive self-assessment online, using actual situations, and providing a videoconference option made possible by Internet2. THRO currently provides eight active learning course modules that employ technology to improve not only critical thinking about human rights but also to facilitate student interaction with classmates, their instructors, and fellow learners in other countries. (See http://oz.uc.edu/thro.)

- *A Just War? President Clinton's Response to Kosovo*
- *Prime Minister Rao's Dilemma: Terrorism and Human Rights in India*
- *The International Court of Justice Considers Genocide: Bosnia v. Yugoslavia*
- *Shah Bano: Muslim Women's Rights in India*
- *Rape and Genocide in Rwanda: The ICTR's Akayesu Verdict*
- *Slavery in Burma? Doe v Unocal.*
- *Sanctions or Engagement: SLORC and Myanmar*
- *Business Ethics and SLORC: Unocal and the Yadana Gas Pipeline*

Those cases have been successfully used for both video and text conferences connecting students from Cincinnati with classes in North Dakota and Ankara, Turkey. Specifically THRO targets undergraduate and graduate/professional courses in the social sciences, history, jurisprudence, philosophy, comparative religion, ethics, international studies and education. At a large university where commuter students rarely collaborate on educational projects outside of class, asynchronous communication in cyberspace can increase interaction with peers and faculty. (Bloom, 1956; Dewey, 1933; Gamson and Chickering, 1987; Perry, 1970; Romm and Mahler, 1986)

THRO capitalizes on the latest instructional technology to employ a unique combination of learning strategies—active, authentic, collaborative learning with educative assessment and cross-cultural exchange. Email exchange and electronic bulletin boards facilitate advance collaboration by students preparing as co-counsel for in class role-playing. Videoconference simulation or online discussion with students from other institutions and countries also requires advance posting of advocacy papers in electronic text. THRO cases encourage students to become independent, learning on their own and from each other without relying exclusively on teaching professionals. The instructor's role shifts from a "sage on the stage" to a "guide on the side." Direct exchange with peers abroad stimulates more thorough preparation and a deeper understanding of the difficult quest for universal human rights norms. Engaging individuals from another culture encourages students to work through their own beliefs and assists them in understanding why others may see the world differently. Cross cultural dialogue based on THRO exercises could bridge the digital divide to include students at historically African-American institutions and also facilitate improved cross cultural interaction at universities with significant minority and international student enrollments.

Guided by a course instructor, students communicate with classmates by using an electronic bulletin board and exchanging email. At a large university where commuter students rarely collaborate on educational projects outside of class, asynchronous communication in cyberspace can increase interaction with peers and faculty. Teaching Notes for each THRO problem describe in-class role playing exercises that require advance collaboration online by student work groups. Properly used by a skilled professional, technology should enhance student preparation for in-class simulation and facilitate cooperative problem solving. The resulting classroom exchange should be more, not less personal.

New videoconferencing technology such as Polycom ViaVideo should provide considerably more valuable learning opportunities. Instructors can engage their classes in simulations and seminar discussions with students of different cultures. After examining a case problem from their American perspective, students can learn directly and personally how individuals of another faith or country assess the same situation. Synchronous text chat room interaction has become a common and all too often aimless exchange. Live video and audio transmission on the internet overcomes the anonymity and impersonal quality of text chat. THRO problems establish a structure for instructors to maximize the educational value of a live videoconference. Rather than dehumanize learning, video communication hardware should mediate face to face conversation between diverse groups whose members may never travel abroad to meet in person. With desktop videoconferencing equipment an instructor can arrange personal interviews with academic experts and non-governmental human rights activists working on the issue.

Evaluation

During case development, THRO obtains formative assessment by peer review and pilot testing before a final version of each interactive exercise and teaching note become available online. Each THRO case was subject to peer review at one or more professional meetings that included the North American Case Research Association, 1997, 1999, and 2001; World Affairs Case Research Association 1998; International Studies Association, 1997 and 1998; International Political Science Association, 2000.

For overall project evaluation or summative assessment, an advanced doctoral candidate in education has used the Flashlight Student Inventory developed by AAHE to assess collaborative learning and changes in study methods by students completing the exercises in professor Tolley's class. Statistical analysis of student responses to multiple choice self-assessment items identifies items by level of difficulty and ability to discriminate. Professor Wheeler has also completed preliminary research comparing students taught online and offline. Course instructors provide feedback after using THRO cases, and the project director monitors global use with software that tracks hits to each page in the web site.

Peer reviewed articles and book chapters about THRO (Tolley, 1998, 1999, 2000), conference presentations, [1] course adoptions beyond U.C., and grants from the U.S. Institute of Peace and Ohio Learning Network demonstrate growing acceptance and impact in several disciplines. THRO enables instructors to use classical forms of active learning--the case method, simulation, and Socratic dialogue—not only in the classroom but also in cyberspace communication between students of different cultures. Project THRO was recognized by the American Political Science Association as the best political science website for 2001.

Future

In 2002, the project will complete three cases under development providing distinct perspectives on the Unocal Corporation's Yadana pipeline project in Burma/Myanmar—business ethics, claims of forced labor in U.S. courts, and U.S. sanctions policy. New cases are planned on the International Criminal Court and the death penalty.

The University of Cincinnati THRO project directors are committed to developing global distance education partnerships employing the most advanced instructional technology. The project will seek grant support to provide overseas partners with videoconferencing equipment. With external funding, one THRO exercise has been translated into Spanish and French disseminated with the English versions both online and with an interactive CD-ROM. Future transnational conferences should enable multilingual students to debate issues raised in THRO exercises with peers in Spanish and French speaking countries. It might also be possible to obtain simultaneous translation during online conferences using foreign language majors or international students.

Ethnic hostilities, famines, arbitrary detention, torture, and killing of political dissidents and their families threaten both individual liberty and global security. Human rights education for the next generation of lawyers, teachers, politicians, journalists, and businessmen deserves high priority. Project THRO can pioneer a unique method of transnational education that moves beyond the Jessup international law moot court and undergraduate Model U.N. programs. Future transnational videoconferences will build key constituencies for a global civil society—advocates trained to bring human rights claims before national and international tribunals, leaders of nongovernmental organizations, teachers and professors, government officials and community activists.

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[1] EDUCAUSE, annual Lilly Conferences on College Teaching, (Oxford, Ohio), and the Midwest Political Science Association

References

Arzt, Donna (1998). Multi-Lateral Treaty Drafting Project http://www.law.syr.edu/faculty/arzt/il/ Syracuse University

Bloom, B.S., Engelhart, M.D.. Furst, E.J., Hill, W.H., & Krathwolh, (1956). D.R. *Taxonomy of Educational Objectives. Book I Cogniive Domain.* New York: Longmans Green.

Bonk, C. J., & King, K. S. (Eds.). (1998). *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse*. Mahwah, NJ: Erlbaum.

Bonham, G. M. (1999). "The Disruptive and Transformative Potential of Hypertext in the Classroom: Implications for Active Learning" Prepared for Delivery at the Annual Meeting of the International Studies Association, Washington, DC.

Cranston, Maurice. (1983) "Are There Any Human Rights?" *Daedalus* 112 (Fall 1983), pp. 1-18.

Dewey, John. (1933). *How We Think*. Boston: Heath.

Gamson, Z. and A. Chickering, (1987). "Seven Principles for Good Practice in Undergraduate Education," *AAHE Bulletin* (March 1987), pp. 5-10.

Gewirth, Alan . (1982). *Human Rights: Essays on Justification and Applications.* Chicago: University of Chicago Press.

Haladyna, Thomas. (1997). *Writing Test Items to Evaluate Higher Order Thinking*. Allyn & Bacon.

Khan, B. H., (1997). *Web-based Instruction*. Educational Technology Publications.

Nelson, Craig (1997). "Tools for Tampering with Teaching's Taboos," in *New Paradigms for College Teaching*, William Campbell and Karl Smith, eds. Interaction Books.

Perry, W.G. Jr. (1970). *Forms of Intellectual and Ethical Development in the College Years, A Scheme*. Holt, Rinehart and Winston.

Renteln, Alison Dundes. (1990). *International Human Rights: Universalism Versus Relativism.* Newbury Park, Calif.: Sage Publications.

Romm, T. and S. Mahler. (1986). "A Three dimensional model for using case studies in the academic classroom." *Higher Education,*15(6): 677-696,681, 687.

Starkey, Brigid and Jonathan Wilkenfeld. (1996). 'Project ICONS: Computer-Assisted Negotiations for the IR Classroom," *International Studies Notes* 21, 1(Winter): 25-29.

Tolley, Howard. (1998). "Project THRO: Teaching Human Rights On-line," *Human Rights Quarterly* 20, 4 (November).

________. (1999a). "The ICJ Considers Genocide: Bosnia v. Yugoslavia" in Hans Klein, ed. *Interactive Teaching & the Multi Media Revolution* Proceedings of the 15th International Conference of the World Association for Case Research and Application.

________. (1999b). "Terrorism and Human Rights in India: Teaching Human Rights Online," *International Studies Notes* Vol. 24, Number 2, pp. 39-46.

________. (2000a). "Teaching Human Rights On-line: The ICJ Considers Genocide" in Jeffrey Lantis, Lynn Kuzma, and John Boerher, ed. *Active Learning in International Affairs for the 21st Century* , Lynne Reinner.

________. (2000b). "Using Multimedia to Teach Human Rights Online," *Syllabus* Vol 13 #10 June 2000, p. 54.

Wiggins, Grant. (1998). *Educative Assessment: Designing Assessments to Inform and Improve Student Performance* San Francisco, Jossey-Bass. www.classnj.org

Task-Generator: A Portable System for Generating Learning Tasks for Intelligent Language Tutoring Systems

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Abstract: This paper describes the *Task Generator*, a component of an authoring tool for an intelligent language tutoring system. The *Task Generator* automatically creates learning material from authentic texts. The architecture is designed so that it can be readily ported to create learning material for other languages, with minimal resource requirements. This paper reports on a recent study which evaluates the accuracy of the system.

Introduction

The goal of authoring tools for Intelligent Tutoring Systems (ITSs) is to reduce the cost in time and expertise that is required to produce a usable intelligent learning environment. This paper describes the *Task Generator*, a component of an authoring tool for an Intelligent Language Tutoring System (ILTS). The *Task Generator* allows teachers to automatically create learning material by merely specifying the learning objective and providing samples of text which are likely to contain examples of the learning objective. The primary advantage of the *Task Generator* is that the authoring tool is more usable since the tasks and expertise required of the user are reduced.

Since we have developed intelligent tutors for a variety of languages (English, German, Greek), the architecture of the *Task-Generator* is designed so that the system can be readily ported to create learning material for a variety of languages, requiring only those linguistic resources that can be expected to be widely available. The *Task Generator* is currently implemented for English.

This paper is organized as follows. Section 2 introduces the basic functions of the ILTS for which we created the authoring environment, and introduces the authoring environment itself. Section 3 describes the architecture of the *Task Generator* and its implementation for English. Section 4 reports on the findings of a study to evaluate the accuracy of the tool. Concluding comments can be found in Section 5.

Intelligent Language Tutoring Systems & Authoring Tools

The goal of the ILTSs that we have developed is to provide meaningful and interactive vocabulary and grammar practice for second language learners, as illustrated in Figure 1. Each system analyzes sentences from the student and detects grammatical and other errors (see Schneider & McCoy 1998). The feedback modules of the system correlate the detailed output of the linguistic analysis with an error-specific feedback message. Unlike other ILTSs (Gerbault 1999, Yang & Akahori 1997, 1999), in our system feedback is individualized through an adaptive Student Model, which monitors a user's performance over time across different grammatical constructs.

In order to make intelligent tutoring systems useful to a wide audience, it is necessary to have authoring tools which allow the tutor to be modified. Ideally the authoring tools can be used by the instructors themselves. However, as Murray (1999) points out, when developing authoring tools for ITSs there is a tradeoff between usability and flexibility.

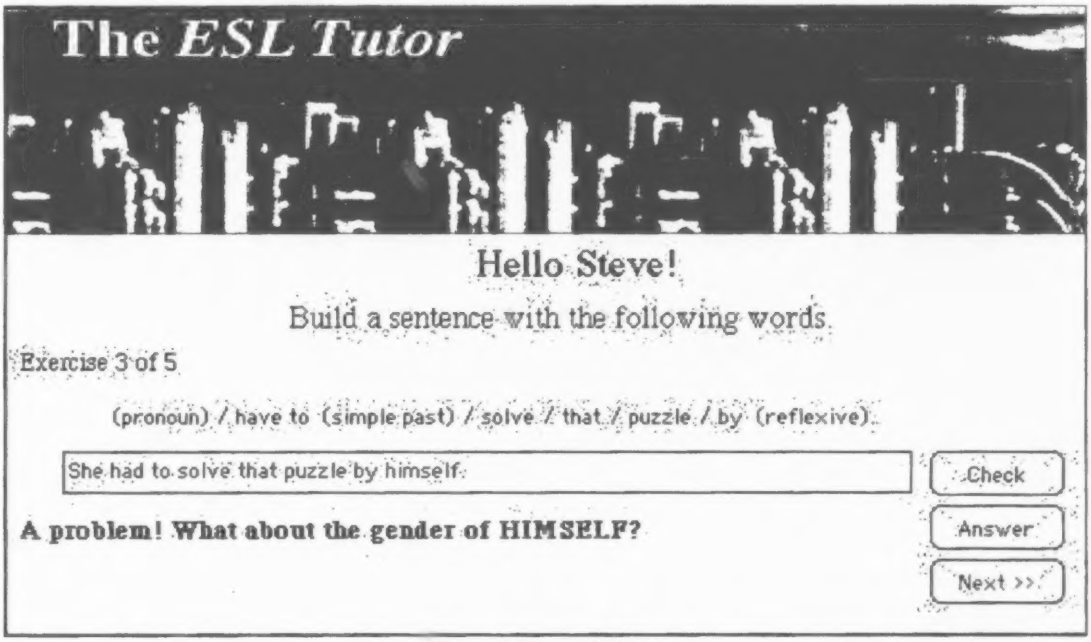
We have argued elsewhere that in the language learning domain usability can be maintained without significant loss of flexibility. This paper describes additional means by which the usability of ILTS authoring tools can be increased. As a first step, the basic functions of the authoring tool we have developed are described. Following this, we introduce the issues which the *Task Generator* addresses.

The authoring tool, the *Tutor Assistant* allows instructors to create on-line vocabulary and grammar exercises for a beginner and intermediate language skill level. In addition, instructors can author teaching strategies and the student model.

When adding or editing an exercise, the instructor has two main tasks:

- create the student task
- list all the possible answers

The student task is a set of words and prompts that the student must use to complete the task. In the case of the Build-a-Sentence example, the student task lists the words that the students must use in their answer. The user of the authoring system can also add additional prompts like "simple past" to further restrict the student's task, as illustrated in Figure 1.



Hello Steve!

Build a sentence with the following words.

Exercise 3 of 5

(pronoun) / have to (simple past) / solve / that / puzzle / by (reflexive).

She had to solve that puzzle by himself.

A problem! What about the gender of HIMSELF?

Figure 1: The *ESL Tutor*

Our previous studies have shown that ESL teachers who are inexperienced with both the authoring system and the ILTS, can develop one hour worth of learning material in about 2-3 hours. While this is a significant improvement over development times for authoring tools in other domains, the participants indicated they found some sections of the process difficult. In particular, they found it challenging to create student tasks which were varied, interesting and relevant. Significant time was spent thinking of relevant examples.

In order to alleviate this problem, and to decrease the overall development time for authoring learning material, it was decided to automate the process of creating the learning task.

The Task Generator

The goal of the *Task Generator* is to extract learning material from unedited texts. Unlike similar work by Kunichika et. al. (1998), the *Task Generator* creates examples from texts which already contain the target learning objective. Kunichika et. al. on the other hand, generate questions for reading comprehension from assertions existing in the text. The disadvantage of the Kunichika approach for the current task is that significant syntactic, semantic, as well as discourse information must be supplied - either automatically, or by the author.

This level of analysis is infeasible given the goals of our system. Firstly, our goal is to reduce the skill level and time required from the human authors. Secondly, from a computational perspective, one of the design goals for the *Task Generator* system is portability between languages. This is motivated by the fact that the system needs to be used by ILTSs from more than one language. Hence, in order to develop a system that is both usable and portable, all of the task generation must be done by the system, and minimal linguistic resources should be used.

The *Task Generator* meets these goals. The user is required only to specify a particular learning objective, such as *past tense*, *passive*, or *plural nouns*, and to provide a range of texts which contain examples of the learning objective in use. Furthermore, the linguistic resources are restricted to a sentence boundary detector, a Part-of-Speech (POS) tagger, and a lexicon containing syntactic information. These resources are generally available for the more widely studied languages, and are what is minimally required to disambiguate the input text.

The overall architecture of the system can be found in Figure 2.

The first module of the system detects sentence boundaries, and separates the text into its constituent sentences. We use the MXTerminator system (Reynar & Ratnaparkhi 1997).

The next stage is the out-of-vocabulary (OOV) words filter. The ILTSs for which the learning material is being created perform significant linguistic analysis on the student input. Hence, all words in the task must be known to the ILTSs. The purpose of the OOV Filter is to remove sentences which contain out-of-vocabulary words.

The Part-of-Speech tagger assigns one of fourteen tags to each word token. The POS tagger is a Hidden Markov Model based on Church (1988). The tagger disambiguates the input so that the correct lexical information can be retrieved from the lexicon. Our lexicon is derived from the XTAG lexicon (Egedi & Martin 1994).[1]

The Learning Objective Filter removes all sentences which do not contain an instance of the specified learning objective. For each possible learning objective a Learning Objective Filter has been developed which specifies positive and negative constraints on the lexical entries that occur in a given sentence. For example, the filter for the *Present Continuous* learning objective specifies that the sentence must contain an auxiliary with a base form of 'be' and an additional verb in present participle form. It is also possible to specify a window within which the lexical items that match the constraints must co-occur.

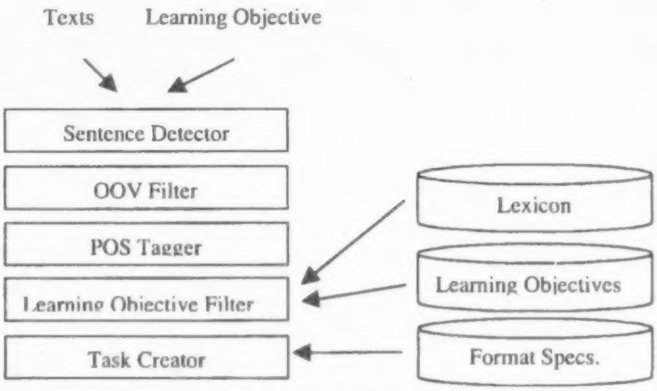


Figure 2: System Architecture

The sentences remaining after the learning objective filter each contain at least one example of the learning objective. These sentences form the input to the *Task Creator*.

The *Task Creator* converts the sentence into one or more of the grammar-practicing exercise types used in our ILTSs: Build-a-Sentence, Fill-in-the-Blank, and Drag-and-Drop. The Format Specification file contains information about how the words in the sentence should be converted for each exercise type. In the case of converting a present continuous sentence into a Fill-in-the-Blank, the main verb is converted to base form, the auxiliary is removed, and the remaining words remain in their original form. This is illustrated in (1). In the case of converting the same sentence to Build-a-Sentence, a similar process is followed except that all words are converted to their base form, as illustrated in (2).

(1) But more than half also said they [**save (present continuous)**] for a dream vacation.
(2) but more than half also say they **save (present continuous)** for a dream vacation .

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[1] Available at http://www.cis.upenn.edu/~xtag/

Evaluation

This section describes a recent evaluation of the *Task Generator*. The main aim in this study is to evaluate the accuracy of the system in producing learning tasks for the *ESL Tutor*. To this end, the accuracy of each individual component, as well as the overall accuracy of the system is evaluated. Since the OOV Filter achieves 100% accuracy (it is not a difficult task), this filter was excluded from the system for the purpose of the evaluation. This provided a wider range of input to the later parts of the system.

Procedure

The input to the *Task Generator* was 7,600 words from 13 texts that were selected by an independent analyst. The texts covered a range of subject areas from personal descriptions to family finances to net access for business travelers. Ten learning objectives were selected from the forty we have currently implemented. These were selected to include objectives for a variety of parts of speech, with an emphasis on the inflecting classes. The selected learning objectives are listed in Table 1. The input text was submitted to the system, once for each of the selected learning objectives.

Any/Some/No Words	
Comparative and Superlative Adjectives	
Count / Mass Nouns	
Indefinite Articles	
Prepositions	
Passive	
Present Continuous	
Reflexives	
Singular Pronouns	(masc., fem.., neuter, accus., nomin.)
Verb Agreement	

Table 1: Learning Objectives Used in Study

Results

The performance of each system component can be found in Table 2. The accuracy of a component for a specific learning objective was determined by considering just those sentences that contained the learning objective. For example, the accuracy of the sentence boundary detector for the Passive learning objective was determined by evaluating all of the sentences that were identified as containing a passive construction. The percentages specify the percentage of sentences which were analyzed correctly by each component. The **Correct** column specifies the percentage of the created examples that are correct. The **Total Produced** column specifies the number of examples that were created for each learning objective - there is an upper limit of 150. Finally, the **Total** row provides the total calculated by averaging the original scalar values of each column (for reason of brevity original values are not provided in the table. They can be calculated from the information provided in the table). For example, in 99.5% of the tasks created, the Learning Objective Filter performed correctly.

Discussion

The results show that 90.8% of the examples produced were correct. In 8.2% of the cases, there was some error that was caused by one of the preceding modules.

By far the largest source of errors was the sentence boundary identifier. In 7.4% of the created examples there was an incorrect sentence boundary. This comprised 80% of the errors. A review of the data found that the detector we are using appears to rely heavily on periods and capitalization as an end of sentence identifier. In cases where periods do not frequently occur, such as at the end of headings, a sentence boundary was omitted, leading to problems such as (3). In addition, there were cases with a period and appropriate capitalization that were not identified as sentences. Hence, in order to increase our overall accuracy, an improved sentence boundary identifier is required.

	Sentence Boundary	Tagger	LO Filter	Lexicon Problem	Correct	Total Produced
Any/Some/No Words	95.0%	100.0%	100.0%	100.0%	95.0%	40
Comparative & Superlative Adjectives	78.1%	100.0%	100.0%	84.4%	62.5%	32
Count/Mass Nouns	100.0%	100.0%	100.0%	100.0%	100.0%	6
Indefinite Articles	95.3%	100.0%	100.0%	100.0%	95.3%	150
Prepositions	92.0%	100.0%	100.0%	100.0%	92.0%	150
Passive	94.7%	100.0%	100.0%	100.0%	94.7%	38
Present Continuous	90.9%	100.0%	100.0%	100.0%	90.9%	11
Reflexives	85.7%	100.0%	100.0%	100.0%	85.7%	7
Singular Pronouns	94.0%	100.0%	98.0%	100.0%	92.0%	150
Verb Agreement	84.0%	76.0%	100.0%	100.0%	72.0%	25
Total	92.6%	99.0%	99.5%	99.2%	90.8%	609

Table 2: Results

(3) Effective vs. Ineffective One way to distinguish effective from ineffective employees is in how they act and react to the demands of their positions.

The remaining modules each achieved very high accuracy. The tagger performed extremely well, except in the case of the verb agreement category. In this case, the tagger occasionally incorrectly tagged a noun as a verb. One example is the input given in (4).[2] In this case the noun **Hikes** was tagged as a verb. This is not surprising since the input is not a complete English sentence. This type of error accounted for three of the six tagging errors. In order to reduce this type of error it will be necessary to include filter mechanisms that exclude input items which are not complete sentences. The existence of an increased proportion of punctuation and capitals may provide sufficient indication of this.

(4) CALIFORNIA Great Day Hikes In & Around Napa Valley (Ken Stanton, Bored Feet Publications, Mendocino, CA, 1995, 707/964-6629; $12).

The Learning Objective Filter also performed very well: the only source of error was with the singular pronoun filter. In three cases this filter incorrectly identified cases like (5) as containing an example of the singular pronoun **it**. In each case the actual word was an acronym. A solution to this problem is to consider capitalization as a factor in the learning objective filters. At present, the filters only place constraints on information that is present in the lexical entry for this word.

(5) The most significant case is that of Lois Franxhi , an IT manager who was sacked for using the Internet during her lunch break to track down a bargain holiday.

The final source of error in our system is the lexicon itself. Firstly, the lexicon incorrectly identifies **modest** as a superlative adjective. An example is given in (6a). Secondly, the lexicon incorrectly lists the base form of **lower** as **lower** instead of **low**. An example in (6b). These two errors accounted for all of the five lexicon problems.

(6a) They tend to defer to others, are less likely to take risks, are [modest (superlative adjective)] and cautious, and try to avoid conflict.

(6b) People with [lower (comparative adjective)] dominance are congenial and cooperative.

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[2] This example also has an incorrect sentence boundary. The CALIFORNIA is a heading.

We are very encouraged by these results. With the exception of the examples influenced by the sentence boundary detector, the *Task Generator* is highly accurate. In particular, the shallow approach to analyzing the sentence has proved sufficient for the purposes of producing learning tasks for a specific learning objective.

Our analysis of the data indicated several areas for improvement. Firstly, the sentence boundary detector needs to be significantly improved. The detector needs to be able to deal with text **in context** i.e. text that includes components such as headers. Secondly, an additional module is required in order to filter sentences that have an unduly high proportion of capitals and punctuation. This should reduce the number of tagging problems. Thirdly, we need to update our language for stating learning objectives so that word capitalization can be used as a constraint.

Having established the reliability of the *Task Generator*, a next task is to integrate the system into our ILTS authoring tool. This will allow us to conduct studies with real users of the system. Our goal will be to establish to what degree the *Task Generator* affects the authoring process.

A further goal is to establish the portability of the system by porting it to German. While the language-specific resources must be replaced, it is expected that the rest of the system should need no modification.

Conclusion

This paper introduced the *Task Generator*, a component of an authoring tool for intelligent language tutoring systems. The *Task Generator* automatically creates learning content from existing texts. In order to ensure portability, the system is designed to require minimal linguistic resources. The current version of the system requires a sentence boundary detector, a POS tagger, and a lexicon with syntactic information. The results show these resources are sufficient to automatically produce learning content for a range of learning objectives.

References

Church, Kenneth. (1988). A Stochastic Parts Program and Noun Phrase Parser for Unrestricted Text, In the *Proceedings of the Second Conference on Applied Natural Language Processing*, Austin, Texas, pp. 136-143.

Egedi, Dania and Martin, Patrick. (1994) A Freely Available Syntactic Lexicon for English. In the *Proceedings of the International Workshop of Sharable Natural Language Resources*, Nara, Japan, August 1994.

Gerbault, J. (1999). Towards an Analysis of Answers to Open-ended Questions in Computer-Assisted Language Learning. Artificial Intelligence in Education: Open Learning Environments: New Computational Technologies to Support Learning, Exploration and Collaboration. Lajoie, S. and Vivet, M. (eds.). IOS Press: 686-690.

Kunichika, Hidenobu, Takeuchi, Akira, and Otsuki, Setsuko. (1998). Automatic Generation of Questions for a Comprehension Test in English Learning. In the *Proceedings of Ed-Media* 1998.

Murray, T. (1999). Authoring Intelligent Tutoring Systems: An Analysis of the State of the Art. *International Journal of Artificial Intelligence in Education*. Vol. 10:pp. 98-129.

Reynar, Jeffrey and Ratnaparkhi, Adwait. (1997). A Maximum Entropy Approach to Identifying Sentence Boundaries. In the *Proceedings of the Fifth Conference on Applied Natural Language Processing*, March 31-April 3, 1997. Washington, D.C.

Schneider, D., and McCoy, K.F. (1998). Recognizing Syntactic Errors in the Writing of Second Language Learners. In the Proceedings of the Thirty-Sixth Annual Meeting of the Association of Computational Linguistics and the Seventeenth International Conference on Computational Linguistics, Volume 2, 1198-1204. Universite de Montreal, Montreal, Quebec, Canada: COLING-ACL.

Yang, J. and Akahori, K. (1999). An Evaluation of Japanese CALL Systems on the WWW. Comparing a Freely Input Approach with Multiple Selection. *Computer Assisted Language Learning* 12 (1): pp. 59-79.

Yang, J. and Akahori, K. (1997). Development of a Computer Assisted Language Learning System for Japanese Writing Using Natural Language Processing Techniques: A Study on Passive Voice. *Proceedings of the Workshop "Intelligent Educational Systems on the World Wide Web"*, 8th Conference of the AIED-Society, Kobe, Japan.

Interactivity and Threaded Discussions

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Abstract: This paper summarizes a study conducted with Faculty of Education students preparing to teach Junior/Intermediate Visual Arts. The study investigates the potential and issues of computer-based systems to present and discuss theoretical material within a particular community context. The results suggest that active participation in threaded discussion is predominantly driven by reward motives such as grades, and that students do not normally participate beyond the minimum course expectations. Passive participation in the discussion areas such as browsing and reading was difficult to evaluate and document. Findings indicate that discussion tied to real-world experiences have a greater level of participation.

Introduction

A learning community is a group of individuals engaged intentionally and collectively in the transaction or transformation of knowledge. Building an online learning community is not an organizational problem — the problem is one of *motivating* participants to create a community and giving them an opportunity to do it (Schwier, 1999). Clark (1999) uses the apt term "growing" in place of "building" or "constructing" to emphasize the organic nature of this type of work. Research on online learning communities has established the significance of providing an appropriate structure for discussion. Once such structure is the threaded discussion database, which facilitates an ongoing exchange of topical information among students enrolled in a course. For this particular study, a threaded discussion database was created to support a thought-provoking and offline art project with the expectation that the addition would create observable differences in the responses of the community.

The Study

The community for this study consisted of 179 Junior/Intermediate, Faculty of Education students enrolled in a Visual Arts course as part of a traditional B.Ed. program. Each student had completed a three- or four-year undergraduate degree. The class list indicated that the sample group was divided into 107 females and 72 males. Thirty of the 127 students were Visual Art majors.

A Web browser was the only required interface for the students. The students interacted throughout the school year with three discussion databases using text format only. The first threaded discussion assignment, *Readings Discussion*, instructed the students to initiate a discussion related to one of the assigned readings. Each student was also responsible to read the postings by other students and to respond to at least one posting. The second threaded discussion, *Ask an Artist*, was compulsory only for the 30 art majors and was available to the non-art majors as a resource area, where they could ask the art majors and instructor specific questions to assist with teaching art during their practice-teaching sessions. The third threaded discussion, *Stick Project*, was set up as a crossover project with B.Ed. students taking a Language Arts class. The same level of participation was required for this project as for the *Readings Discussion*, a minimum of one posting and one response.

Findings

A minimal level of participation by the students was expected due to the heavy course load of the program and practice teaching sessions. The access logs on the server indicated the number of times the database was accessed, but provided no true indication of level of participation. The results, however, indicate a higher level of interest in reading rather than posting. The higher level of "lurking" to posting corresponds with the instructor's observation that the majority of his students did not feel comfortable participating in threaded discussions. All students, regardless of their Visual Arts background, demonstrated a lack of confidence in the two databases that required participation for course credit. The students met only the required number of posts. In their messages, they expressed concern about whether their answers were right and appreciation for the examples of good submissions provided by the instructor. The instructor noted that the number of quality submissions exceeded his expectations for the *Stick* discussion, but not for the other two databases. A survey distributed to students indicates that the majority of them agreed that the *Stick* crossover discussion allowed more room for creativity and individuality.

Conclusions

- Threaded discussions should be structured to be very simple. One way to do this is to create multiple discussion areas; for example, one for each project in the course, or one for each week in the curriculum. The instructor should state clearly to students the protocol for using the discussion areas (minimum number of posts, participation grades, timelines, etc.).
- The ratio of one instructor to many students creates a situation where topics or directions can be overdone very quickly by the students and become stale. As part of the protocol for online discussion, the instructor should clarify for students that they should not contribute to a discussion thread unless they have something of value to add.
- Discussions on topics *chosen* by students – for example, related to overcoming the challenges of their course projects – are more lively and productive than discussions on topics required by the instructor.
- The workload on the instructor to provide more material online, monitor discussions, close topics, and provide fresh starting points is substantial compared to the traditional classroom. Universities should recognize this in their collective agreements and compensate accordingly.

References

Bruckman, A. (1996). Finding one's own [space] in cyberspace. *Technology Review*, 99(1), 48. Available WWW: (http://www.techreview.com/articles/jan96/Bruckman.html).

Clark, C. J. (1998). Let your online learning community grow: Three design principles for growing successful email listservs and online forums in educational settings. Available WWW: (http://et.sdsu.edu/cclark/papers/pop.html).

COPPE/Sistemas, Borges, Marcos R. S., Santos, Neide. (1999). Computer-Supported Cooperative Learning Environments: A Framework for Analysis, ED-MEDIA 1999.

Greenspun, Philip. Building an Online Community. Available WWW: (http://www.arsdigita.com/books/building-community/)

Guzmial, CaMILE: Collaborative and Multimedia Interactive Learning Environment (http://www.cc.gatech.edu/gvu/edtech/CaMILE.html)

Kumar, V.S. (1996). Computer-Supported Collaborative Learning: Issues for research. 8th Annual Graduate Symposium on Computer Science, University of Saskatchewan. Available WWW: (http://www.cs.usask.ca/grads/vsk719/academic/890/project2/project2.html)
Scardamalia, Marlene, Bereiter, Carl. (1998). Computer-Supported Intentional Learning Environments. Available WWW: (http://www.ed.gov/pubs/EdReformStudies/EdTech/csile.html)

Schwier, Richard, A., *Turning Learning Environments into Learning Communities: Expanding the Notion of Interaction in Multimedia*, ED-MEDIA 1999.

Barriers in Using Technology

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Introduction:

Today's children are raised in a generation of "digital age" (Hruskocy et al. 2000). The new digital technologies provide faster links to the world and from agriculture to medicine, all areas are implementing technologies. Therefore, this age's children's future, employment is dependent on how much they can implement technology skills and transfer those skills into their content is becoming more and more important In order to do this they depend on their teachers. That's why we have to look into the barriers in using technology.

It has been observed that the schools are trying their best on the hardware part by replacing the old machines with the new ones and even purchase more computers whenever they have the budget. On the other hand, it has been observed that technological readiness of America's teachers to use these new technological tools is very low. According to a 1999 National Center for Educational Statistics Study (in Haselbring et al, 2000), only 20% of all teachers feel very well prepared to integrate technology into their teaching. As Ertmer mentions (1999), although teachers recognize the importance of integrating technology into their curricula, they are limited. In the literature these limitations are called as internal and external barriers. Although the barriers are common in other studies, they are not always classified as Internal and External Barriers. However, I find that it would be a good idea to explain them under these two headings. Ertmer (1999), also mentions that training programs, recently, have incorporated pedagogical models of technology use as one means of addressing internal barriers. If pre- and in-service teachers are to become effective users of technology, they will need practical strategies for dealing with the different types of barriers they will face.

As mentioned above, the barriers are not always classified under the two headings in all studies but it is helpful to classify them as the "internal" and "external" barriers.

External Barriers:

Means and Olson (1997) describe external barriers as the types of resources like equipment, time, training and support that are missing or not provided adequately in teachers' implementation environments. External barriers to technology integration are described as being extrinsic to teachers and include lack of access to computers and software, insufficient time to plan instruction, and inadequate technical and administrative support (Ertmer, 1999). She also adds that teachers have to acquire technical skills needed to operate a computer. Dias (1999) also mentions the importance of external barriers. He says that the most common barriers include time, training, resources, and support. Teachers need time to learn how to use both the hardware and software, time to plan, and time to collaborate with other teachers. According to him another concern is training. Some educators do not have local training options available or the time to attend training. There is also the problem of lack of resources. Without computers in the classroom and appropriate software to support the curriculum, integration cannot take place. Support is critical as well. Lack of leadership, financial support, or an on-site technology expert sends many integration efforts into a tailspin. However, there is a very important factor that should always be kept in mind especially when dealing with technology and that is "time" and "change in time".

Internal Barriers:

Brickner (1995) defines internal barriers as the barriers that interfere or impede fundamental change. They are intrinsic to teachers and include beliefs about teaching, beliefs about computers, established classroom practices, and unwillingness to change (Ertmer, 1999). Kerr (1996) adds that these are rooted in teachers' underlying beliefs about teaching and learning and may not be realized by others or even by the teachers themselves for sometime. Internal barriers change fundamental beliefs about current practice, thus leading to new goals, structures, or roles (for example, electronically conversing with an author to explore the cultural and political context of a story rather than writing a book report summary). Current literature shows that internal barriers are common among today's teachers (Hannafin & Savenye, 1993; Kerr, 1996; Riedl, 1995).

Suggestions to overcome the barriers:
Here are some suggestions that are compiled from different articles that I read:

- Professional preparation programs should continue to emphasize technology skills preparation within their pre-service curriculum. Special attention should be given not only to use of computers in administrative tasks but should include how effectively use technology to enhance instruction. (Dorman, 2001)
- Faculty in schools or colleges of education preparing educators should integrate technology use within their professional preparation courses by modeling appropriate use of technology. (Hruskocy et al, 2000)
- Teacher candidates should be exposed to technology based curriculum materials and products within their pre-service period. (Abdal-Haqq, 1995)
- Special attention should be given to field placements and internships to ensure students are placed in a technology-rich environment where supervising teachers are actually using technology in their classes. (Hruskocy et'al, 2000)
- Experienced teachers may lack the formal training to feel comfortable using the computer in the classroom. Therefore, in-service programs featuring use of technology to teach about their content should be provided. Where possible, teachers should be given release time and support to develop technology skills. Grooves & Zemel, 2000)
- Curriculum planners and product developers should consider innovative ways to enhance the learning about their content by using technology in creative ways. (Hruskocy et al, 2000)
- Technology enhanced curriculum products should be an integral part of a planned approach to learning about the content. This effort will assist teachers to use technology for instructional activities in addition to aiding with administrative tasks. (Dorman, 2001)

Most of this section comes from Byrom's article (1998):

heightened abilities to collaborate in performing tasks He adds that designating appropriate assessment strategies helps teachers look for evidence of deeper understanding, statements of relationships, synthesis, and generalization of ideas to new domains. These kinds of strategies often include writing samples, student products, and portfolios. (Byrom,1998)

Conclusion:
Technology integration into teaching is one of the goals of educators. However, teachers today face with various barriers as explained above. Although there has been some research done on barriers in using technology, the field still needs more research as technology develops so fast and the skills and the hardware that are used change so quickly as well. In order to catch up with the speed of this technological development, professional development training programs should always be kept up to date and be continuous. There is still need for study on:

- teachers' use of advanced education technology and barriers in using them,
- professional development and technical support strategies for enhancing teachers' effective use of technology

On the other hand, the biggest challenge for most of the teachers is to learn to use new technology tools and take major steps to change their
classroom practices.(Ertmer, 1999) However, we can overcome these barriers if teachers are well prepared against them with effective strategies.

References

Abdal-Haqq, I. Infusing Technology into Preservice Teacher Education. ERIC Digest. ED:389699

Brickner, D. (1995). The effects of first and second order barriers to change on the degree and nature of computer usage of secondary mathematics teachers: A case study. Unpublished doctoral dissertation, Purdue University, West Lafayette, IN.

Dorman, M. S. (2001) Are Teachers Using Computers for Instruction? The Journal of School Health v71 n02 p83-4 F

Ertmer, A. P. (1999). Addressing First- and Second – Order Barrires to Change: Strategies for Technology Integration. Educational Technology -Research and Development. 47 no47-61

Hannafin, R.D., & Savenye, W.C. (1993). Technology in the classroom: The teachers' new role and resistance to it. Educational Technology, 33(6), 26-31.

Hruskocy, C., Cennamo, S. K., Ertmer, A. P., Johnson, T. (2000). Creating a Community of Technology Users: Students Become Technology Experts for Teachers and Peers. Journal of Technology and Teacher Education 8 no1 69-84.

Kerr, S.T. (1996). Visions of Sugarplums: The future of Technology, education and schools. In S.T. Kerr (Ed.), Technology and the future of Schooling: Ninety-fifth yearbook of the National Society for the Study of Education, (part2), pp. 11 – 27. Chicago: University of Chicago Press.

Means, B. & Olson, K. (1997). Technology and Education Reform: Studies of education reform. Washington, DC: U.S. Government Printing Office.

Riedl, J. (1995). The integrated technology classroom: Building self-reliant learners. Boston: Allyn and Bacon.

U.S. Congress, Office of Technology Assessment (1995). Teachers and technology: Making the connection. Report Summary. Washington, DC: U.S. Government Printing Office. OTA-EHR-616

The Relevance of Haptic Experience in Remote Experiments

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Abstract: Experiments are an important part in technical education to improve understanding of the theoretical content. In the last years efforts have been made to provide access to real experiments via Internet (Aktan et al. 1996; Wagner et al. 2001). Unanswered is the question on the effects of learning outcomes, the problem solving process, the, acceptance and the motivation of these non haptic experiments with their reduced focus of real world experience.

In this paper we describe the didactic concept of our remote lab and the evaluation framework for an empirical study which aims at examining the effects of the haptic component on problem based learning in remote laboratories.

The Remote Experiment

In our remote experiment for learners of process control at technical schools the learners have to develop and upgrade a program for an industrial controller (PLC) that controls a process engineering plant. In this process a fluid can be filled into the two tanks and heated or mixed in the reactor below.

The learners process the reaction of their program on the process through a remote controlled web cam. To access the lab devices the learners only have to run a web browser.

Didactic concept and task structure

The didactic concept in our remote lab course is orientated on problem based learning (see Norman 1991). The experiment is done in small groups of two or three learners. They are guided through the experiment and get additional information from a web based course. The course is structured in two parts. The first part is divided intro three subtasks with increasing aspiration level. The second part is a thematic structured knowledge base of the content for explorative learning. Designed as a guided tour through the subject matters we address three different types of learners. The practically inclined learner may start with an example, the analytically inclined one with a description of the structure of a PLC-program. Learners who already have gained experience with PLC program development may choose the third, the quick path being offered.

In the beginning of the experiment the learners have to find an error in a controller program (*remote diagnostic task*). They have to read the data sheets of the actors and sensors in the system and understand their relation to the given program. They have to correct the program, upload it to the controller and examine the function of their solution at the plant by using the web cam *(remote maintenance task*). During their next steps they have to upgrade the program and include functions additional for a local operation unit (see figure 1) and a "notification of fault" function.

Evaluation Approach

To evaluate the relevance of the haptic experiences in our experiment we made a comparative approach, where the learners execute the experiment in three different settings (see table 1).

Setting	Description
Local learning setting	The conventional learning setting, where the learners and the experiment are in one room.
Remote learning setting	The group of learners are separate from the experiment.
Distributed learning setting	The learners are distributed and collaborating by synchronic tools like chat or video conferencing.

Table 1: Variation of the learning environment

All groups have the same devices (for the local group they were 'real', in the other two setting they were 'virtual' for the groups) and the same lab exercises. But only in the local learning setting the students had the full sense of impression of the lab devices and of the other learners.

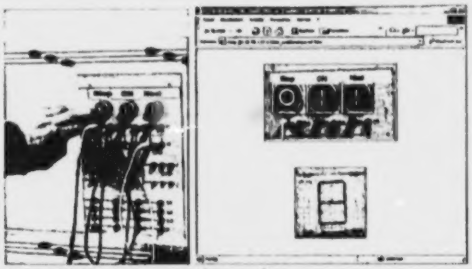

Figure 1: Local operating unit and Virtual operating unit

Evaluation Methods and Data Acquisition

Our three different learning settings have one evaluative question in common: How far does a loss in haptic experience effect the outcomes of the learning process to be achieved?

To measure the increase in knowledge we will carry out short pre- and post tests. To evaluate the quality of the problem solving process, we will observe the learners' activities during the experiment by means of a self developed evaluation tool that enables the evaluator to write down the activities of each learners' group into a database. Additionally, we will analyze the server log data by another self developed tool to trace information about the ways a group of learners took through the web based course and for how long they stayed in each chapter. At the end of the lab exercise all learners will have to answer a questionnaire gaining subjective information about their acceptance and motivation during the experiment.

The collected data will give us the possibility to compare the outcome of the learning process, the structure of the problem solving process as well as the acceptance and motivation in the three setting.

Conclusion

Setting up remote experiments raises many questions in the field of education. One of the main question is: How the loss of haptic impression change the learning effect. Special areas of interest are the acceptance, motivation, learning outcomes and quality of the problem solving process. Currently we are acquiring data in three classes with about 75 learners in vocational schools. Our aim is to find out if Remote Labs are a suitable way for problem based learning compared to traditional experiment settings.

References

1. Aktan B., Bohus C.A.,Crowl L.A. and Shor M.H. (1996). *Distance Learning Applied to Control Engineering Laboratories*, IEEE Transactions on Education, Vol. 39, No. 3, August 1996.

2. Tuttas, Jörg; Wagner, Bernardo (2001). *Distributed Online Laboratories*, International Conference on Engineering Education (ICEE01), Oslo, Norwegian, 6. -10. Aug.2001.

3. Norman GR, Schmidt HG (1991). *The psychological basis of problem based learning: A review of the evidence*. Acad. Med 1991, 67:557-565.

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Evaluating the Effectiveness of Online Courses

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Abstract: Evaluation is needed to justify the existence of online courses and to provide feedback on the performance of them. In this study, Kirkpatrick's 4-level evaluation model is proposed as a framework for the evaluation of online courses. The model and procedures are explained for collecting and analyzing data at each of the four levels for the ultimate purpose of the evaluation of online courses.

Introduction

Once the design, development and implementation of an online course are completed, it is time to evaluate it. Evaluation is needed to justify the existence of the online course and to provide feedback on the performance of it. Historically, educational perspective has treated the evaluation as the measurement of learning (Hawthorne, 1987). However, in the corporate environment, evaluation focus has been on the enhanced individual and corporate performance. Evaluations of corporate training have traditionally asked four questions. The purpose of this study is to evaluate the effectiveness of online courses by adapting these four questions asked in the corporate environment: 1) What the learners liked and disliked about the online course, 2) The amount of learning that occurred as the result of the online course, 3) To what degree learners have transferred the course attitudes, skills, and knowledge successfully to their jobs, and 4) What Return on Investment (ROI) have the learners' affiliates received due to participation in the online courses? There are various evaluation models, which can answer the questions above. Kirkpatrick's model will be used for this study, which is a widely used method of evaluating corporate training programs (Basarab & Root, 1992). Kirkpatrick developed a series of levels to use when deciding the type of data to use and the timeline for collecting evaluation data. In his model, Kirkpatrick calls for four levels. Levels 1 and 2 are formative and levels 3 and 4 are summative.

Methodology

Data Collection Procedures

Level 1: Reaction

A standard reactionnaire form completed by all learners will gather data to implement level 1 evaluation. All learners will complete the level 1 reactionnaire form prior to finishing the online course. The questions used on the reactionnaire will evolve from interviews with online course stakeholders and observations made by the researchers. Sample questions that might be included are: 1) How did the learners feel about the quality of the subject content, library services, the online learning process, and assessment tools? 2) How did the learners feel about the sequence of the materials? 3) How did the learners feel about the quality of online mentors' availability, answering questions, and knowledge of subject? 4) How did the learners feel about the course objectives as they relate to the learners' job requirements, and the applicability to the learners' job?

Level 2: Learning

The researchers will look for answers to the following questions at this level: 1) By learning objective, what skills and knowledge were acquired in the online course? 2) What amount of learning occurred after the online course? A pre-test and a post-test will be admin istered for the online course to evaluate the amount of learning gained from the online course in the short term. Online course developers will create the pre-test and post-test instruments.

Level 3: Behavior

Since the learners cannot apply what they learned until they have an opportunity, the measurement of transfer of knowledge, skills, and attitudes can only be done in the long-term. The researchers will look answers to the following questions at this level: 1) How many times have the learners applied course objectives on the job? 2) What are the reasons for not applying the behavior on the job? 3) How the online course impacted the learners' job performance? 4) What skills have learners had to learn on their own to perform a required job behavior that the online course did not provide? To answer these questions, all learners will complete a post-course questionnaire three months after the course's completion. The researchers will get additional information by interviewing the people around the participant such as immediate supervisors, subordinates, and peers.

Level 4: Results

For online courses, which don't have tangible results and therefore a measurement in terms of dollars and cents is not possible, the researchers will observe the learners in the workplace. When performing cost/benefit analysis seems logical, the researchers will still observe the learners, but they will also use the causal model and ROI model to find out if it has been worthwhile to spend money on the online course. The researchers will look answers to the following questions when the casual model and ROI model are used: 1) What was the cost of online course for the learners' companies? 2) What value the companies has received due to the online course? 3) What is the ROI from the online course?

Data Analysis Procedures

Level 1: Reaction

The researchers will summarize data from reactionnaires finding an average mean score for each item. Patterns will be detected in the open-ended questions.

Level 2: Learning

Statistics calculations such as mean, standard deviation, and t-score will be performed on pre-test and post-test scores for the online course. Using .01 level of significance, t-scores will be performed on pre-test and post-test results to see if the learning gain from online course is a true representation of learning. The percent of gain score indicates what percentage the participant has learned as the result of the online course. After gain scores are computed for each participant for the online course, the average percent of gain score for that online course will be computed. Item analysis of pre-test results will be performed to evaluate what learners knew before entering the online course. Based on this, recommendations will be made to modify course objectives and course content. Item analysis of post-test results will be performed to evaluate what objectives the learners could not master. Based on this, recommendations will be made to modify course content.

Level 3: Behavior

The researchers will compile the results of the questionnaires sent to the learners. To do this, data from questionnaires will be summarized finding an average mean score for each item. Patterns will be detected in the open-ended questions. The researchers will compile the results of the interviews made with the people around the learners. The interview records will be transcribed and analyzed to compare the behavior of the learners before and after the online course.

Level 4: Results

The researchers will analyze the observation records of learners to detect end results gained by the company. If the casual model and ROI model are used, the mean of sales/income for the experimental group and the control group will be calculated. The mean of the control group sales/income will be subtracted from the mean of the experimental group sales to find the value of training. This will be divided by the cost of the online course to find the return rate spent on each dollar. Due to lack of pure experimental design, the researchers will make judgments after the comparison of the data, and will not try to prove its statistical significance.

Conclusions

The data collection and data analysis techniques described above are generated based on the key characteristics and assumptions of Kirkpatrick's evaluation model. The described procedure does not yet have a strong empirical foundation to support it. Empirical work is needed to understand if the proposed model works.

References

Basarab, D. J., Root, D. K. (1992). The Training Evaluation Process. Boston/Dordrecht/London: Kluwer Academic Publishers.

Brinkerhoff, R. O. (1987). Achieving Results from Training: How to Evaluate Human Resource Development to Strengthen Programs and Increase Impact. San Francisco : Jossey-Bass Publishers.

Hawthorne, E. M. (1987). Evaluating Employee Training Programs: A Research-Based Guide for Human Resources Managers. New York: Quorum Books.

Kirkpatrick, D.L. (1994). Evaluation Training Programs: The Four Levels. San Francisco: Berrett-Koehler; Emeryville, CA: Publishers Group West [distributor].

Phillips, J.J. (1991). Handbook of Training Evaluation and Measurement (2nd ed.) Methods. Houston: Gulf Pub. Co.

Instructor Support in Web-Based Instruction

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Abstract: In this study instructor support problems related to the Web-Based Instruction (WBI) were identified after examining their experiences. It was found that the instructors need support in the area of hardware, software, design of the course, and handling student requests. In addition to this, it was also found that web-based course instructors will benefit from the knowledge management support, peer support, support for cooperation with school technology services, and web-based related research support. At the end, we propose a model for a support center for web-based course instructors.

Introduction

Using the Internet for different purposes has entered a revolution during last two decades. Especially, after the development of the hyperlink on the World Wide Web (WWW), the Internet has offered more user-friendly environments (Starr, 1997). Researchers indicated that WWW is not only a communication medium for e-mail and document distribution but it is also a place to learn (Lightfoot, 1999; Mioduser, Nachmias, Lahav, & Oren, 2000). With the combination of the specifically designed software and pedagogy, WWW can provide an educational environment that maintains the knowledge building approach to learning. These understanding, technological developments in communication and WWW have been used as new opportunities for delivering instruction online. Thus, web-based distance learning has emerged as an alternative approach to education in the last few years (Yellen, 1998). Especially for graduate students, universities have started to offer online courses (Barnard, 1997; Duchastel, 1997; Kearsley, Lynch, & Wizer, 1995). These practices in new educational agenda initiated some questions on researchers' mind. Support in web-based courses is one of these questions.

Researchers examined the support issue in web-based courses usually from the perspectives of distance education students. Paneitz (1997) made a research to assist community college personnel in the development of relevant student support services for web-based coursestudents. She found academic advising as the most essential student service for students. Other essential student services were found as access to library and media services and counseling. Hudson (1999) equalized the progress of a web-based course with supporting the learner. The support for their adult learners included an on-site orientation at the beginning of each semester, a support CD-ROM developed by school's distributed learning office, student peer assistance through a help forum, teaching interns, and paid graduate assistants.

Lever-Duffy (1992) stated that a WBI program will not be functional without proper support. They indicated the support for instructors is a prerequisite for interactions between the instructors and the students. Their project recognized the need for support in four specific areas: technical support, technology training support, instructional design support, and staff support. Technical support included such tasks as network maintenance, hardware installation and repair, software installation and maintenance, and helping through an electronic help desk. A qualified technical staff specialized in each of these areas provided the technical support. Technology training support serves for two kind of audience: students and instructors. The technology training reduces the threat and interference of the technology for both kind of audience. Instructional design support is required to design web-based courses which differ from residential courses in the unique delivery style. Finally, the staff support facilitates the communications and trades between the department and distant student in terms of administration. Secretarial and clerical staff can handle information flow and clerical tasks.

Para-professional staff can assist instructors with student load. The research published by Lever-Duffy identifies the most detailed information to date related to the support of web-based course students and instructors. However, she did not provide information on how she has foreseen the support in four specific areas.

There are also some research papers in the literature that included minor information about supporting the web-based course instructors. For example, Kuchinke et. al. (2001) received support from a technical support team consisted of six half-time staff with expertise in web design and development. A full-time academic professional directed the support team. While Friedrich and Armer(1999) developed a web site for a graduate course in statistics and measurement, an instructional designer/developer was assigned to each faculty member on a part-time basis to help with the technical aspects of the course. According to the authors, universities should support web-based course instructors by providing training to them. This training can inform the instructors about the types of technologies that exist and provide information related to the instructional design and development. Some studies mentioned lack of instructor experience in WBI as a problem (Lightfoot, 2000; Friedrich & Armer, 1999). Some authors recommended creating a permanent instructional design team and technical support team to overcome this problem (Ingebritsen, Brown, & Pleasants, 1997; Kuchinke et. al., 2001). Ingebritsen et al. (1997) utilized a resource center for the development of their biology course on the Internet. The purpose of this center was 'to assist faculty in the development of on-line courses by providing technology resources, technical assistance and training'.

Motivation for the Work

The review of the literature reveals that there is not much information in the literature on the topic of supporting web-based course instructors. The purpose of this study is twofold: to present the support needs of the instructors in web-based courses and to develop a support center model. The results might help those actively involved in educational use of the Internet research, those participating in the development of web-based courses, and finally those who are teaching web-based courses.

Methodology

Research Questions

Is there a need for a support center for web-based distance courses?
What kind of support do web-based course instructors need?
What are the functions of a support center built for web-based course instructors?

Participants and Context

In this study, two instructors from a large mid-western university were interviewed. Instructors were selected with purposeful sampling. Since the nature of this study is qualitative, participants were selected according to their previous experience with the WBI to get deep and broad understanding about their support problems related to WBI. It was required for the instructor participants to teach at least one Web-based course. Instructors were the members of the same university, but none of the participants had a relationship through the courses.

Instructor1 was a non-native speaker of English and he was an AI in the Informatics department. He taught a web-based course three years ago. The students took this course within another country while the instructor was in US. The course was related with courseware design for computer mediated learning. It was at the graduate level and 10 students took the course. The course was offered in an instructional technology department. There was another instructor for the course.

Instructor2 was a native speaker of English and she was a faculty in an Instructional Systems Technology (IST) department. She had already finished the first nine weeks of her web-based course when the interview was conducted. Instructor2 taught 2 courses. One of the courses aimed to provide an introduction to the field and profession of instructional technology. The other course provided information on the instructional design process. Both courses were at the graduate level and they were part of an online master's program. The courses were offered in an instructional technology department. There were 1 instructor and 10 students in the first course, 2 instructors and 18 students in the other course.

Data Collection and Data Analysis

Semi-structured interview questions were used to collect interview data. Interviews were conducted over a one month period. Each interview session was treated as an individually constructed discourse between the researchers and the participant. Both open ended and probing questions were used to get deep information.

The study called for an in-depth understanding of the experiences of participants involved in WBI. Instructors' data were analyzed separately from each other. All data were transcribed from audiotapes for analysis. Then, researchers struggled to understand the context, discourse, and meaning behind the participant responses to determine the main areas about which respondents have problems with support in WBI. To increase the credibility of the study, participants' responses were coded by both researchers separately. Later, common themes accepted as the emergent categories. In addition, the data obtained from the literature was used for detailed interpretation of the results.

Findings

1. Is There a Need for a Support Center for Web-Based Distance Courses?

After the interviews it was clear that without adequate instructor support, web-based courses would fail. The instructor of web-based course, one way or other, will either find the required support for his problem, or there will be problems in the web-based course. This result is also aligned with Lever-Duffy's (1992) findings in that support for web-based course instructors is a vital element for the success of the online courses. Both of the instructors indicated that they did not have a support center for the instructors of web-based courses. They both agreed that the lack of instructor support created major problems for their courses:

> *Instructor1: The biggest problem was the support problem. Since I was alone as the instructor, I had to arrange everything.*
>
> *Instructor2: Every week there is a new problem, which really points to the fact that there is a lack of support for faculty for teaching online. ... Lack of support for faculty teaching in online environments is a huge problem.*

Also, the instructors dwelled upon the importance of a support center for web-based courses:

> *Instructor1: Dealing with both the technical aspects of the course and content aspects of the course is an exhausting process. Personally, I prefer to teach in an environment where there is a support for non-teaching tasks. Because, giving feedback to students, getting together online, and grading the assignments are already very time consuming. If you add technical things on top of these, you are pretty swamped.*
>
> *Instructor2: We need training and support for faculty teaching in an online environment. The combination of 3 issues, lack of faculty training, lack of faculty support, and a design process that lacks faculty buy-in, are the reasons for a lot of problems that are beginning to emerge [in our distance master's program].*

2. What Kind of Support Do Web-Based Course Instructors Need?

The support needs of web-based course instructors will be summarized in the following categories: where to get support from, support for hardware, support for software, support for design of the course, and support for handling student requests.

2.1. Where to Get Support From

When the instructors got into problems and needed support to solve them, they tried several mechanisms. For example, instructor2 mentioned 11 instances where somebody came and supported her with different aspects of the course. These aspects included design support, and technical support. Below are 2 excerpts from the instructor2 on this issue, one for the design support and one for the technical support:

> *Instructor2: Even though the documentation was written, Dreamweaver was a brand new program for me. Thankfully, [the person who produced the course with dreamweaver] came in, spent about 15 minutes with me showing the basics to me. And that helped tremendously. And she was available during that period for a while. If I run into problems, she would allow me to call and [ask for support]. That whole process went fairly smoothly thanks to [this person]. That could have been worse.*

> *Instructor2: The audio problem in PowerPoint was a problem that I don't even think design team could have perceived. It has taken all these weeks, just for [Person1] and [Person2] working together to figure out how to fix it.*

Instructor1 had advanced technical skills. For that reason, he did not need much external support. However, he stated that the situation would be different for people with low technical background.

> *Instructor1: I didn't have many technical problems, but the reason for that is I have a good technical background. However, for somebody who has not as many technical skills as mine will suffer a lot from the lack of technical support.*

2.2. Support for Hardware

Instructor2 indicated that she was not able to have a Macintosh computer (which she was used to using) at the beginning. Because of the lack of this, she had a lot of communication problems with the students. She had to provide feedback much later than her planned time frame.

> *Instructor2: I supposed to have a Macintosh computer [when I started teaching]. And there was a PC here, so I didn't have the right computer. Later I got a Macintosh computer but it was also having all sorts of problems.*

2.3. Support for Software

One of the biggest time consuming tasks for the web-based course instructors is making the software feasibility analysis:

> *Researcher: Did you have any problems with software?*
>
> *Instructor1: I didn't have a problem with using the software. I had to look for software functionally appropriate for the course. For example, the kind of chat software, and the kind of whiteboard software to be used during the course. There were several freeware software available, but I had to evaluate them to see their powerful and weak sides. I could test the software one-on-one with someone, but I had no idea what would happen when 10 student will be using the software.*
>
> *Instructor2: Software was available only if I took the time to track it down. It would be nice to look beyond the tools that have been already used in the courses. I know there are better tools out there. But the time is limited to find them.*

Learning new software also creates problems for instructors if they learn them while teaching web-based courses. They need support from the people who know these software:

> *Researcher: How about learning new software?*
>
> *Instructor2: Yes, because I had to learn Dreamweaver and I did not have the application, so I needed to track down getting the application from one of my friends. Even though the documentation was written, it was brand new program for me.*

2.4. Support for the Design of the Course

Instructor2 had to deal with the re-design of the course during the course delivery. This increased her task load for the course incredibly. To overcome the instructor related issues, she had to hire someone. Otherwise, she would not be able to keep up with the instructor tasks. She explained the design problems as the following:

> *Instructor2: ... The other big and huge problem was [eliminating the design problems]. ...So, you can go through the whole week then look how to fix it. That has been very time consuming for me. Probably more time consuming than any other thing that I have done for the course. I have been doing the redesign of the web pages and then going through and editing the lessons, [and] the visual parts of the lessons.*
>
> *Instructor2: [The time spent for the preparation for the course is] absolutely unreasonable. I spent 30 hours every weekend just doing the revisions, so that lesson could be ready before Monday 8:00am. That even doesn't count the other times during the week that I spent on [the design]. It is taking an unbelievable amount of time.*

2.5. Support for Handling Student Requests

Both instructors utilized support personnel hired for handling student requests:

Instructor1: On-site technical support for students was an important issue. Therefore, someone was arranged to support the students in the computer lab. For example, he showed people how to use the Paint Shop Pro software, and how to use the scanner. After the course was over, we concluded that such a support for handling student requests was important. Lack of such a support would increase the load of the instructor.

Instructor2: There are 2 distance master graduate assistants who handle all the administrative type of things. The instructor should only receive issues related to the content and the class. Graduate assistants handle any administrative tasks like books, registration, technical issues, all that are not supposed to be instructor's problem.

2.6. Support in Other Areas

In addition to the five areas described above, it was also found that web-based course instructors either received support or would like to receive support in the area of knowledge management, peer cooperation, cooperation with school technology services, and web-based related research. Limited space prevents giving more information on these issues.

3. What Are the Functions of a Support Center Built for Web-Based Course Instructors?

A Support Center Model

Finding support when they are in need is the biggest problem for the instructors teaching web-based courses. Since they do not know what kind of problems they will have during the course, it is difficult for them to be prepared against these problems in advance. After analyzing the interview data, we came up with a support center model for web-based course instructors. This model is shown in (Fig. 1).

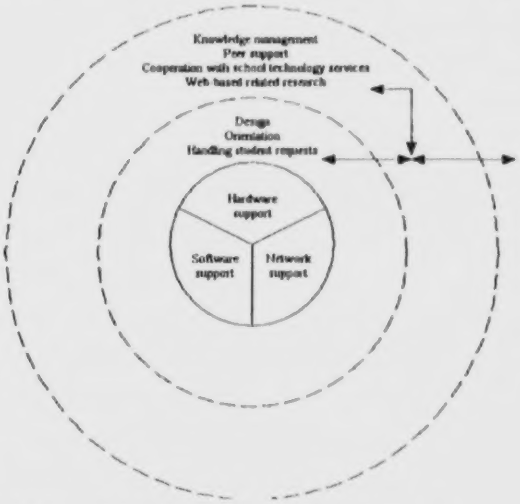

Figure 1: Support center model for web-based course instructors

In this model, we divided the support for the instructors into two categories: support for hard technologies and support for soft technologies. Support for hard technologies make up the nucleus of the model, because hard technologies are the essential elements of web-based courses. Hard technologies include the area of hardware, software, and network. These three essential elements provide the backbone, on which the web-based course system resides. All of these three elements have equal importance since lack of any of them will result in failure on the backbone. In sum, providing support for all of these three elements is essential. Although the model is open to development, we expect no major modification to the nucleus of the model in the near future.

The two circles around the center constitute the support for soft technologies. We define soft technologies as a combination of all elements that go outside the nucleus. The inner circle contains essential soft technology elements to be supported. These elements are support for design, support for orientation, and

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support for handling student requests. When support for any of them is missing, there is a high possibility that the web-based course will fail. The dashed nature of the inner circle represents the fact that the model is open to development, and items might move away from the inner circle, or new items might be added to the inner circle. The outer circle contains non-essential soft technology elements to be supported. These elements are support for knowledge management, peer support, support for cooperation with school technology services, and support for web-based related research. It is useful to have support for these items. When support for any of them is missing, the web-based course will not fail. The dashed nature of the outer circle represents the fact that the model is open to development, and items might move away from the outer circle, or new items might be added to the outer circle. The two-way arrows also represent the openness of the model to further development. They show that soft technology support elements in the circles might become essential or non-essential or even obsolete in time. Or, new elements might be added as soft technology support elements. We think that the future modification and development of the model depends on the changing needs of instructors in parallel to the advancements and changes in Web-based course technologies, and also to the roles of instructors in web-based course environments.

Conclusions

For web-based course instructors, support should be provided on time and when it is needed. Hard technologies are the only way to communicate with students, which is essential for web-based instruction. If instructors have difficulty in obtaining the support on time, their communication with students can be disastrous. Students can easily drop the course just because of this. The designers of web-based courses, and especially the coordinators of web-based courses should understand that supporting the instructors is as important as supporting the students. The following phrase emphasizes the importance of this issue:

Instructor2: I probably had 100 times problems the students had.

The proposed support model for web-based course instructors provides a framework for supporting the instructors. It is up to the coordinators and designers of the web-based courses to implement the model formally. For example, the software support may be provided by a specialist or by an electronic performance support system (EPSS). Most probably, available resources will impact the form of the components of the model.

References

Bardner, J. 1997. The World Wide Web and higher education: The promise of virtual universities and online libraries. *Educational Technology, 37*(3), 30-35.

Duchastel, P. (1997) A web based model for university instruction. *Journal of Educational System Technology, 25*(3), 221-228.

Friedrich, K. R., & Armer, L. *The Instructional and Technological Challenges of a Web Based Course in Educational Statistics and Measurement* (ED432262).

Hudson, L. (1999). *Organization, Support and Interaction for Adult Students in Web Courses*. Florida.

Ingebritsen, T. S., Brown, G. G., & Pleasants, J. M. *Teaching Biology on the Internet* (ED429536).

Kearsley, G., Lynch, W., & Wizer, D. 1995. The effectiveness and impact of online learning in graduate education. *Educational Technology, 35*(6), 37-42.

Kuchinke, P.K., Aragon, S., Bartlett, K., (2001). Online Instructional Delivery: Lessons From the Instructor's Perspective. Performance Improvement. 40(1). 19-27.

Lever-Duffy, J. C. *Planning for Computer-Based Distance Education: A Review of Administrative Issues* (ED387169).

Lightfoot, J.M. 1999. A blue print for using the World Wide Web as an interactive tool. *Journal of Educational Technology Systems, 27*(4), 325-335.

Mioduser, D., Nachmias, R., Lahav, O., & Oren, A. 2000. Web-based learning environments: Current pedagogical and technological state. *Journal of Research on Computing in Education, 33*(1), 55-76.

Paneitz, B. (1997). *Community College Students' Perceptions of Student Services Provided When Enrolled in Telecourses*. Colorado.

Starr, R.M. 1997. Delivering instruction on the World Wide Web: Overview and basic design principles. *Educational Technology, 37*(3), 7-14.

Yellen, R.E. 1998. Distant learning students: A comparison with traditional studies. *Journal of Educational Technology Systems, 26*(3), 215-224.

Returning the power to the users:
The effect of computers that apologize

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Abstract: Believing that the essence of user-based design lies in the fundamental power structure between human and computer, this study examines the effect of computers that offer an apology to users whenever the users fail to accomplish what they intend to do. It is hypothesized that users will feel better about themselves and the program as well when the computers shift the responsibility of failure from users to computers. In this pilot study, a computer program was designed to play a revised "20 questions" game with four subjects, who were randomly assigned to 2 X 2 treatment groups (difficult question, easy questions, apologetic-feedback group, functional-feedback group). Users will receive either an ordinary functional feedback or an apologetic feedback whenever they fail to guess the answer. The tentative result supports the hypot hesis, and the users will feel better even if they are aware of the hypocrisy of the apology.

Introduction

Nowadays, as "user-centeredness" becomes the golden rule for design, it is time to re-examine the power structure between human and computers. Unless the imbalanced status of power between computers and human can be reversed, a computer program will never be truly "user-centered". The first and the most important step to change this imbalance is to have computers take the responsibility and apologize for its inability to accommodate users' needs. In other words, while computers intend to be, and should be, designed as error-proof for users, computers should apologize for their inability to deliver this or whatever promises that they make and take the blame for a failed transaction between them and the users. Not only because it is the courtesy that runs our human society, but also because any design should be aimed at making users feel better about the program and themselves. Currently in the human-computer interaction literature, many studies have shown that instead of designing complicated program to have a computer act like a human and express emotions (i.e., Anthromorphism), we often project our emotion onto computers as if they were the counterparts at the other end of the emotional interactions (i.e., Ethopoeia). That is, we have the tendency to treat computers as social actors, a phenomena called "CASA paradigm" (Nass & Steuer, 1993; Nass, Moon, Fogg, Reeves, & Dryer, 1995). Following the idea of ethopoeia, this study tries to investigate the effect of applying one of, if not the, most powerful impression management tactic-apology-to the human-computer interactions. In this study, although computer's apology is not due to violation of a serious felicity condition or a mere reflective locution for a perfunctory social interaction, it is about taking the blame of failure away from users' shoulders in the hope of creating a stress-free type of environment for the users. However, the question is, do users actually care about whether computers apologize or not? If they do, what are the effects that computers' apology will bring to the users? The following experiment was designed to answer these questions.

The Study

A computer game called "10 questions" was designed for this study. Similar to "20 questions" game, the computer had one noun (could be an object or an abstract concept) in "its mind" for subjects to guess. Instead of 20 opportunities, subjects had 7 chances to type a keyword to ask for feedback from the computer regarding whether or not the keyword is associated with the answer. Then they had 3 chances to guess the answer. To compensate for the lost of 10 questions, the computer will provide 3 hints at the very beginning of the game, after the 7th keyword guess, and before the last chance to guess respectively. For the first 7 keyword guesses, the keyword that subjects input would be matched with a pool of attributes that were related to the answer. Then the computer would provide a functional feedback like "Yes, ... can be associated with the answer", or "No, ... cannot be associated with the answer" to provide a direction for subjects to think. After the 7 keyword guesses, subjects would have three chances to guess the answer, and only the exact word as the answer would elicit positive feedback. At this point, if the guess was accurate, the computer would give a simple feedback such as "Great, ... is the correct answer", then asked whether the subjects wanted to play another game or not. However, if the subject input an incorrect guess, two types of feedback would be provided: (a) a functional feedback to inform whether or not the guess was accurate (e.g., "Incorrect, the answer is not..." or "Correct, the answer is..."); or (b) apologetic feedback that the computer volunteered to take the blame for users' failure (e.g., "Sorry, ... is not the right answer. I apologize for not able to provide more useful hints for you to guess... your answers will be incorporated to the database for future improvement"). This apology not only contains regrets, but it also promises improvement to make it sounds more sincere. It is hypothesized that people who receive apologetic feedback would feel better about the program, their performance, or themselves. For this pilot study, a convenient sample of three female and one male doctoral students were recruited. All subjects use computers frequently to do their class assignments. One subject is a consultant in Educational Technology Service, and thus was more advanced in computer skills.

Findings

The following seven findings were obtained from this study.

1. Apologetic feedbacks may or may not have significant impacts on subjects' performance.
2. Apologetic feedbacks may or may not exert positive impact on subjects' self-evaluation of their performance.
3. Apologetic feedbacks may help subjects enjoy the program.
4. Apologetic feedbacks help to ameliorate subjects' negative feelings from the program.
5. Apologetic feedbacks make subjects feel better about themselves.
6. Subjects in apologetic-feedback group rate the program more favorably than those in functional-feedback group.
7. Even if they believe the program was flawed, the subjects still tend to blame themselves for their performance.

Conclusions

What the computer's apologies indicate is a shift of power that defines the "appropriate behaviors in human-computer interactions" from computers to users. While users' having this power is supposed to be the bedrock of the concept of "user-centered design", what most designers do are to thoughtfully take users' needs into account but still retain this power in their hands. Believing that giving this power back to users will enhance their satisfaction level with the program, this study shows that when computers volunteer to take responsibility for the users' failure, users not only feel better about the program and themselves, they also show more interests in interacting with the program again, even though those apology did not generate any improvement of their performance.

In addition, the question of whether the users are ready to ask computers to take responsibility for users' failure receives a negative answer from this study. Even after subjects had clearly identified the flaws of the program, they were still reluctant to ask computers to take the blame. While this may has a lot to do with their personality, what this reveals is that users still feel helpless in the face of computers' failure, and they were overpowered by the computers because they felt they did not know computer enough to demand more user-centered treatment. When computers failed them, they even blame themselves for as a defense of the computers' failure, just as Postman (1992) predicted. Such a sense of helplessness in front of computer is the result of the reversed power structure that we are having with computer now. If users do not have the power to demand an action from the computer (as opposed to submit a request to computers), a design could never be truly user-centered.

Reference

Nass, C., Moon, Y., Fogg, B. J., Reeves, B., & Dryer, D. C. (1995). Can computer personalities be human personalities? *International Journal of Human-Computer Studies*, 43, 223-239.

Nass, C. I., & Steuer, J. (1993). Voices, boxes, and sources of messages: computers and social actors. *Human Communication Research*, 19, 504-527.

Postman, N. (1992). *Technopoly*. New York: Alfred A. Knopf.

Novice Designers of Online Learning: A Contribution to Principles for Instructionally Effective Online Learning Design.

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Abstract: This paper reports on a study conducted at the Rand Afrikaans University in Johannesburg, South Africa. The study aims to determine to what extent novice online instructors can advance contemporary knowledge of instructional design in an online environment. Participants in the study were generally uncertified in teaching practice, but were faculty members in various disciplines and considered themselves as experienced face-to-face instructors. In addition, none of the participants have taught online before. The study showed that the participants had varied design needs, many which have not been anticipated by the expert course designers. It therefore appears that course design needs to be contextualised, and that novices can indeed contribute to design principles for online learning.

Context

The importance of instructionally designing (or educationally designing) online learning is widely reported in the literature (compare Alessi & Trollip, 2001; Driscoll, 1998; Horton, 2000; Kruse & Keil, 2000; Piskurich, 2000; Ravet & Layte, 1997). Investigative visits to higher learning institutions in Australia (1999 & 2001) and the USA (1998 & 2000) have shown that the majority of higher learning institutions employ trained instructional or educational designers for the design of print-based materials as well as for instruction delivered online. Furthermore, a scrutiny of the conference programmes of a variety of conferences (Ed-Media 1998 - 2001, and CAL 99) has shown that instructional design (ID) is considered to be an important factor in online learning.

It appears that many higher learning institutions worldwide are using skilled and trained professionals to design their courses. The Rand Afrikaans University (RAU) in Johannesburg is a modern, medium-sized institution offering courses for residential students as well as for distance learning students. During the last four years, several courses have been facilitated online, in a range of modes. Some courses have a limited, administrative presence, while others are fully online and integrated. However, RAU have not employed a single instructional designer for online delivery of courses. Courses are generally designed and developed by the presenters themselves. Many of these lecturers do not have teaching qualifications, and hold no qualifications in online teaching practice either. However, most of the lecturers who participated in this study consider themselves to be effective as instructors in the face-to-face situation, and believe that they have the ability to design effective online learning. They would argue that they have "natural" expertise gained from experience, and that they did not necessarily need "learned" expertise. Currently, there is limited evidence on how effective current online courses are. Van der Westhuizen (1999), Lautenbach (2000) and Cronje & Murdoch (2001) have reported on the experiences of lectures and students at RAU. None of these studies however have attempted to measure the effectiveness of the design of the particular courses.

The expectation is that the expert design of online courses will realise effective courses. However, Dimitrova, Sharp and Wilson (2001) postulate that the evaluation of expert-based approaches are often unreliable as evaluators make subjective choices, and that the discrepancies between teacher ratings and learner ratings are not explained sufficiently. Furthermore, Tergan (1998) points out that checklist-based assessments of online courses do not adequately assess the efficacy of courses. It therefore appears that expert design of online courses may not necessarily imply instructionally effective online courses. The question is therefore whether it is possible for non-designers and novice online practitioners to meaningfully contribute to the expert design of online learning.

The Participants

Six novice online learning instructors were chosen to participate. Four of these practitioners had no formal qualifications in any form of educational science, and had little or no knowledge of pedagogy as a science. These practitioners taught Mathematics, Zoology (2) and Human Movement Studies. The other two participants had qualifications in education, and taught in the Faculty of Education. None of the participants had any training in instructional design.

Methodology

Participants were asked to explain how they envisaged an online environment that could facilitate the presentation of their subject field. The purpose here was to determine to what extent the participants could match their instructional needs with a) what they knew of the web environment and b) their expectations of what the online environment could offer. This initial "design" was referred to as the 'coarse design'.

Participants were then briefly introduced to online learning, and specifically to the WebCT environment (WebCT was used as the delivery platform). The learning resources that are facilitated by WebCT were explained and the application of the tool in an online teaching environment was demonstrated. Participants, now having seen applications of the WebCT tools, were asked to amend and refine their original coarse designs. Specifically, they had to re-design the course considering different methods of content presentation and facilitation, tool application, learner activities, and also consider typography, the use of graphics and colour. The aim of this segment of the research was firstly to determine whether there were significant differences between the designs of those participants with educational training and those without. Secondly, an attempt was made to derive "novice design principles", and to find areas of commonality with design principles derived from literature and instruments for good online learning design (expert principles).

Findings

The study is a work in progress. The intercrossing of the "novice principles" and the "expert principles" showed some consistencies, although it was clear that the novices could benefit by exposure to principles of online learning design. Conversely, the novices contributed principles that were not encompassed by expert principles, although many of these proved to be contextualised. In the main, all participants required high levels of interactivity, visual representation of content and a sense of control over student activity. Some of the needs of the novice practitioners that were not anticipated by the expert designers, and that were not consistent with general principles are:

- A need to duplicate paper-based materials online so that students could manipulate text. Some practitioners required detailed content online.
- The use of metaphors was not required.
- The inclusion of visual "bridges" between objectives and the nature of the subject field.
- Most participants required a linear design.

Participants who had educational qualifications were more concerned with aspects of learner activity, visual design and assessment practices than those who were not educationally qualified. Their design of the learning experience appeared to be more structured. Clearer threads between course objectives, teaching method and assessment practices existed in their approach to the design of the course.

Conclusion

Generally, it was found that all participants had some "sense" for design principles, but participants with formal educational qualifications had approaches supported by pedagogical principles. All participants could apply the WebCT tools once they were made aware of the capabilities of the software. However, participants reported that they greatly benefited from exposure to principles for the design of online learning. The participants believed that the online modules were instructionally effective, but made suggestions for improvement. The intercrossing of the novice principles, the expert principles and the improvements suggested by the participant experience may therefore generate context-specific instructionally effective design principles.

List of sources

Alessi, S.M. & Trollip, S.R. (2001). *Multimedia for learning*. Boston: Allyn & Bacon.

Cronje, M. & Murdoch, N. (2001). *Experiences of lecturers using WebCT, from a technology adoption perspective*. Paper delivered at the 3rd Annual Conference on World Wide Web Applications 5 - 7 September 2001. Available: http://general.rau.ac.za/infosci/www2001/default.htm. 12 December 2001.

Dimitrova, M., Sharp, H. & Wilson, S. (2001). *Are experts able to predict learner problems during usability evaluations?* Proceedings of ED-MEDIA 2001. Seattle, WA: AACE Publications.

Driscoll, M. (1998). *Web-based Training*. San Francisco: Jossey-Bass.

Horton, W. (1999). *Designing Web-based Training*. New York: Wiley.

Kruse, K. & Keil, J. (2000). T*echnology-based Training*. San Francisco: Wiley.

Lautenbach, G. (2000) *Learner experience of web-based learning: A university case study*. (Unpublished M.Ed dissertation, Rand Afrikaans University, Johannesburg).

Ravet, S. & Layte, M. (1997). Technology -based Training. London: Kogan Page.

Tergan, S. (1998). Checklists for the evaluation of educational software: critical review and prospects. *Innovations in Education and Training International*, 35(1), February 1998, 9-20.

Van der Westhuizen, D. (1999). *Teaching Information Technology in Education using online education*. (Unpublished D.Ed thesis, Rand Afrikaans University, Johannesburg).

Using Computer-Assisted Case-Based Instruction in Corporate Training

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Abstract: This paper discusses a computer-based, corporate training program that was developed through a private enterprise/university partnership. The program was designed using a case-based instructional approach. At the core of the program is a set of multi-media cases depicting realistic situations and problems that trainees are likely to face in the workplace. A major goal of case-based instruction is to prevent "inert knowledge" by integrating content learning with problem solving. Case-based instruction provides learners with the chance to become familiar with the types of situations and problems that they are likely to encounter in the workplace, and to learn important content as necessary to help solve these problems. An overview of the theory of case-based instruction and the learning issues that it is designed to address, a demonstration of the computer program, and a discussion of the advantages of case-based instruction in corporate training settings is provided.

A recalcitrant problem in corporate, post secondary and K-12 education is the problem of transfer of learning. Educators have long lamented that learners often do not use what they "learn" in the classroom to help them solve problems outside of the classroom or in the workplace. Whitehead (1929) referred to this as the "inert knowledge" problem. Current research suggests that knowledge becomes inert when information is presented to learners as a set of discrete facts or procedures to-be-remembered (NRC, 2000). Under these conditions, learners do not understand when it is appropriate to apply what they have learned, and consequently, knowledge is not organized in memory in ways that will enable learners to later retrieve it to solve new problems. Furthermore, formal educational settings typically provide few opportunities for learners to practice applying new knowledge and skills. Without these opportunities, knowledge tends to be rigidly bound to the context in which it was learned.

A partnership of learning scientists from Vanderbilt University, disease management specialists from American Healthways Inc, and multimedia designers from Little Planet Learning, Inc have developed a case-based corporate training program, at the core of which is a set of cases depicting realistic situations and problems that trainees are likely to face in the workplace. A major goal of case-based instruction is to prevent inert knowledge by integrating content learning with problem solving (CTGV, 1997; Williams, 1992). Case-based instruction provides learners with the chance to become familiar with the types of situations and problems that they are likely to encounter outside of the classroom (in this case the workplace), and to learn important content as necessary to help solve these problems. When knowledge is used to solve related but non-identical problems, it becomes better differentiated. Consequently, learners acquire knowledge that is more flexible and adaptive for use in a variety of contexts. Learners are also generally motivated by case-based instruction presumably because they are more actively engaged in the learning process than in lecture-based classrooms. Case-based instruction has been used successfully—albeit on a limited basis--in K-12 and post-secondary education (Williams, 1992 for a discussion of use in legal, business and medical education). However, the use of case instruction in corporate training settings is undocumented and the use of a computer-based delivery system for case instruction is rare. Some exceptions to this are Vanderbilt University's AMIGO project that is redesigning undergraduate instruction in bioengineering and the Cognition and Technology Group at Vanderbilt's anchored instruction projects in middle school mathematics and early literacy (CTGV, 1997)

The training program to-be-discussed was developed for American Healthways, Inc (hereafter AmHealth). AmHealth is a leader in the field of chronic disease management, providing telephonic interventions to patients with diabetes, coronary heart disease and other chronic illnesses. The company employs registered nurses and dieticians to provide regular interactions with patients; clinicians educate patients about health issues, remind them about upcoming physician and lab appointments, and support them in making behavioral lifestyle changes that can improve their health status. Patients also can "call in" with questions and concerns. The new training program was developed in AuthorWare and is on CD-ROM. The cases consist of simulated phone conversations between clinicians and patients that provide new clinicians with integrated practice on computer and clinical skills. The program consists of 26 multimedia cases that the trainee uses over 15-days of training. The software also has content resources—in audio, video and graphic format--which are helpful in solving the cases. Additional resources are provided in print form.

Using cases for instruction requires a systematic approach to helping learners explore potential solutions. The software is designed to support a specific sequence of learning activities (see Schwartz, Lin, Brophy & Bransford, 2000 for more a detailed rationale of the learning cycle). Each case consists of: 1. A Multi-media Scenario involving a clinician. In many of the cases, the clinician is conducting a call with a patient. 2. A Challenge which is a problem(s) related to events depicted in the scenario. Sample challenge questions are "What might be your next steps in working with this patient?", "What issues with medications might be discussed with the patient? Why?" and "What are the patient's symptoms likely to be?"

Cases depict patients with acute and potentially critical health conditions and patients with more typical problems related to disease management and behavior change. After viewing each case, trainees: 1. Record their initial thoughts in a notebook, and 2. Examine resources related to the case. Recording their initial thoughts gives trainees the opportunity to articulate what they currently know about the challenge. Having people record their initial thoughts is extremely important. First, it is a "generative" (i.e., thoughtful) act. Learners are articulating and evaluating what they know in relation to the case at hand (and in the process may make knowledge gaps apparent, creating a "need to know" in the learner). The notebook entries also serve as a baseline or pre-assessment of what learners know about a case and how they approach it. The trainer and learners can use these entries to illustrate the growth in learners' thinking.

After recording their initial thoughts, learners are given the chance to examine the resources related to the case. Resources consist of expert commentaries on the case, expository materials, and computer simulations. Trainees access resources as needed as they work through each case. Depending on their skill level learners may need to access only a portion of those available. In this way, case-based instruction can easily adapt to pre-existing knowledge differences among trainees—an outcome that is difficult to achieve in lecture-based training programs.

Case-based computer-assisted instruction in corporate training has several important advantages. As designed in the present context, the system is easily updated. Resources for training can be deleted and others added as medical information changes or is revised. In addition, it provides consistency in training that is often difficult to achieve when large numbers of individuals need to be trained. From a learning and motivation standpoint, the approach is engaging for trainees and provides opportunities for them to become familiar with the types of situations and problems that they are likely to encounter in the workplace, and to learn important content as necessary to help solve these problems

References

Cognition and Technology Group at Vanderbilt. 1997. *The Jasper Project: Lessons in Curriculum, Instruction, Assessment, and Professional Development.* Mahwah, New Jersey: Lawrence Erlbaum Associates.

National Research Council (2000). *How People Learn: Brain, Mind, Experience, and School.* Washington, DC: National Academy Press. http://www.nap.edu/html/howpeople1/.

Schwartz, D. L., Lin, S. D., Brophy, S. P., & Bransford, J. D. (2000). Toward the Development of Flexibly Adaptive Instruction Design. In C. Reigeluth (Ed.), *Instructional Design Theories and Models: New Paradigms of Instructional Theory.* Mahwah, New Jersey: Lawrence Erlbaum Associates.

Whitehead, Alfred N. 1929. *The Aims of Education.* New York, NY: MacMillan.

Williams, Susan M. 1992. Putting Case-Based Instruction into Context: Examples from Legal and Medical Education. *The Journal of the Learning Sciences 2*: 367-427.

Patterning Evaluation Models: Assessment in Support of Institutional Goals for Learning

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Abstract: The aim of this paper is to demonstrate how evaluation models were developed and implemented in order to support institutional goals of an e-learning university. The paper will discuss the aim of assessment to support institutional learning goals, the benefits and challenges of this approach to assessment in e-learning, the use of pattern language to develop evaluation models, and the results based on implementation at the graduate and undergraduate levels of the TechBC.

1.0 Introduction

Quality assurance in learning at an e-learning university like the Technical University of British Columbia (TechBC) is critical due to the goals of innovation, the investment costs in an online curriculum, and the investment in organizational structures. In order to meet the goals and create the return on investment, the application of e-learning must be learning effective, cost effective, and scalable.

The role of assessment in this context is to validate (or invalidate) policies, methods, and ultimately, the outcomes. If assessment is in support of institutional goals, it is even more valuable toolset. As such it must be linked to the strategic goals of the learning institution in order to successfully implement e-learning.

Managerially, it is a toolset to ensure a cost and learning effective implementation of scalable e-learning. A key tool of assessment in addressing these issues is the use of evaluation models.

2.0 Supporting Institutional Goals

In the case of TechBC, the use of evaluation models is strategically shaped by the need to support institutional goals of effective learning, learner-centered learning, and the effective use of technology.

The mission of the academic program can best be described as creating an accessible and effective learning environment. The use of evaluation models strives to achieve and support the mission and goals.

3.0 Evaluation Models

3.1 Pattern Language

Christopher Alexander developed a powerful design tool and process known as "pattern language", to help define environmental planning and architecture. It has evolved and has been applied to computer programming, human interaction, and organizational design (Coplien, 1995), as well.

We developed evaluation models within a pattern language design framework. Each model was described as a pattern, including elements of each pattern – such as name, description, application, how it works, example, and scenarios. We also provided the larger framework for the relation of patterns as "parent" and "child".

In order to meet the goals of developing cross-disciplinary implementation of evaluation models, and certainly implementing their uses successfully creates a considerable challenge for "buy-in" and the required collaboration. Any development process, iteration and ongoing implementation required significant authorship roles by the learning staff at each stage. At TechBC, we modeled our approach to development and structuring of the evaluation models after Christopher Alexander's "pattern language". In addition, we benefited from the highly collaborative and inter-disciplinary culture of TechBC.

3.2 The Models

Evaluation models were created to address the need for a comprehensive document capable of supporting intended assessment practices. We identified pattern language as the design framework for the evaluation models applicable to TechBC's modular learning structures and delivery models.

In addition to the components of a pattern, the evaluation models are accompanied by a "success criteria", is drawn from past experiences. The goal is to adapt assessment a learning environment that benefits from effective curriculum implementation, effective management, cost-effectiveness.

Good instructional design is a significant enabler of effective learning (Belfer and Nesbit, 2001). Following a systemic approach to instructional design good pedagogical practices are embedded in assessment that is integral to learning and adhere to basic learning principles.

The evaluation models have these principles embedded, and therefore greatly support curriculum development, and ultimately move toward ensuring quality in the use of educational technology in learning

4.0 Results

We have measured the success of the evaluation models by the degree to which assessment has supported institutional goals for learning, and derived the benefits of doing so.

4.1 Effective curriculum implementation

Key results for curriculum implementation is the achieving of coherency for the learner and exchange of best practices. Inter-disciplinary practice and collaboration were seen to be critical requirements. Similar to other implementations of pattern language, authorship by learning staff is critical. Faculty and learning staff were invited to re-define past practices as a pattern, or generate new ones. The results clearly support a goal of coherency for learners of assessment methods and the collaborative exchange of assessment knowledge and practice.

4.2 Effective Management

Key results for management are the scalability and portability of the programs. The name and description of each evaluation model tell a story and the means of assessment. Together with the details of each pattern, it is easier for learning staff other than developers to effectively deliver a course, even for the first time. The pattern language approach equally ensures the purpose each assessment activity and the goal in the overall scheme of learning activities is as evident as the evaluation method. In addition, evaluation models are linked to one or more delivery models, allowing for scalability to be a factor of learning activities and goals and not disciplinary content, i.e. the delivery and evaluation methods do not need to be re-written for new content.

4.3 Cost-effectiveness

A key result for cost effectiveness is the ability to effectively manage resources. Evaluation models have been developed to support a learning practice that is understood in discrete elements and as a team effort Therefore, modules identified for revisions, can be analyzed component by component. If the main concern of both learners and instructors in the assessment structure, the evaluation models provide an easy procedure to re-evaluate the assessment structure by choosing a new evaluation model, an not revisiting the module in its entirety.

5.0 Conclusions

We've argued and hopefully demonstrated that assessment must be linked as a management toolset to the strategic goals of the learning institution. This need is particularly critical to derive the benefits of an e-learning. For administrators and learning staff, it is a toolset to ensure a cost and learning effective implementation of e-learning that ultimately supports scalability. We have focused on how a key tool of assessment in addressing these issues is the use of evaluation models.

A critical conclusion is the bridging of practice to goals requires buy-in, collaboration and participation in the design, selection, modification and adaptation of the evaluation models. A specific goal is that each module has a particular evaluation model that successfully prescribes assessment methods while establishing an organizational structure towards the process, making the process of assessment transparent and creating a common language for assessment as part of the learning culture.

References

Belfer, K. & Nesbit J *(2001).* GUIDE: An instrument for evaluating quality of instructional design in mixed-mode university courses. *World Conference in Multimedia Hypermedia and Telecommunications (Ed-Media)* Tampere, Findland, June 25- 31.

Coplien, J. O. (1995). *A Development Process Generative Pattern Language.*
Retrieved, March, 2002 from http://www.bell-labs.com/user/cope/Patterns/Process/

Role with IT… the Evolution of Faculty and Faculty Support Roles and Responsibilities in the Rapidly Changing Climate of Educational Technology

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Abstract: As digital technology becomes more widely integrated into the teaching and learning environment, particularly in distance learning, faculty members face new challenges. To thrive in this new teaching environment, faculty must simultaneously develop their pedagogical and technological skills. The process of technologically-based faculty development is often time consuming and difficult, especially for faculty who have less experience working with the nuances of instructional technology. To alleviate this problem at WPI, the Educational Technology Services team (ETS) was created as a functional workgroup under the Instructional Media Center. The mission of this group is to support and empower WPI faculty in the effective use of technology to enhance their teaching

Introduction

Through the advancement of educational technology, an ever-widening variety of course material delivery and presentation options are available to faculty members. While this myriad of options can be exciting, it can also be frustrating and overwhelming. To alleviate this, and to create a knowledge base of standards and pedagogically sound best practices, we have expanded the services of our Instructional Media Center to include extended instructional support and design assistance. These services are provided by the Educational Technology Services (ETS) team, consisting of an instructional designer and director, a content coordinator, a graphics production coordinator, an online delivery coordinator and two technicians, one for video support and one for courseware support. The formation of this group and associated services provided, fueled an evolution in roles and responsibilities for faculty, staff and students at WPI in relation to teaching and technology.

Where We Have Been

As on most university campuses, there have been three consistent adoption levels for teaching with technology at WPI. These levels consist of a few early adopters, eager to try out new technology in their courses, intermediate adopters, using tried and true practices and basic adopters who prefer more familiar forms of technology or avoid it altogether. The early adopter role is often referred to as the "Lone Ranger and Tonto" approach to teaching with technology, offering grants to faculty members to fund software, equipment and a part-time graduate student. (Bates, 2001) For all levels of technological expertise, most faculty have received adequate hardware support but have received mixed levels of support in regards to incorporating the technology into their teaching. Faculty at basic and intermediate levels tend to become frustrated when something does not work, even with available support, so they tend to take fewer instructional risks in favor of a more stable teaching product. Most of our training in the past has focused on the technical side of teaching with technology, with instructional design issues handled separately or as a special interest of lone rangers. The need for more integration between instructional design and the use of technology is now understood by a greater proportion of the university at large, thus providing a foundation in the campus culture for emerging roles.

Evolution of Faculty and Staff Roles and Responsibilities

Through the process of providing extended instructional support, these roles have begun to shift at WPI along with the development of new responsibilities for each role. The "Lone Rangers" remain interested in new technology, but are freed from many of the technical burdens that can arise when exploring new technology alone. With this knowledge and research, we are able work together to implement best practices (instead of creating a project from scratch) while working within the context of supported university computing systems and resources. Thus keeping compatibility and scalability in mind and encouraging faculty collaboration on similar projects or combining efforts to expand on existing work. Our mission to technologically empower faculty has materialized through the execution of our instructional services and implementation of new training materials, workshops and programs. We have created a supportive atmosphere to foster intrinsic faculty motivation at all levels of technological expertise by providing support staff, access to technology, faculty encouragement and incentives for implementing the technology. Extrinsic factors are supported by the assistance of our staff with technological projects and providing a channel for delegation of student technical support requests to the appropriate group on campus. (Irani, 2001)

Example: A Distance Learning Course

We have particularly noticed the emergence of new roles and responsibilities for faculty, staff and students in our distance learning courses which rely on technology for communication and course delivery. Each of our distance faculty members is partnered with an ETS course coordinator who manages the technical aspects of the course and assists with the development and assessment of course-specific materials. With this new partner, faculty are supported while re-tooling their teaching model as they learn to use technology more effectively. Throughout this partnership, the coordinator provides technical, pedagogical and moral support in weekly meetings and other communications. Several of our distance learning faculty are new to distance learning and the extra support helps to minimize the transition to a new teaching medium. This partnership creates an opportunity to build strong working relationships with the faculty and to fully understand how the media and technology are being applied in live courses. This added knowledge makes for a more efficient workflow, as each faculty member has one main contact and the coordinator becomes aware of each faculty members' individual style. Assessments become integrated into the curriculum as the coordinators work to improve student learning through course materials that are created. The students on the receiving end of our collective work find that with additional expertise behind a course, fewer technical glitches occur, and when they do, response time decreases as support requests are quickly routed to the appropriate place by the coordinator. Time and project management also play a key role in getting course materials delivered on time and without technical glitches.

Learning, Growth and Change

With new responsibilities for faculty, staff and students come growing pains – some faculty experience a more difficult adjustment to distance learning and new technology. A sense of loss of autonomy may be felt as the faculty move towards a learner-centric teaching model and as more people have a hand in course development. The process of working with a coordinator provides a forum for discussion of these issues and helps to alleviate any fears a faculty member might have. The experience of collaboration between the Educational Technology Services team and our faculty provides many opportunities for learning and growth for everyone involved. Our focus is on applying instructional design theory to these courses and learning along with the faculty. The faculty gain valuable technical skills and understanding while providing more effective learning tools and environments to their students. Faculty shifts from teaching in a lecture based mode to a more interactive mode provide a richer experience to the students, but also require students to take more responsibility for their learning.

Conclusions

As our group continues to evolve, we will pursue our mission of empowering faculty by encouraging our more experienced faculty to expand their technological skills and to share these skills and learning experiences not only with us, but with their colleagues. We have implemented multiple campus-wide workshops along with a Teaching Technology Fellowship program and are in the final development stages of an Instructor Certification in Academic Technology program that will serve this purpose well. Marketing materials and sessions to inform more faculty members and departments of our services are also planned, along with a collection of best practices that we have compiled in our first year as an online reference to help faculty get started with different media and technology types. The ETS group is beginning to see an actualization of technical change now happening at many institutions and looks forward to providing improved services and sharing our experiences.

References

Bates, Tony. (2000). *Managing Technological Change: Strategies for College and University Leaders* [e-book]. San Francisco: Josey-Bass Publishers

Irani, Tracy. (2001). Going the Distance: Developing a Model Distance Education Faculty Training Program. *Syllabus Magazine*. http://www.syllabus.com/syllabusmagazine/article.asp?id=4575

Back to Basics:
Non-Technical Tips for Improving Technology-Based Presentation Skills

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From a simple PowerPoint™ presentation to a complete online course, technology now allows educators unprecedented freedom to create, modify, and disseminate their own instruction; however, this same freedom also offers unprecedented opportunities to create and disseminate ineffective or poorly designed instruction. Ineffective technology-based instruction often stems from neglect of the basic principles of effective instruction. This paper describes four non-technical tips educators can use to enhance the quality and effectiveness of technology-enriched instruction. They include (a) identifying instructional objectives, (b) understanding the target audience, (c) organizing the content, and (d) preparing for instructional delivery.

Introduction

It is no longer surprising to see P-12 teachers and college or university faculty with the technical ability to create multimedia-rich PowerPoint presentations, develop and maintain their own course Web sites, or, with no technical assistance, setup and operate a wide variety of computer-based equipment. As educators, we are rapidly becoming more technologically savvy. Fortunately, many of us are learning to embrace this change and are enjoying the unprecedented freedom technology offers us in our ability to create, modify, and disseminate instruction, however, this same freedom also offers us ample opportunity to produce ineffective or poorly designed instruction. In allowing us to personalize and package the instructional messages we convey to our students, technology also gives us much latitude to miss the mark, and that is precisely the issue raised in this paper. Perhaps we need to be reminded that, as we run to jump on the technology bandwagon, we must not forget to bring the basics of good instruction along with us.

Most of us have endured PowerPoint presentations with font sizes so small that we could not possibly read the information being presented or lectures by professional educators who stood with their backs to the audience as they read paragraph after paragraph from the information projected on the screen. In these and many other situations, technology, in all its capacity to enhance instruction, only served to impede the dissemination and reception of the intended message. It is with this in mind that we offer a few reminders on how, as professional educators, we can reduce the chances of getting blindly caught up in technology's enticement and instead, capitalize on its potential to support effective teaching.

Identifying Instructional Objectives

In simple terms, objectives are specific descriptions of what we want the learner to know or be able to do as a result of instruction. Whether we are using PowerPoint in the classroom or delivering our instruction online, it is critical that we make the effort to identify specific instructional objectives, even if it requires a considerable amount of time. Surprisingly, many of us spend more time selecting background colors and clip art, digitizing video clips, creating endless lists of hyperlinks to online resources, or toying with any number of technology's fun and often frivolous features than we do identifying and incorporating objectives into our technology-based instruction. While technology's bells and whistles or its ability to expedite our productivity should not be neglected, our first priority should be to identify and incorporate instructional objectives in the design and development of our instruction.

Determining and writing good objectives is not always, if ever, a quick and easy process. Taking the time to determine instructional objectives, refining them, and then developing content and evaluation methods around them can be a very detailed and time-consuming process. This stands in direct contrast to the expectations we may have of technology and its ability to assist us in rapidly creating a finished product. While convenience and expediency are enticing attributes, as educators, surely we are not willing to trade them for quality and effectiveness.

Understanding the Target Audience

In a traditional setting, when teachers walk into a classroom to teach a lesson or deliver a lecture, they are in direct, face-to-face contact with their audience and can react, make accommodations, and modify the information they are presenting and the way in which they present it based on audience reaction and response. Trained educators know this ability can greatly improve the effectiveness of instruction. Unfortunately, technology, if we allow it to, can easily separate us from the learner.

As many of us have already discovered, our efforts to understand and accommodate our audience often tend to lead us away from the rigid and inflexible presentations that can be so instructionally ineffective and instead, toward the development of presentations that simply support the information we wish to convey. For example, rather than creating a presentation that contains slide after slide of the exact content being presented, forcing the instructor to follow the pre-developed content precisely, we instead find ourselves more often creating presentations that merely contain supporting electronic artifacts such as charts, graphs, maps, photographs, video clips, or a few talking points. By simply augmenting a lecture or presentation with technology instead of letting technology dominate it, we help create an instructional environment that is much more responsive to our audience.

Organizing the Content

The appropriate organization of content is crucial when conveying information or providing instruction. The clear articulation of the content order reduces the chance of misinterpretation or confusion by the learner while assisting him or her in establishing important and necessary associations between the elements that make up the content and between prior knowledge and current information. Fortunately, content organization is often made simple by the content itself. For example, the order in which a step-by-step task such as creating a new slide in PowerPoint is presented is very sequential and straightforward. On the other hand, some content is more open ended and much more complicated to organize. Imagine having to organize the content for a presentation on how to deliver a persuasive oral speech. This type of content could be effectively organized in a wide variety of ways.

It is in the delivery of this open-ended type of material that it becomes crucial for educators to give careful attention to the appropriate organization of content. Unfortunately, as we now find ourselves with the technology-enhanced ability to create our own instruction, we must often assume the responsibility of organizing our instruction ourselves. To do so effectively, we must have a strong understanding of the content itself, of our target audience's existing skills and knowledge, and of the desired learning outcome we wish to achieve. Based on these, we can begin to organize our instruction or information in clear and appropriate ways.

Preparing for Instructional Delivery

This is perhaps the simplest but most overlooked aspect of delivering effective technology-based instruction. Simply put, make sure everything works before getting up in front of your audience. Audiences or students are no longer tolerant of our lack of preparation and consideration when we don't know how to operate equipment. In addition to being familiar with the operation of the equipment, we must also be familiar with our presentation and its content. Were not suggesting that hours of rehearsal and practice are required in order to deliver a polished and professional presentation, however, adequate steps must be taken to ensure that, as the presenter or teacher, we are familiar with what we are presenting and with the equipment used to present it. Anything less runs the risk of seriously jeopardizing the instructional effectiveness of our presentation. This is a big price to pay for failing to take a few extra minutes to make certain we are prepared.

On Using Data-Mining Technology for Browsing Log file Analysis in Asynchronous Learning Environment

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Abstract: In this paper, we develop a tool for analyzing browsing log file based on data mining technology. The extracted knowledge includes the associative material clusters and the sequences among the material clusters. These findings enable teachers to study the dynamic browsing structure and identify some interesting or unexpected learning patterns, which in turn may provide decision lines for teachers to organize their teaching structure for better efficiency. Finally, application of the tool is conducted on a database collected from a web-based course in Ming Chuan University, Taiwan, to investigate its effectiveness, and some revelations are presented and discussed.

Introduction

In asynchronous web-based learning environments, teachers could conduct many kinds of educational activities such as material posting, homework assignment, group discussion, online testing and so on. However, the most prevailing issue in such a learning environment is that it is not easy for teachers to monitor students' learning behaviors instantly. Nevertheless, as compared with conventional CAI systems, web-based learning environments are able to record most learning behaviors of the students, and hence are able to provide a huge amount of learning profile. As a result, there is an urgent need of analyzing methods to discover useful information for improved instruction performance from the huge log database. Usually, web materials are divided into units of topics that are structured by some semantic relations among them (Barker, 1979). This study assumes that browsing behaviors of students in a web-based learning environment might reveal the true structure required of the material documents for being helpful to students. Therefore, this study proposes a browsing model to describe the useful browsing patterns, and develops a portfolio analysis tool based on data mining technique (Fayyad et al. 1996) to discover them from the browsing portfolio database. Finally, application of the tool is conducted on a portfolio database collected from a web-based course in Ming Chuan University, Taiwan, to investigate its effectiveness, and some revelations are presented and discussed.

The Document Browsing Model

In this study, the browsing model consists of two kinds of relations. The first is the association relation between document clusters and the other is the precedence relation among them. In the following, we present preliminary definitions that are related to the depiction of the browsing model.

Description 1 *(Association Relation): For any documents* p_1 *and* p_2*, we say* p_1 *is associated with* p_2 *if and only if* p_1 *and* p_2 *are "frequently" browsed in a learning session without "observable" sequence between* p_1 *and* p_2*.*

Description2 (*Sequence Relation*): *For any documents* p_1 *and* p_2*, we say* p_1 *precedes* p_2 *if and only if* p_1 *and* p_2 *are "frequently" browsed together and there is "observable" browsing sequence between* p_1 *and* p_2*.*

Application and Discussion

This study applies the aforementioned tool in three web-based classes of the "Expert System" Course in Ming Chuan University, Taiwan. There are totally 172711 browsing records in the log database? Setting the minimum threshold of browsing time as 7 seconds, and the minimum support as 0.03, totally 22846 session records are left after the cleaning process and 960 browsing session records are attained after the transforming process. The total number of material documents is 96, and the number of sessions and average session length of each class are listed in [Table 1].

Class	Number of Sessions	Documents	Average Session Length
A (Day Time)	349	85	2.9
B (Day Time)	334	85	3.1
C (On-Job)	277	80	3.4
Total	960	96	3.1

Table 1: The number of sessions and average session length of each class

To increase the reliability of the mining results, this study combines the session records of the three classes for the associative and sequential mining tasks. The result shows that 23 clusters are found with the largest cluster of size 3. Among these clusters, it is found that the "Theory" and "Demo Systems" categories are often browsed together, and "Demo System" and "Language" categories are also browsed together. These imply that the cross-reference usage of the materials is effectively achieved.

Most of the browsing sequences found meet the instructor's expectations. Nevertheless, some interesting sequence patterns are also found, including the sequence ([Backward-chaining ES], [Inference Engines]) -> ([CLIPS Language]), which reveals that about 20 to 30 percents of the students mistake the CLIPS language (a tool for designing forward-chaining expert systems) for a design language for backward-chaining expert systems.

Conclusions

This study develops a data-mining model and tool for analyzing the browsing portfolios in asynchronous learning networks. This study also finds that the amount of browsing records is still not large enough for more accurate mining results. This might be attributed by the fact that most students are prone to download all materials first for off-line browsing at home. Finally, more effective mining tools are still in lack for analyzing other kinds of portfolio information, such as the behavior of "thinking order" in web-based on-line discussions, and help to explore the relations among the various learning factors (efforts) and the learning outcomes.

References

Barker, F. B. (1979). *Computer managed instruction: theory and practice*. New Jesey: Englewood Cliffs, 1979, pp. 4–10.

Chen, M. S., Park, J. S. & Yu, P. S. (1998). Efficient data mining for path traversal patterns. *IEEE Trans. on Knowledge and Data Engineering*, 10(2), 209-221.

Fayyad, U., Piatetsky-Shapiro, G., & Smyth, P. (1996). Knowledge discovery and data mining: towards a unifying framework. *Proceedings of the second International Conference on Knowledge Discovery and Data Mining (KDD-96)*, pp. 82-88.

Kuo, C.-C. (2001). A Data Mining Approach to Auto-extraction of Browsing Structures of Web Materials. MD. Thesis, Graduate school of Information Management, Ming Chuan University, Taiwan.

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A Knowledge Management Framework of Building a Technology Integration Community of Practice

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Abstract. Building upon a knowledge management framework manifested in the Nonaka's knowledge creation model, the Knowledge Innovation for Technology in Education (KITE) project, funded by US Department of Education, seeks to build a technology integration community of practice through a knowledge repository with case-based reasoning capabilities that allows to capture and disseminate the best practices and lessons learned of technology integration experiences by teachers and teacher educators. The project's overarching mission is to enable learning through sharing, communal understanding through storytelling, continuous exchange and creation of new knowledge, and collective problem solving within this technology integration community.

Introduction

As the face of American classrooms continues to change with rapidly increasing technological changes, greater diversity, and a projected need for 2.2 million new teachers in the next decade, teacher training institutions are faced with the challenge of graduating new teachers who will be adept at keeping pace with the technology explosion in the classroom. To increase the level of technology integration in teacher education programs, the Milken study recommended that researchers, professional societies, and education agencies should identify, study, and disseminate examples of effective technology integration on an ongoing basis (ISTE, 1999). Building upon a knowledge management framework, the Knowledge Innovation for Technology in Education (KITE) project, funded by US Department of Education, seeks to collect, organize and make accessible, and then disseminate technology integration knowledge of teachers and teacher educators with access to a practice-based collection of "how-to" resources.

Knowledge Management Framework

We believe the needs of teacher education programs described before can be addressed with the concept of knowledge management that has gained a wide acceptance in the business circle today. Knowledge management experts (Davenport & Prusak, 1997; Nonaka & Takeuchi, 1995) hold that an organization should actively locate, capture, and disseminate knowledge and expertise in a systematic manner to enhance organizational performance and innovation. In particular, Ikujiro Nonaka (1994), a prominent scholar in knowledge management, developed a model that explains how knowledge in an organization is created through a continuous process of knowledge conversions between explicit knowledge and tacit knowledge between explicit knowledge and tacit knowledge (Polanyi, 1966).

Explicit knowledge is formal and systematic in nature such as technical data, general principles, and standard operating procedures (Nonaka, 1994). Explicit knowledge can readily be elaborated, codified, and shared, and thus can be represented in books and databases and made accessible through libraries and online information systems. Tacit knowledge is practical "know-how" acquired through practice and experience (Leonard & Sensiper, 1998). Tacit knowledge approximates what Schön (1983) referred to as "knowing-in-action." Nonaka argued that "…tacit knowledge is deeply rooted in action, commitment, and involvement in a specific context" (p. 16). Tacit knowledge may require little or no time or thought when executed and can be so internalized that it is taken for granted.

As shown in Figure 1, in the context of technology integration, knowledge creation takes place in four modes of knowledge conversion. Socialization is "the process of creating tacit knowledge through shared experience" (p. 19). The socialization mode requires a field of interaction where practitioners share their experiences and perspectives through technology integration dialogues in the form of questioning, reflection, and feedback and through mentioning relationships between technology integration novices and experts. Second, externalization is the process of converting personal tacit knowledge into public explicit knowledge. Externalization is facilitated by synthesizing tacit technology integration experiences into explicit technology integration cases that allow practitioners to reflect their understandings and insights through interviews. These cases represent new experiences and perspectives which become transferable through case-based reasoning processes and functions in the knowledge repository. Third, combination is the process of converting existing explicit knowledge into new explicit knowledge. Combination implies that a community of practice should invest in a knowledge repository so that knowledge can be preserved, processed, and made available quickly without space and time boundaries. In other words, explicit knowledge can be "combined" upon the new experiences and insights gleaned from the practices of technology integration. Lessons learned and best practices can be compiled from the cases. Fourth, internalization is the process of enriching one's own tacit knowledge by internalizing explicit knowledge. In this phase, practitioners create a "field of action" that becomes the learning and working space in which they can reflect, practice and apply what they know and how they implement technology in teaching and learning. Internationalization can also take place by taking online technology integration courses.

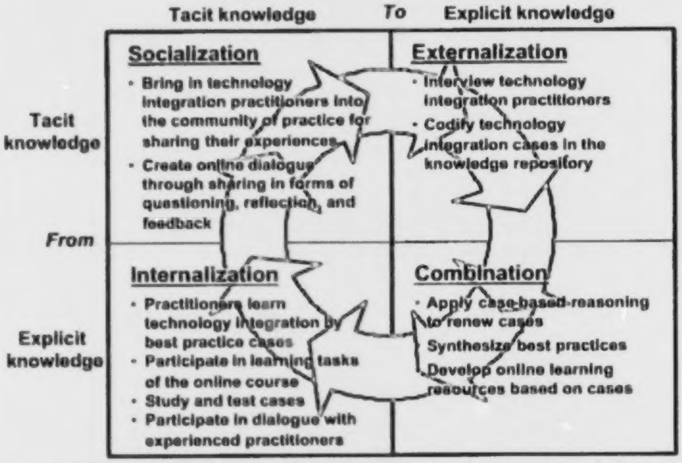
Tacit knowledge
To
Explicit knowledge
Tacit knowledge
From
Explicit knowledge
Socialization
• Bring in technology integration practitioners into the community of practice for sharing their experiences
• Create online dialogue through sharing in forms of questioning, reflection, and feedback
Externalization
• Interview technology integration practitioners
• Codify technology integration cases in the knowledge repository
Internalization
• Practitioners learn technology integration by best practice cases
• Participate in learning tasks of the online course
• Study and test cases
• Participate in dialogue with experienced practitioners
Combination
• Apply case-based-reasoning to renew cases
Synthesize best practices
Develop online learning resources based on cases

Figure 1. Knowledge creation as an ongoing cycle of knowledge conversion

The knowledge management framework highlights the essential components of the KITE project that need to be developed, implemented, and evaluated. Building upon this framework, the project involves a consortium of 8 teacher education programs collaborating to create and diffuse technology integration knowledge. As the lead institution of this project, The University of Missouri-Columbia enhances and continues to support the ongoing development of the knowledge repository. Each partner institution hire knowledge scouts who are responsible for collecting, reporting, and updating technology integration cases in the knowledge repository; and work with local technology integration practitioners (teachers and teacher educators) as knowledge sources to capture their technology integration knowledge and experiences. The overarching mission is to build a k-16 technology integration community of practice through this knowledge repository that enables learning through sharing, communal understanding through storytelling, continuous exchange and creation of new knowledge, and collective problem solving.

References

Davenport, T. H., & Prusak, L. (1997). *Working Knowledge : How Organizations Manage What They Know*. Boston, MA: Harvard Business School Press.

International Society for Technology in Education (1999). *Will New Teachers be Prepared to Teach in a Digital Age?*

Leonard, D., & Sensiper, S. (1998). The Role of Tacit Knowledge in Group Innovation. *California Management Review*, 40(3), 112-132.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), 134-139.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. New York: Oxford University Press.

Polanyi, M. (1966). *The Tacit Dimension*. Garden City, NY: Doubleday.

Schön, D.A. (1983). *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books, Inc.

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Missouri-Specific Web-based Lesson Planning System

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Abstact. Lesson planning is considered a critical but complex task to attain effective instruction. The traditional paper-based approach was found to be cumbersome and consequently detrimental in the willingness and effectiveness of teachers' lesson planning. A Web-based lesson planning system combining instructional planning and calendaring functions to support Missouri's education reforms was in the process of development and testing. Early usability tests proved the system to be positive in helping Missouri teachers plan their instruction. Some design issues were identified.

Introduction

The success of Missouri's education reforms, to improve student performance as measured by the Missouri Assessment Program (MAP), will require new and different teaching and learning strategies that align curriculum and state standards using inquiry-based instructional strategies and infusing instructional technologies. Successful teaching and learning does not occur by chance. It relies on careful planning of instruction. Since lesson planning is considered to be critical to the success or failure of teaching and student learning, it is vital that teachers are competent in planning daily lessons that support Missouri's education reforms.

Lesson planning is an essential but complex task (Borko & Livingston, 1989; Doyle & Holm, 1998; Johnson, 2000; Ornstein, 1997). Various theoretical models were developed to help teachers plan lessons (Eisner, 1967; MacDonald, 1965; Tyler, 1950; Yinger, 1980). While numerous studies exist to discuss lesson planning and its effects, the research on the effect of technology-based lesson planning systems is conspicuously lacking.

The use of technology to support lesson planning is not new. Several systems such as Computer-Prompted Instructional Planning System and Lesson Plan Maker appeared shortly after personal computers gained acceptance in early 1980s. Several studies have showed the positive effect of using personal computers to support lesson planning. Today, the advancement and prevalence of technology in schools makes it a very viable option for teachers to utilize in planning, sharing, and communicating instructional information. In particular, the Web allows teachers to create and access instructional plans without time and space boundaries. However, a search revealed that a Web-based lesson planning system combining instructional planning and calendaring functions to support Missouri's education reforms does not exist.

Issues

While Missouri has undertaken a State initiative to support Missouri teachers as they integrate multimedia technology into inquiry-based, student-centered instructional practices (http://emints.more.net), most teachers are still using pencil and paper to do lesson planning. Major drawbacks of this paper-based lesson planning include:

- The process is very labor-intensive and cognitively arduous. The task becomes perfunctory to many teachers. They feel obligated to write out lesson plans only because it is required by the administration.
- There are no systematic prompts or built-in links to information that can guide the teachers' lesson planning to focus on Missouri's education reforms.
- Lesson plans are not accessible to colleagues or school administrators unless special requests are made. Consequently, sharing instructional information among teachers is difficult.
- Parents have no access to lesson plans and, as a result, must rely on other methods to know what their children are learning on a daily basis.
- It is difficult to modify the contents of lesson plans once they are written on paper.
- Paper is not very durable and thus, valuable instructional information can be easily damaged.

Implementation and Preliminary Results

To help resolve these issues in lesson planning, a Web-based lesson planning system is under development with "teacher friendly" tools. The objectives of the system are threefold. First, it streamlines the lesson planning process to align with curriculum and Missouri standards and provides guidance with checklist functions to help teachers focus on addressing Missouri's education reforms. Second, it preserves valuable lesson plans developed by teachers for dissemination and facilitates the sharing of lesson planning knowledge and skills among teachers. Third, it promotes better lesson planning results through sharing and collaboration and enhances communication between parents and schools, thus increasing parental involvement in their children's education.

This Web-based lesson planning system is a work in progress; consequently, only formative evaluation is available. To date, a preliminary working system developed in Lotus Domino has gone through several rounds of prototyping and usability testing to collect user feedback. Early indicators suggest the system will be particularly helpful in the areas of:

- searching and adapting existing lesson plans for other uses,
- communicating instructional plans with other teachers and students, and
- developing lesson plans to meet Missouri academic standards.

User feedback also reveals several issues that need to be resolved before the objectives of the system can be fully realized. Among them, the following two are most critical:

- The system has to be flexible to accommodate different instructional needs and processes of schools and teachers.
- Other non-technical arrangements such as training and support have to be in place to motivate teachers to use the system and to share their instructional plans.

Conclusion and future research

Preparing teachers for technology integration in their instruction and enhancing teachers' instructional quality are two important endeavors to advance K-12 education reforms. This initial phase of this project is to develop, implement, and pilot test the lesson planning functions. Later phases will include additional functions to support communication with parents via the Web and to scale-up the lesson planning model for statewide access and use, and to disseminate to a national audience. From a research perspective, this project will lead to a better understanding of:

1. How teachers plan instruction using technology?
2. How teachers share instructional information through technology, how technology can assist with instructional planning?
3. How the Web can serve as a communication means between parents and schools?

The on-going process of building the lesson planning system and preserving instructional plans in a sharable library enables teachers to better plan their instruction and share their instructional materials. As the system matures and the content grows, it will have the potential of improving instructional planning process and products of Missouri teachers and thereby advancing the entire K-12 education enterprise at Missouri.

References

Borko, H. & Livingston, C. (1989). Cognition and improvisation: Differences in mathematics instruction by expert and novice teachers. *American Educational Research Journal, 26*, 473-498.

Doyle, M., Holm, D. T. (1998). Instructional planning through stories: Rethinking the traditional lesson plan. *Teacher Education Quarterly, 25*(3), 69-83.

Eisner, E. W. (1967). Education objectives; Help or hindrance? *School Review, 75*, 250-266.

Johnson, A. P. (2000). It's time for Madeline Hunter to go: A new look at lesson plan design. *Action in Teacher Education, 22*(1), 72-78.

MacDonald, J. B. (1965). Myths about instruction. *Educational Leadership, 22*, 571-576, 609-617

Ornstein, A. C. (1997). How teachers plan lessons. *The High School Journal, 80*, 227-237.

Tyler, W. W. (1950). *Basic principles of curriculum and instruction.* Chicago: University of Chicago Press.

Yinger, R. J. (1980). A study of teacher planning. *The Elementary School Journal. 80*, 115-127.

Investigating Education Faculty's Perspectives of Their Experiences in a Technology Project: Issues and Problems Related to Technology Integration

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Abstract: The ISTE (1999) stated it is important to study models that are making effective use and integration of technology in teacher education on an ongoing basis. The purpose of this study is to respond to this need by portraying three education faculty members after they experienced a federally funded technology-based project. Their practices, beliefs, and experiences are the focus of this study. Findings include 1) the range of previous experiences with technology varies dramatically, but all participants have used some computers for personal and professional tasks; 2) although actively learning to integrate technology and seeing positive impacts on their students, they do not believe that technology is the only tool for effective instruction; and 3) gender, age, social networking, access to current hardware and access to technical support remain issues needing consideration in the design of technology implementation in higher education settings.

Many educators today are facing the issue of integrating technology into their instruction. They no longer limit themselves to textbooks, chalk, and handouts to deliver course content because they are facing an increasing need to adjust their approaches to "teaching, preparing contents and delivering learning materials in accordance with" emerging technologies (Neo & Neo, 2001, p. 328). Some teachers have experienced great success in making effective use and integration of technology, but many teachers are still struggling with technology. This paper examines the beliefs and practices of education faculty regarding their integration and implementation of technology. In particular, what are the perceptions of their experiences after they participated in a year-long project to implement technology in their instruction?

Literature Review

Most faculty members have realized the positive impact that technology brings to students and believe that it is important to increase technology integration in the classroom. However, there is a significant gap between their beliefs and their practices. The factors underlying this situation include teachers' beliefs, fears of technology, reluctance to change, lack of access, and lack of technical and administrative support (Ertmer, 1999). Both external and internal factors may impede technology integration; external factors include access to technology, funding, and administrative and technical support, while internal factors are intrinsic to teachers, such as personal fear of technology, traditional teaching style, and reluctance to adapt (Ertmer, 1999). The internal barriers are often more difficult to identify and overcome than the external factors, because they are "less tangible" and "more personal and deeply ingrained" (Ertmer, p. 51), and these barriers can completely block implementation. Ertmer found that the focus on helping teachers integrate technology has been on grappling with the external factors but training programs have started to "incorporate pedagogical models of technology use as one means of addressing internal barriers" (p. 47). Ertmer also addressed the complexities of relationships between the external and internal factors and the strategies to overcome the two barriers to help faculty members incorporate technology into their classrooms efficiently.

What should faculty do?

First, before teachers integrate technology into the classroom, they should possess proficiencies with technology and develop a desire to apply technology in their instruction. This desire incorporates the premise that they have been provided with access to technology resources, technical support and training. Second, teachers should possess the knowledge of how to integrate technology into their classroom. Throwing a computer and software into the classroom is not integration. According to (Ertmer, 1999), successful integration involves careful evaluation of the curriculum and learning goals. Teachers should develop careful plans for improvement and assessment, and they should also be able to follow models that can help develop their own plans(Ertmer, 1999).

What can school/university systems do?

To help faculty members make effective use of technology and integrate technology into instruction, systems should provide proper and sufficient training and technical support. Only technology access combined with technical training, support, and assistance with using technology will serve as a significant motivation. Technology integration depends on facilities; however, other factors that influence integrating technology include faculty professional development and course-development time, which provide opportunities and time for teachers to concentrate on technology (ISTE, 1999).

Giving teachers sufficient time to plan students' technology experiences is one practice that facilitates technology integration. Teachers need to spend sufficient time planning how technology integrated is going to function most effectively, and determine the best practice to enhance students' learning outcomes (Walker, Ennis-Cole, & Ennis III, 2000). Teachers need to consider the necessary course content to be delivered in a normal class and to evaluate the impact that technology will have on teaching and learning (Lawler, Rossett & Hoffman, 1998; Walker, Ennis-Cole, & Ennis III, 2000).

Background of the Project

This project, according to Speaker and Dermody (Speaker, et al, 2001) is part of a $1.2 million grant from Preparing Tomorrow's Teachers to Use Technology (PT3), initiative of the U.S. Department of Education. The consortium, focused on strategically implementing technology in the classroom, is comprised of six partner schools working closely with two universities. The major purpose (Speaker, et al, 2001) is to make modern multimedia computer technology ubiquitous in content and methods courses, and field experiences for future teachers. Faculty and students in teams from the two institutions participate in the project and implement instruction using technology in their courses and field experiences with children in partner schools. This project (Speaker, et al, 2001) uses the model of teachers teaching teachers developed initially in the Bay Area Writing Project to produce teaching with technology. Over last two years, the project has involved 40 university faculty, approximately 100 university students as student technology mentors (STM), more than 2,000 other university students, and approximately 2,250 learners in 40 classrooms in 6 schools in the area. This project focuses on the training of both pre-service teachers and university faculty through summer institutes, as well as through numerous mini-session trainings, one-on-one tutoring and mentoring. These training courses cover a range of topics including web design, Internet in the classroom, presentation software, integrated curriculum, and video on the web (Speaker, et al, 2001).

Methodology

In this project, faculty members are categorized as Faculty Technology Participant (FTP), and student participants are categorized as Student Technology Mentor (STM). Each faculty member was assigned an STM to assist with teaching and preparation. Both FTPs and STMs attended a summer institute, in which they learned technology from invited teachers, students and faculty members who are using technology. These presenters share with their experience and demonstrate how they model technology implementation in their classrooms. Faculty and students completed individual projects using technology or completed a project on a cooperative basis. Processes began with a simple form to collect some demographic information from three FTPs. After that, course syllabi, which faculty developed after they participated the summer institute, were analyzed. Based on the analysis and review of literature, we developed interview questions to delve deeper into the personal world of faculty members who are integrating technology into their classrooms.

Interpretivism, a "philosophy of science related to constructivist theory in psychology and to forms of research" (Willis, Thompson, & Sadera, 1999, p. 34), best suits this study. Interpretivists believe that it is difficult to find make valid generalizations about human behavior in social science due to the individual differences. Instead of making generalizations, Willis, Thompson, and Sadera indicated that interpretivism emphasizes understanding the individuals and interpreting them. What is true for one group does not necessarily stand true for another group since each group might be unique in certain ways (Willis, Thompson, & Sadera, 1999). The reasons to choose qualitative rather than quantitative design are manifold. First, our personal biases towards qualitative research present it as a flexible and non- restrictive method, which we can use to understand individuals' perceptions and processes. Second, our research question determined that this study should use qualitative design because the purpose of this study was to investigate the perspectives of education faculty members' experience in a technology project. This study was completed in a natural setting without the involvement of experimental and control groups. Third, since the number of faculty members who have participated in this project is relatively small, it is not possible to obtain a sample size to make valid and reliable quantitative generalizations. Fourth, ISTE (1999) suggests that future researchers should observe classroom activities, interview teachers, and analyze technology-based lesson plans to seek concrete evidence of effectiveness.

Process

Three faculty members, two female and one male, who had participated in the project gave consent to be interviewed. Each interview lasted thirty minutes to an hour. Semi-structured interviews were based on prepared a list of interview questions and audio taped. After transcription, the data were synthesized with demographic information, the electronic journals from the summer institute, and course syllabi to confirm the analyses. Transcripts and other data were coded as themes emerged. Follow-up interviews with member checking of the interpretations occurred after the initial data reduction.

Findings

There are some commonalities among the three faculty members and individual differences as well. The similarities and differences include previous experiences with technology, attitudes toward participation, beliefs and practices, technologies' impacts on students, and issues relating to gender, age, social networking, access to current hardware and access to technical support.

Previous Experiences

All three teachers had some experiences with technology prior to the participation of the grant project. Their experiences ranged from word processing and Internet browsing to PowerPoint presentations and web page design. Each had an office computer with access to a university local area network and e-mail. They had access to two computer labs in the building and supposed access to a faculty multimedia development lab which was usually locked, unavailable and unstaffed. Two of the faculty members mainly used computers for word processing, emails for communication and Internet browsing to search for information for their teaching and research. They did not develop web pages prior to the project. The third faculty developed web pages using HTML prior to the project and posted his course syllabi online and links for students to retrieve information about how to conduct research. He used some software similar to PowerPoint prior to the project in his classrooms.

Attitudes Toward the Participation

The three faculty members demonstrated satisfaction with the whole experience of the project. One is very happy to see her accomplishments in terms of products. The other two consider the project has provided a large variety of resources and support to motivate their learning, interests and rethinking of the goals of their instruction. "But I might argue that the project workshop in that summer was again the catalyst that recognize in my mind ... (it) allowed me to recognize in my mind the limitations that ... are associated with all the alternatives that I have available to me. The workshop did serve as a catalyst to at least allow me to understand what my needs were and how I could most effectively meet those needs, helping me because it forced me to rethink what I want to present in class." (Dr. Swanson, male). Walker, Ennis-Cole, and Ennis III (2000) say that teachers' positive experience in workshops and intensive institutes helps promote a sense of accomplishment or self-efficacy.

During their participation, each of the three faculty members was assigned one student technology mentor. All the three faculty members reported that their student technology mentors basically did not produce anything that they expected, due to mentors' lack of technological competency and proficiency, and conflicts of time schedule for the faculty and the student mentor to work together. So the mentor relationships were not productive according to the three faculty members. "And then I was assigned a person who is still in the program. She knew less than I did. Well, she is a marvelous person, did subsequently take my literature class. We are still working on...um...she didn't do much to help. . I met her and she joined in. Whenever I ask questions, she would certainly attempt to figure it out or tempted to work on it, but basically I went to (person a). Every problem I have, I just go to (person a), who is not involved in the grant at all. He is a computer support person. I went to him prior to the grant and I continue to use him as the chief source. I did ask my mentor to do a couple of projects for me. I don't want to give the impression that she is not completely compliant, willing, certainly she is and would independently go out and get her own help. I would ask her this is what I need in excel and later I would have it in my hands. And I wanted to have a powperpoint presentation made, and she did that." (Dr. Bonnett, female).

Beliefs and Practices

All three faculty members believe that technology is not THE answer to instruction. The purpose of using technology is to enhance teaching and learning. Technology is a tool, and so if one particular type of technology gets in the way, faculty will not use it; instead, they will seek other alternatives to improve their teaching. These three faculty members take a strong critical/evaluative view of the functions of technology which they are implementing in their instruction.

It is not surprising to find out that faculty's personal interest in technology is highly related to their motivation and adoption of technology. Therefore, the more interest one has, the easier it is to learn and incorporate technology into practice. Personal interest is also related to self-confidence and comfort. If individuals do not have an interest in learning technology and bringing technology into their classrooms, they will be reluctant to change practices and resist learning technology and technology infusion. When resistance exists, the level of confidence and comfort is crucial, influencing processes even though a faculty member may feel forced to bring technology into classroom to keep up with times.

After they participated in the technology-based project, the two female faculty members started to integrate technology into their classrooms. They developed their web pages for easy communication, information delivery and their own research. The male faculty member continually was working on his web pages to convert his website into a more non-linear site. He learned PowerPoint in the project and integrated it heavily into his classes.

Technology's Impact on Students

All faculty members see technology as a positive impact on students' learning. Through technology, students are no longer limited in their communication with peers and instructors. By using technology in their learning, students demonstrate enhanced learning outcomes in terms of activities and products. One faculty member mentioned teaching preservice teachers by modeling and requiring technology use in instruction so that preservice teachers can follow and integrate technology into their academic activities and future classrooms. By watching how the instructors model the use of technology, students are able to use technology in their own academic activities and explore different learning resources. Dawson and Norris report (2000) that technology integrated into classroom by the instructor increased the possibility that preservice teachers transfer the computer skills into their classroom as compared to preservice teachers who learned computer skills in an isolated manner.

Issues

One interesting finding is that among the three participants, the male demonstrated higher motivation than female faculty members, and he is also the youngest (between 35 and 45; both female participants were over 45). He had already sought and received grants for further technology implementation in his courses. Ertmer and Hruskocy (1999) said the challenge that teachers face is to change the way they teach, which is often entrenched. In considering the idea of integrating technology into their instructional activities, many teachers find it difficult to confront their established beliefs about instruction and their traditional roles as classroom teachers. In addition, Becker (1994) reported that teachers' practices incorporating technology are not only dependent on teachers' personal interests in technological activities, but also highly correlated with gender, and this might be related to our culture, in which more males have patterns of personal interest that are "technical, mechanical, and numerical" (p. 311), which is consistent with having a deep interest in technology, specifically with computers. In this study, personal interest on an individual basis and gender basis has been identified as a major issue in promoting faculty members to use technology and incorporate technology into classrooms.

Other issues arise when faculty deal with technology. The two female faculty feel time is a problem because it always requires a large amount of time for them to deal with hardware and software. In Becker's report (1999), he distinguished difference among exemplary technology uses between female and male teachers. Becker indicated that female teachers usually have higher demands on time. If faculty members are not allowed sufficient time to construct their lesson plans, they may find integrating technology into classrooms ineffective.

Another factor is the faculty member's social network. The faculty member who is not very interested in technology and has experienced frustration mentioned that friends in some schools simply gave up whenever they encountered problems with technology, even without bothering to seek technical support. Presenters that this faculty member has met do not use Powerpoint to do presentations; instead, they use the traditional slideshows, so peer's views and practices influence faculty members' beliefs and practices.

In addition to requiring time, the male faculty member thinks it is important to update hardware so that it can meet the increasing needs. Faculty think that there are always problems with technology that they do not have sufficient technical skills to solve, so they are highly dependent on someone who is technologically savvy and has the expertise to deal with the situation. Faculty members feel that there should be someone to whom they can turn whenever they encounter technological problems. In this sense, technical support availability plays an important role in helping faculty members; it eases the pressures of learning new things and thus helps them integrate technology into their classrooms. Becker (1994) said available access to someone from whom teachers can learn or share experience with is very important in helping teachers incorporate technology.

Conclusions and Implications for Future Research

Three participants were involved in this study, two females and one male. Dr. Swanson and Dr. Bonnet are at their forties and fifties, while Dr. Greene is at her thirties and forties. Their teaching years of experience in higher education range from five to thirteen years. Although these faculty members had different experiences prior to the project, their attitudes toward participant, and beliefs and practices are undergoing changes as they use technology. They are either adding to their technology use or rethinking it, seeing the need to consider the technology as a tool through a critical evaluative lens. Issues continue to exist related to gender, age, access and currency of technology. Technologies have significant impact on both teachers and students. They help both teachers and students reconceptualize their ways of working and thinking and strengthen the relations with the rapidly changing world. However, past studies show that teachers' professional development has not "kept pace with the rapid changes in the quality and quantity of information technology" (ISTE, 1999, p. 1). Factors that impede effective use and integration of technology have been identified as both external and internal factors. Future research should be more focused on factors that influenced faculty's use of technology and integration from studying both successful examples and unsuccessful examples, and these designs should balance gender and age.

References

Becker, H.J. (1994). How Exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. Journal of Research on Computing in Education. 26(3), 291-321.

Becker, H.J. (1999). Internet use by teachers: conditions of professional use and teacher- directed student use. Teaching, Learning, ND computing: 1998 National Survey. Report #1. Irvine, CA: Center for Research on Information Technology and Organizations, University of California, Irvine. Available online: http://www.crito.uci.edu/TLC/FINDINGS/internet-use/.

Dawson, K. & Norris, A. (2000). Preservice teachers' experiences in a K-12/university technology-based field initiative: benefits, facilitators, constraints, and implications for teacher educators. Journal of Computing in Teacher Education. 17(1), 4-12

Ertmer, P.A. (1999). Addressing first-and second-order barriers to change: Strategies for technology integration. Educational Technology Research & Development, 47(4), 47-61.

Ertmer, P. & Hruskocy, C. (1999) Impacts of a university-elementary school partnership designed to support technology integration. Educational Technology Research and Development. 47 (1), 81-96.

International Society for Technology in Education (1999) Will new teachers be prepared to teach in a digital age?: a national survey on information technology in teacher education. Santa Monica, CA: Milken Family Foundation, commissioned by Milken Exchange on Education Technology

Lawler, C., Rossett, A., & Hoffman, R. (1998). Using supportive planning software to help teachers integrate technology into teaching. Educational Technology, 38(5), 29-34.

Neo, K. & Neo, M (2001) Multimedia technology: Using multimedia authoring tools to enhance teaching and learning in the classroom. Paper presented at the Annual Conferences of Technology in Teaching and Learning in Higher Education: An International Conference at June 27-29, 2001, Samos Island, Greece. 327-331.

Speaker, R.B., Dermody, M., Knighten, B., Wan, L., & Parigi, A. (2001). Student/Faculty relationships, methods courses and K-12 classrooms: examples of integration of technology in teacher education. Paper presented at the Annual Conferences of Technology in Teaching and Learning in Higher Education: An International Conference at June 27-29, 2000, Samos Island, Greece. 307-313.

Walker, M., Ennis-Cole, D., & Ennis, III, W. (2000) Down to the Nuts and Bolts: Considerations for the Infusion of Classroom Technology. Paper presented at the Annual Conferences of Technology in Teaching and Learning in Higher Education: An International Conference at August 25-27, 2000, Samos Island, Greece.115-120.

Willis. J., Thompson A., & Sadera, W. (1999). Research on Technology and teacher education: current status and future directions. Educational Technology Research & Development 47(4), 29-45.

Student Perceptions of Relative Advantages in Physical Versus Online Submission of Multimedia *e*Portfolio Projects in Graduate Coursework

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Abstract: This study will investigate student perceptions of two different methods of submitting multimedia class projects in a graduate educational technology course. All students will create a variety of multimedia files as standard course requirements. One group will be required to submit the projects physically, by directly providing to the course instructor paper or portable media containing the files. The other group will be required to submit the projects online, storing them in a central "*e*Portfolio" area on a class file server. Student attitudes and perceptions toward these two methods of project submission will be studied, along with their relative susceptibility to error and malfunction.

Introduction

Electronic portfolios are student portfolios which incorporate multimedia components. Wiedmer (1998) described a digital (electronic) portfolio as a learner's compilation of work growth in one or more fields which is developed and exhibited by electronic media. These media may include diskettes, Zip, Syquest, and Jaz drives; compact disk recordable (CD-R); local area networks (Farmer, 1997); and the World Wide Web (Kahtani, 1999). Electronic portfolios can reduce physical storage necessities (Moersch & Fisher, 1995), and encourage students to take more responsibility for themselves and perform better in self-assessment (Tancock & Ford, 1996).

Little research known to the author has yet addressed the use of a remote file server as a medium for creating or storing *e*Portfolios. Such a "remote *e*Portfolio" is accessible anywhere at anytime, and is defined for the purposes of this study as a multimedia portfolio created and maintained exclusively on a remote file server accessed by students using a computer network (including but not limited to the Internet).

With respect to remote *e*Portfolios, this project proposes four research questions. Each focuses on the difference between having students submit multimedia projects via portable media (e.g., papers; floppy disks; SuperDisks; Zip disks; CD-ROMs; etc.) and having students submit multimedia projects online to a central server. The four questions are: (1) Is there a difference in student attitudes toward these two methodologies? (2) Is there a difference in student perceptions of these two methodologies? (3) Which method of submission is more prone to errors? (4) Which method of submission is more prone to malfunctions?

Context

The study will be held in a graduate educational technology class taught at a midwestern urban state university during the Summer 2002 term. Approximately 40 graduate student participants, who are Prek-12 educators, from two sections of this educational technology course will serve as subjects. All students in both course sections will be required to create multimedia *e*Portfolios. All students in both course sections will be instructed in the use of a remote file server, and in the transfer of files to and from the server using FTP.

All subjects will encounter the same course content, learning activities, and instructor during the same term. The distinction between the control and experimental groups will be in the ways in which students are required to maintain and submit their *e*Portfolios. The control group will be required to maintain and submit their *e*Portfolios on portable media only, and the experimental group will do so using a remote file server (only).

Data Sources

At the beginning and at end of the term, subjects will complete a questionnaire dealing both with their attitudes toward and their perceptions of electronic submission of projects. The questionnaire administered at the beginning of the term will also collect information about students' prior computer experience and experience with online file transfer.

The first research question regarding attitudes (e.g., preference, satisfaction, etc.) and the second research question regarding perceptions (e.g., course delivery, knowledge and skills learned, etc.) will be addressed using data from these questionnaires.

The third of the research questions addresses errors (that is, human mistakes) in the project submission process. Students in both groups will be asked to record and report any mistakes or errors they are aware of making during the process of creating, maintaining, and submitting their *e*Portfolios; the instructor will maintain an equivalent log.

The fourth of the research questions addresses malfunctions (that is, hardware/software malfunctions) in the project submission process. Students in both groups will be asked to record and report any software, network or equipment malfunctions they experience in the process of creating, maintaining, and submitting their *e*Portfolios. As with the third question, the instructor will also log such malfunctions.

An Analysis of Variance (ANOVA) model will be used to test the significance of the differences in students' attitudes, perceptions, errors, and malfunctions in multimedia coursework submission between physical (via portable media) and online (via remote file handling) *e*Portfolio formats. Students' attitudes, perceptions, errors, and malfunctions are the primary dependent variables while the method of *e*Portfolio submission (portable media vs. remote file handling) is the primary independent variable.

Educational Importance of the Study

The study is educationally significant because it is one of the few studies investigating the difference between coursework submission formats (physical vs. online) on student attitude, perception, error, and malfunction. Should an online format of submission prove to be both equally effective and equally popular, such *e*Portfolios can provide a cumulative multimedia record of student progress and outcomes which is continuously maintained and improved, as well as accessible to both the instructor and student from all locations around the clock.

References

Farmer, L. S. J. (1997). Tools for Electronic Portfolios. *Technology Connection, 4*(7), 30-32, & 47.

Kahtani, S. A. (1999). Electronic Portfolios in ESL Writing: An Alternative Approach. *Computer Assisted Language Learning, 12*(3), 261-68.

Moersch, C., Fisher, L. M., III. (1995). Electronic Portfolios–Some Pivotal Questions. *Learning and Leading with Technology, 23*(2), 10-14.

Tancock, S. M., & Ford, K. L. (1996). Facilitating Reflective Thinking: Technology-Based Portfolios in Teacher Education. *Journal of Technology and Teacher Education, 4*(3-4), 281-95.

Wiedmer, T. L. (1998). Digital Portfolios: Capturing and Demonstrating Skills and Levels of Performance. *Phi Delta Kappan, 79*(8), 586-89.

Electronic Cognitive Apprenticeships: Building Students' Understanding of ID

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Abstract: This study explored how students' understanding of instructional design developed as they participated in collaborative learning activities in an electronic apprenticeship environment during a semester-long course. Novice and advanced learners analyzed a set of instructional design case studies. Novice learners also developed instructional design projects with feedback from the advanced learners. By engaging in joint case analyses and design reviews it is expected that both groups of learners will increase their understanding of the ID process.

Theoretical Framework

Literature shows that an apprenticeship environment provides students with opportunities to apply expert problem-solving strategies. Collins and his colleagues argued that cognitive apprenticeships, in contrast to traditional apprenticeships, could most efficiently occur in school settings (Collins, Brown, & Holum, 1991). In a cognitive apprenticeship environment, the goal is to make visible and explicit complex thinking and problem-solving strategies that experts use in particular domains. By combining six distinct teaching strategies, students can conceptualize their knowledge and use that knowledge in a variety of settings (Collins, Brown, & Newman, 1989). The six methods include: modeling, coaching, scaffolding, articulation, reflection, and exploration.

Along with these methods of cognitive apprenticeships is the concept called authentic activity—the use of ordinary practices of a given culture as a basis for learning (Brown, Collins, & Duguid, 1989). One promising approach to initiating authentic, contextual learning is case-based instruction.

Case-based instruction has been used in professional preparation programs to make a bridge between classroom and field. Recently case-based instruction was introduced into instructional design field (Ertmer & Quinn, 1999). The effective use of cases requires students to apply critical thinking to a problem situation to analyze the situation and recommend realistic solutions through better understanding (Ertmer & Russell, 1995; Shulman, 1992; Wright, 1996).

Flynn and Klein (2001) examined the role of group discussion in case-based instruction. Participants working in groups performed better while analyzing cases than those who worked alone. Other researchers (Griffith & Laframboise, 1997; Levin, 1995) found that, for experienced learners, discussion appeared to act as a catalyst for reflection based more on personal experiences than on theory and course content, while for less experienced learners, discussion appeared to allow them to clarify or elaborate their understanding and increase their perspective on the issues in the cases.

Simply stated, case-based instruction becomes more effective when learners at different levels work collaboratively in an apprenticeship environment. However, previous research focused more on the growth in novice learners' problem-solving expertise and their benefits from this learning experience. Few of them explored how advanced learners perceived the collaborative experience with novice learners. Therefore, it is important to examine how both novice learners and advanced learners perceive the benefits of case-based instruction in apprenticeship.

Purpose

This study examines the development of novice and advanced students' understanding of instructional design during one-semester in which they engaged in an electronic apprenticeship environment. To be specific, this study:

- examines the benefits to novice learners who participate in case-based collaborative problem-solving activities and instructional design project reviews in electronic cognitive apprenticeship environment.
- examines the perceptions of advanced learners who participate in case-based collaborative problem-solving activities and mentoring instructional design project reviews in an electronic cognitive apprenticeship environment.

Methods

Graduate students (n=20) at one Mid-western university enrolled in an introductory instructional design course (classified as novice learners) and graduate students (n=11) from another Mid-western campus enrolled in an advanced instructional design course (classified as advanced learners) participated in a semester-long study. Three graduate students from the latter group conducted the research. Qualitative data were gathered from discussion board postings revolving around case study discussions, instructional design project reviews, interviews, and an end-of-course reflection.

Throughout the semester participants analyzed and discussed 10 case studies via discussion board as part of their course assignments. During the online discussion, they will be in different case setup including role-play, small group discussion, discussion chain, etc. The novice learners also created an instructional design project and the advanced learners played the role of mentors to review novice learners' projects. The novice learners will also be asked to write a reflection at the end of semester. In addition, the researchers will interview the rest of the advanced learners with a semi-structured interview method. With their permission, the interview data will be tape-recorded and then transcribed.

A constant comparison analysis method (Guba & Lincoln, 1989) will be used to generate the categories and patterns from qualitative data. Specifically, discussion board postings and reflections will be analyzed to examine novice learners' perceptions of their benefits from this learning experience. The advanced learners' project review postings and interview data will be analyzed to identify the advanced learners' perceptions of the benefits from case-based collaborative problem-solving activities and mentoring instructional design project in electronic cognitive apprenticeship environment.

Results

Preliminary analysis of the data collected from the first two online case study discussions and the first instructional design project review demonstrates benefits of this collaborative learning approach to be perceived by both novice learners and advanced learners.

While there were no obviously different patterns found in the approaches to case studies between novice learners and advanced learners, the instructional design project review showed certain differences in participants' understanding of instructional design. For example, the novice learners were easily confused by miscellaneous details of the beginning two steps of the ID model, while the advanced learners considered the design steps in the whole process as a "big picture".

The analysis of the participants' discussion postings will continue throughout the semester. It is expected that the novice learners will demonstrate improved problem-solving skills and better understanding of instructional design through working collaboratively with advanced learners. In addition, it is expected that advanced learners will consolidate their understanding of instructional design through both mentoring novice learners' projects and applying their previous knowledge and skills to complex tasks in case-based discussions.

Implications

Although this study is limited by the number of participants and the inability to control the influence of other factors on students' perceptions, it has important implications for apprenticeship approach in building instructional design understanding. It is hypothesized that both novice and advanced learners benefit from collaborative learning in apprenticeship environment. It is usually considered that novice learners benefit the most from such learning experiences because they are more likely to make greater progress due to their low entry knowledge level. However, this paper hopes to demonstrate that advanced learners can also benefit much through authentic problem-solving activities and mentoring novice learners. Their collaboration further indicates that the cognitive apprenticeship provides an effective social context for understanding instructional design.

References

Brown, J. S., Collins A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18* (1), 32-42.

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American Educator: the Professional Journal of the American Federation of Teachers, 15* (3), 6-11, 38-46.

Collins, A., Brown J. S., & Newman, S. E. (1989). Cognitive Apprenticeship: Teaching the Crafts of Reading Writing and Mathematics, In L. B. Rensnick (Eds.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser*. Hillsdale, NJ: Lawrence Erlbaum Press.

Ertmer, P. A., & Quinn, J. (1999). *The ID casebook: Case studies in instructional design*. Upper Saddle River, NJ: Prentice-Hall, Inc.

BEST COPY AVAILABLE

Ertmer, P. A., & Russell, J. D. (1995). Using case studies to enhance instructional design. *Educational Technology, 35* (4), 23-31.

Flynn, A. E. & Klein, J. D. (2001). The influence of discussion groups in a case-based learning environment. *Educational Technology Research and Development, 49* (3), 71-86.

Griffith, P. L. & Laframboise, K. (1997). The structures and patterns of case method talk what our students taught us. *Action in Teacher Education*, *18* (4), 10-22.

Guba, Y. & Lincoln, L. (1989). *Fourth generation evaluation.* Newbury Park: Sage.

Levin, B. B. (1995). Using the case method in teacher education: The role of discussion and experience in teachers thinking about case. *Teaching and Teacher Education, 11* (1), 63-79.

Shulman. J. (Ed.). (1992). *Case method in teacher education*. New York: Teachers College Press.

Wright, S. (1996). Case-based instruction: Linking theory to practice. *Physical Educator, 53* (4), 190-207.

An Investigation of a Web-Based Learning Environment Designed to Enhance the Motivation and Achievement of Students in Learning Difficult Mental Models in High School Science

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Abstract: A high school science teacher reported that the students have motivation and learning problems to understand the concept of fossilization. Working with the science teacher, a Web-Based Learning Environment (Web-LE) has been designed by a group of students in the Department of Instructional Technology at University of Georgia to enhance and sustain the motivation of learners in the context of secondary science education. The cognitive tool approach is employed to design the Web-LE to enhance the learners' cognition toward the scientific concept of fossilization. Several strategies for increasing students' intrinsic motivation will be involved in the Web-LE design. The goal is to find the practical approaches to design the online fossil course that should be shored up by the instructional theories including cooperative learning and the motivational theories. The high school teachers can use the Web-LE to aid the science subject instruction without purchasing software.

Introduction

This Web-Based Learning Environment (Web-LE) is being designed to explore the unique WWW features and utilize these elements to enhance and sustain the motivation of online learners in the context of secondary science education. The goal is to find the practical approaches to design the online fossilization course that should be shored up by the instructional theories including cooperative learning and the motivational theories. The high school teachers can use the Web-LE to aid the science subject instruction without purchasing software.

Information scientists estimate that the World Wide Web (WWW) now has nearly one billion pages, and the WWW continues to grow at a rapid pace. Although many web sites may be inaccurate, misleading, biased, or even criminal in nature, there are still millions of pages that high school students and their teachers can access to enhance teaching and learning. Unfortunately, while there is enthusiasm in many quarters about the integration of the WWW into education, there appears to be a lack of substantive thinking about the goals, pedagogical dimensions, and outcomes of using the web in secondary education. There is a strong need to develop and test new models of the factors that will enable the effective use of the WWW in high schools. One such model is based upon the concept of the WWW as a "cognitive tool" (Reeves & Reeves, 1997). Cognitive tools refer to technologies that enhance our cognitive powers during thinking, problem-solving, and learning (Jonassen & Reeves, 1996). Using the WWW as a cognitive tool, students tackle difficult problems and complex tasks, organize unique knowledge representations, and share what they have learned with others for analysis, critique, and revision.

The purpose of this research is twofold. First, the features of the WWW that increase and sustain the motivation of online learners will be identified through interviews with students, teachers, and experts. Second, using development research processes, a fossilization Web-based Learning Environment (Web-LE) that incorporates these motivational features will be designed, developed, and tested in the context of high school science.

Background

The primary setting was a local private school located in a small city in northern Georgia. This school is equipped with well-organized computer technology including computer labs and wireless network. Students and teachers are used to the computer environment and equipped with high computer literacy. This research adopts purposive sampling method based on the specific purposes to work closely with the science teacher and students in a local school to promote learners' motivation and learning achievement. The participants are one male teacher and 16 10th grade students. The teacher is an experienced science instructor. The teacher encountered problems to convey the concept of fossilization to students, and has difficulty to motivate students.

The science teacher reported that the students have problems to understand the concept of fossilization. Fossilization is a result of complex combination of organism, ecological and physical burial. The fossil would be formed only under the correct situation. Students have to understand that how and why ecological and physical burial influence fossilization. The teacher couldn't find accurate or useful materials to help students visualize the process of fossilization. Some web sites introducing the fossilization contain only still images, pictures and texts, and the representations are not realistic enough or accurate to be employed in the classroom. The science teacher needs a tool that is realistic and accurate to explain the fossilization and provides opportunities for learners to consider the potential combinations of different decision. The learner will be able to identify situations that will cause fossilization. After evaluating the current available computer-learning environment, a Web-LE has been decided to be employed to carry the instructional contents.

Employing Web-LE as the cognitive tool

Owston (1997) indicated that the key to promoting improved learning with the Web appears to lie in how effectively the medium is exploit d in the teaching and learning situation. The standard online tools mentioned above offer restricted choice to instructors seeking to offer experiences with complexity and dynamics of classroom experiences, and we need new tools to enable a variety of interactions (Hughes & Hewson, 1998). The advent of online interactive learning system enhances the interaction in the learning environment. Participants can interact with other participants to discuss the questions and concepts. With authoring tool (e.g., Macromedia shockwave, Flash, Authorware, JAVA), instructor can design the synchronous or asynchronous activities based on different goals and tasks. The features of open environment and immediate communication can be embedded in the application to enable collaborative learning strategies. The ability of these tools to carry interactive multimedia contents support design of situated learning strategies by simulation, problem solving or authentic activities (Leflore, 2000). The features of dynamic pages allow learners interact with contents directly to process the information individually. Learners will be benefited by the delivery of information with appropriate instructional design instead of presenting information in hypermedia structure and multimedia contents (e.g., streaming audio and video). Web pages can carry multimedia and access to the open environment. Learners can interact with content with pages (browsing, filling questionnaire…), and the level of interactivity depends on how the designers design the web pages. With the features that the WWW provide, it makes Web the appropriate tool to carry the instructional contents.

Several doctoral and master students have been working together to design the fossilization Web-LE in the Department of Instructional Technology at University of Georgia under the guidance of two faculty members. The science teacher is the subject expert, who works closely with the team to verify the accuracy of the contents, identifies the educational problems and provides feasible instructional strategies. The system is developed by Macromedia Flash and combines with the online database with ASP and MS Access.

Instructional design strategies

Several strategies for increasing students' intrinsic motivation will be involved in the Web-LE. First, Lepper and Hodell's (1989) four characteristics of tasks that promote individual intrinsic motivation will be integrated into the instructional design.

1. *Challenge:* Engaging with the activities that challenge learners' abilities may enhance the intrinsic motivation. The premise is that the challenges of activity and skills of learner should be matched.

2. *Curiosity:* Curiosity can be achieved by using the technical events to attract the learner's attention. Highlighting incompleteness or inconsistency is one technique to arouse the curiosity. Through the provision of unpredictable or random events may motivate learners to continue the learning processes.
3. *Control:* Learners' intrinsic motivation may be enhanced if the activities can provide a sense of control over their learning performance.
4. *Fantasy:* Fantasy environment is defined by Malone and Lepper (1983) as one that evokes mental images of physical or social situations not actually present

Second, Web has the capabilities to facilitate the communications among participants, and this feature provides the opportunities to carry out the cooperative and competitive strategies, whereas the open environment feature enables learners to publish their products or achievement and have people recognize their performance. The design of Web-LE will integrate the cooperation, competition and recognition strategies to facilitate collaborative learning pedagogy and stimulate interpersonal intrinsic motivation (Malone and Lepper, 1983).

The third strategy is to integrate multimedia objects into learning context. Learning with multimedia provides an effective alternative instructional strategy (Mathewson, 1999). From the motivational perspective, using medium to assist instruction indeed enhance learners' interest (Freeley, 1982; Kramarski & Feldman, 2000). Computer enables visualization of scientific concept and Internet enhances interaction among learners. The multimedia objects will be employed to represent the fossil concepts to enhance the intrinsic motivation.

Overviews of the system

Instructional content

How does a living thing become a fossil? Not all parts of animals and plants become fossilized. After completing learning the concept of fossilization with this cognitive tool, students will be able to identify conditions necessary for fossilization and construct possible scenarios for formation of fossils by manipulating the variables in the simulated processes. Fossilization is a rare event. The chances of a given individual being preserved in the fossil record are very small. Whether a living thing could become a fossil depends on three categories of conditions (organism, ecological status and physical burial), if an organism has hard part or not, if an organism gets buried quickly and the ecological situation, where an organism dies. It's only possible that a living thing can become a fossil when these three conditions are met.

System function

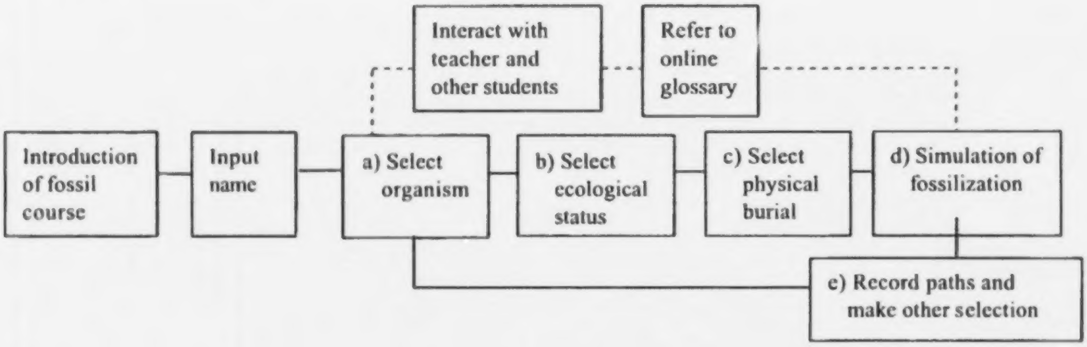

Interact with teacher and other students
Refer to online glossary
Introduction of fossil course
Input name
a) Select organism
b) Select ecological status
c) Select physical burial
d) Simulation of fossilization
e) Record paths and make other selection

Figure 1: Flow chart of the fossil Web-LE

Figure 1 is the flow chart of the fossilization Web-LE. When entering the Web-LE, learners will see the instructional page to explain the learning objectives and goals of the fossil unit. Learners have to input names and login into the system. In screen a, learners can select different organism to observe the fossilization process. The dinosaur is the only available organism in the prototype. The description of this organism is placed under the screen (Screen 1). Learners can access to the online glossary to look up information if they have any questions. In screen b, they need to select the ecological status (Screen 2). In screen c, learners need to select physical burial. The combination of three decisions can decide whether the fossil will be developed. Simulation of fossilization begins when the decision has been made. The system will record paths that learners just made and help learners to identify the learning progress (Screen 3). After experiencing all twelve possible paths, learners will be able to identify the situations that can create fossils (online assessment).

The complete twelve possible combination including:

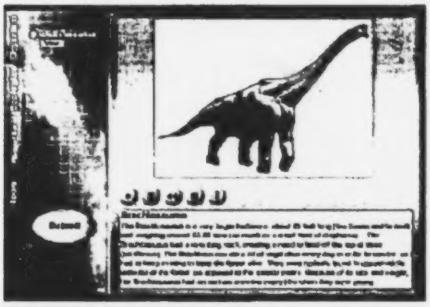
1. Organism
2. Ecological (3 conditions): temperate rainforest, tropical rainforest and tropical mountains
3. Physical burial (6 conditions): weathering, ashfall, lava flow, pyroclastic, flood and swamp mud burial.

Learners can assess to online glossary to look up information about these conditions. With the communication tools that the Web-LE provides, learners can send e-mail to other learners and teacher. They can discuss questions with the bulletin board.

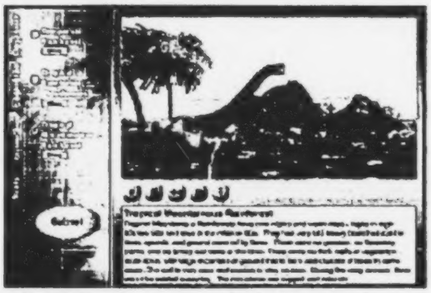
Media development

The primary audience is high school students who appeal to realistic graphics and animation. The science teacher also requests for the realistic representation of the fossilization process. Several endeavors are made to achieve the requirement. Referring the accurate images, the dinosaur is developed with accurate proportion and color. 3D software is used to develop the realistic landscapes and objects including ancient plants, volcano, lake and fossils. Macromedia Flash is the primary authoring tool because of its ability of integrating multimedia and the capability of optimizing media to enhance the speed of transmission.

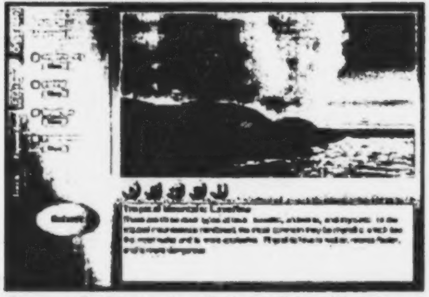
Screens example



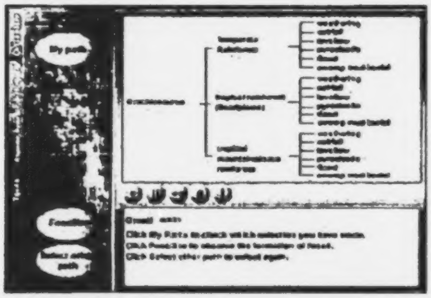
Screen 1: Select organism



Screen 2: Select ecological status



Screen 3: Begin simulation of fossilization



Screen 4: Use "my path" to record selections

Learners need to select organism in Screen 1. The description of this organism will appear in the text area. Learners should continue to select ecological (Screen 2) and physical burial conditions. When learners click

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"submit" button, the simulation of fossilization will begin. An animation will appear to depict the procedures of fossilization. For instance, in Screen 3, learner chooses combination of " Brachiosaurus", "Tropical Mountain" and "Lava Flow". When simulation begins, the volcano explodes and the lava catches up the dinosaur to mantle its body. The fossil will be formed in this situation. In Screen 4, learners can assess to the communication tools (e-mail and discussion board). The function of "my paths" will record the paths that the learners have made and identify their learning progress.

Validation

The formative evaluation strategy is employed to make sure the content is accurate. The subject expert reviews the contents once a week and provides suggestion constantly. After the production is completed, the participants will be formed into one control group and one treatment group. Several instruments will be employed to exam the effects of the Web-LE on motivation, science and learning with Web-LE. The following interview with teachers and treatment group students will be conducted to probe their suggestions toward the Web-LE.

Expected Results

The expected results include: 1) effect of Web-LE on learning is significant difference between the control and treatment groups, 2) learners' motivation toward learning science with Web-LE is significant difference between the control and treatment groups, 3) the previous two results can confirm the usefulness of the pedagogies and identify the motivational indicators, 4) identify the mental model of online learners. The Web-LE will be released online and all teachers and learners who are studying the similar unit can use it as a learning resource.

Future work

The fossil Web-LE contains twelve paths and each of them needs to be completed by March 2002. The online database is under development to record and preserve users information. We're developing the communication tools including email and bulletin board to enable the interaction among participants. The science subject expert is helping us to design the glossary pages for learners to refer to. The glossary pages contain multimedia explanation about the units of fossilization (for instance, the various images of fossils and video clips of reconstructing fossils). The fossil project is one unit of the entire Geology and Ecology course in the school. The URL of the Geology and Ecology course is: http://128.192.78.9/science. Other units (geological time, radio dating, volcano and continental drift) will be designed after the fossil project to expand the web-site into a learning resource for science class in high school. The URL of the fossil project is http://128.192.78.9/science/fossil (the permanent URL will be activated after June 2002: http://www.itstudio.net/fossil).

Reference

Freeley, J. T. (1982). Content Interests and Media Preferences of Middle-Graders: Differences in a Decade. *Reading World*, 22(1), 11-16.

Hughes, C., Hewson, L. (1998). Online interactions: developing a neglected aspect of the virtual classroom. *Educational Technology*, 38(4), 48-55.

Jonassen D. H., & Reeves, T. C. (1996). Learning with technology: Using computers as cognitive tools. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp.693-719). New York: Macmillan.

Leflore, D. (2000). *Theory supporting design guidelines for Web-based instruction*. In B. Abbey (Ed.). Instructional and cognitive impacts of Web-based education.

Lepper, M. R., & Hodell, M. (1989). Intrinsic motivation in the classroom. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (Vol. 2, pp. 73-105). San Diego, CA: Academic Press.

Kramarski, B., Feldman, Y., Internet in the classroom: effects on reading comprehension, motivation and metacognitive awareness, *Educational Media International*, 37(3), 149-55.

Malone, M. R. & Lepper, M. R. (1983). Making learning fun. In R. E. Snow & J. F. Marshall (Eds.), *Aptitude, learning, and instruction: Conative and affective process analyses* (Vol. 3, pp. 223-253). Hillsdale, NJ: Lawrence Erlbaum Associates.

Mathewson, J. H. (1999). Visual-spatial thinking: an aspect of science overlooked by educators. *Science Educatio,* 83(1), 33-54.

Owston, R. D. (1997). The World Wide Web: A technology to enhance teaching and learning? *Educational Researcher*, 26(2), 27-33.

Reeves, T. C., & Reeves, P. M. (1997). The effective dimensions of interactive learning on the WWW. In B. H. Khan, (Ed.), *Web-based instruction* (pp. 59-66). Englewood Cliffs, NJ: Educational Technology.

Salomon, G., Perkins, D. N., & Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher*, 20(3), 2-9.

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If You Build It, Will They Come? Helping Instructors Change Their Role

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Abstract: The study examined three engineering courses that were offered in the Fall 2001 at Greenfield Coalition in order to facilitate the changing role of instructors. These three courses, as other Greenfield courses, with its learner centered instructional strategies and technologically enhanced activities, were designed to have the instructor function more as a facilitator, mentor, and coach rather than the typical stand-up instructor. This study documented the instructional strategies and learning activities that helped instructors transition from a traditional standup instructor to a "guide on the side." In addition, this study identified factors that affected the successful implementation of instructional strategies and technology and also suggested ways to assist instructors to implement technologically enhanced and learner-centered strategies.

Introduction

The high demand to produce knowledge users and problem-solvers requires that instructors play the role of coach, mentor and facilitator rather than director and disseminator of knowledge. This demand calls for change to traditional teaching. As instructors are introduced to new instructional strategies and tactics that force them to function as a "guide on the side," it is essential to study the effect that such strategies and tactics have on the traditional instructor and to identify ways to assist instructors making this transition.

The purpose of investigating the usage of instructional strategies and technology was to identify: instructional strategies and learning activities that facilitate the transition from a director & disseminator of knowledge to that of a coach and resource; the factors that might affect the successful implementation of new instructional strategies and technology; as well as ways to assist instructors implementing technologically-enhanced and learner-centered strategies.

The courses investigated, Arts in Action, Engineering Economics, and Tool Design and Construction, are required courses for all candidates enrolled in a degree program through Greenfield Coalition (GC). GC courses are designed based on the belief that students will learn faster, and will become more effective problem solvers if engineering education and practice are integrated, and students actively participate in their learning.

Data Collection and Analysis

Eight instructors were invited to participate in this study. Five of them returned our survey and participated in a focus-group interview. All but one of them has been teaching for more than 6 years. The survey and interview focused on the use of instructional strategies, instructor's perception of teaching, assessment methods, barriers to adopt Greenfield courses, and types of support that instructor will need to fulfill their role as a facilitator.

Survey data were tabulated by the question items. Qualitative data were coded into indexed categories and subcategories. Through iterative comparisons of these categories and subcategories with the guided research questions, key issues and themes were generated.

Findings

The survey and interview data indicated some trends in using instructional strategies and technology.

Using instructional strategies

All participating instructors were aware of the instructional strategies used in the three courses being studied. All instructors rated lecture as an effective teaching method, and they all used student discussion as well as required student participation in class. Four instructors described their teaching as engaging and interactive. Four out of five instructors used such strategies as case studies and projects and they all viewed them as effective teaching methods. Three instructors thought that students achieved listed objectives. Two instructors required students to work together. One instructor used online interactive problem solving and additional WWW resources. One instructor used student input to determine course content. In assessing student learning, there is a combination of traditional tests and quizzes, and authentic evaluation such as projects, case studies, and peer evaluation.

Instructional strategies rated as "well and will work well" to help the instructor transition from traditional knowledge disseminator to facilitator, mentor or coach include: *instructor* playing role *of* coach, having resources available to students all the time, doing more hands-on, using real world problems or examples, using authentic tools, facilitating group discussion, using interactive activities, what-if questioning, and projects.

Using technology

In class, instructors use more traditional media, such as whiteboard, LCD projector, and audio-visual equipment. Outside of class, instructors use more new media such as computer and Internet resources. Other than traditional media, only two of five instructors indicated incorporation of technology in their teaching. Instructors indicated a desire to use technology more in the future. One instructor hoped that technology-enhanced strategies would help him reduce his reliance on lecturing. Another would like to have a course that is "plug and play," and portable. Yet another would like to explore the possibility of providing real time feedback using technology.

Factors affecting the successful implementation of instructional strategies and technology

Instructors raised some issues regarding the adoption of the role of facilitator. These include: student and instructor readiness, and administrative support. Three instructors felt frustrated with students not taking responsibility for their learning. Also, one instructor was puzzled with the value of teaching if the instructor was not there to "instruct." Yet another felt that his role as a facilitator may be criticized by peers and administration.

Technological constraints, which include the infrastructure, technical support, and reliability issues, discouraged instructors from adopting technologically-enhanced instruction. Additionally, some classrooms did not have enough computers to use, or did not have adequate Internet connections.

Implications and Conclusion

From our limited sample, we noticed that instructors used a combination of instructor-centered and learner-centered instruction. While lecture is the predominant mode of instruction, instructors began to incorporate strategies that required students' active participation, such as real world problem solving and hands-on projects.

Below are suggestions that we believe would enable the greatest ease in the adoption of the GC paradigm:

- Demonstrating course materials and the use of instructional strategies and technologies at partner universities to promote wider use.
- Conducting faculty development workshops to help faculty adopt student centered strategies.
- Planning and implementing an ongoing technical support system.
- Encouraging academic Directors and Deans to promote instruction that is learner-centered, technology-enhanced, problem-based, and reality-based.

Moreover, we feel that the issues faced by GC are not unique or new. The findings verify that if you built it, they (the instructors) may not come. Although instructors were aware of the instructional strategies and agreed that online materials were good, the barriers prevented them from fully implementing the activities. Three things need to take place before instructors can fully adopt facilitator's role and endorse student's responsibility for learning: instructor readiness, support from administration in terms of a reward system (recognition toward tenure, etc.) and the assurance that ongoing technical support will be provided and be considered a priority.

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Yes I Can: Teachers Developing Interactive Classroom Activities Using Digitized Resources

In cooperation with the Education and Research Consortium of Western North Carolina, teachers from WNC public, private, and charter schools as well as undergraduate pre-service education majors are participating in a pilot program which enables educators to utilize through the Internet the millions of resources held by the Library of Congress (http://www.loc.gov). The educators chosen to participate in the project are on the leading edge of the development of a classroom technology program that is expected to become a national model. The pilot program exists at Montreat College as well as 4 other institutions that are a part of the Education and Research Consortium of Western North Carolina.

The focus of the project is to provide pre-service and in-service teachers the tools and instructional skills necessary to integrate technology into the teaching and learning process. The objectives for the four year program are as follows: a) To demonstrate a Library of Congress American Memory Fellows Program pilot that teaches teachers how to utilize technology and digitized primary resources in their classroom instruction (http://memory.loc.gov) b) To train pre-service and in-service teachers to use primary resources in their class instruction c) To further validate the American Memory program with a broad group of K-12 teachers in local settings and d) To demonstrate and evaluate a training program that can be exportable to other communities.

Participants selected to participate in the Adventure of the American Mind program (http://aam.montreat.edu) are required to complete a one-year program that includes three phases. The first phase is a three-day Summer Institute that introduces the laptop which is provided for each participant by the program and immerses the participants in the basics of using PowerPoint. Phase II is a graduate level course, Multi-Media and the Internet in the Classroom(http://aam.montreat.edu/ED504). This course runs for fifteen weeks, 3 hours each week and yields 4.5 CEU's and 3 graduate credit hours. The participants learn how to integrate technology into their classrooms and schools, how to build interactive projects in PowerPoint, and how to engage students in the learning process to build higher level and critical thinking skills. The final phase of the program is the Mentoring Phase. Following the train-the-trainer model, participants act as mentors as they take the skills and techniques and skills from Phase I and Phase II and share them with colleagues. The mentoring may be either in one-on-one or group workshop setting. After successfully completing all phases of the one-year program, the participant earns permanent ownership of the laptop.

Weekly in-class activities for the teachers were designed to enhance their use of and understanding of electronic resources. Journal articles broadened participants' knowledge of ethical and practical issues relating to the integration of technology into classroom activities. Participants were required to respond to the articles on-line in a threaded discussion. Group discussion in class highlighted major issues that arose during the threaded discussion. Mechanics of designing presentations including downloading and uploading graphics and music as well as the esthetics of presenting information on-line were presented in class. Lab time was available for individual practice during each class. As a final product, participants presented an interactive PowerPoint-based lesson that each would use in the classroom. The presentation was accompanied by a unit plan which included state and local course objectives for the grade and subject level taught.

On-line assignments were also a part of class requirements. One class activity required students to read articles on-line and post responses related to the application of the information from those articles. Another assignment was for participants to locate exemplary lesson plans that integrate technology into the lesson. They entered the URL for the lesson plan, a summary of the plan, and an evaluation of the plan into the class database. All of the class work was designed to enhance the participants' skills and informed practice as they formulated lessons and philosophies for their specific classroom needs.

The growth from novice to confident developer of creative and innovative lesson plans was facilitated by opportunities for participants to develop relationships with others in the class. During part of each class, participants worked in a group. Rotating the members in the groups each week gave the opportunity for participants to interact throughout the semester with each member of the class. In addition, a portion of each class period was allocated for mentoring. Pre-service teachers were assigned a hypothetical "class" which included the characteristics of each student. The pre-service teacher education students then visited the classrooms of the in-service teachers who taught the same grade level. The classroom visits enabled the pre-service teachers to develop strategies and appropriate classroom activities for their "class." Reciprocally, the pre-service teachers mentored their in-service partners in technology skills.

The final component of the class was its instructional team. During each class meeting a curriculum specialist, an instructional technology specialist, and a technical support specialist provided input. These three instructors were available on-line or by telephone during the week as well as during class to assist teachers in their learning process.

Mitigating Risks During the Transition to Fully Automated Exams:

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Abstract: In this paper we present a strategy how traditional in-class exams can be substituted by computer-based exams. Exams obviously involve security issues; for instance, the aspect of availability is of great concern to students whereas teachers expect integrity of the results. Under no circumstances will students tolerate exams being lost while they take them or will teachers use a system where exam answers can be changed after the exam.

The stepwise migration strategy from traditional paper-based to computer-based exams proposed in this paper has multiple benefits: (1) advantages of migration are perceived at every stage by all stakeholders. (2) Fall-back options exists that may be used if problems occur. (3) Paper-based backup used to cover legal uncertainties. (4) Instructors can independently decide when to migrate to the next step.

1 Introduction

During the transition of a conventional examination system to fully automated Web-based tests, day-to-day business processes should only be briefly interrupted. We therefore show how we use a stepwise migration strategy to eventually establish a fully automated Web based examining system that allows students to take exams almost anytime.

Our main contribution is to show how to setup a stepwise migration strategy that minimizes organizational interruptions. Moreover, we emphasize an approach where moving to the next step is always perceived as advantageous by all stakeholders.

2 Multi-Step Approach

Before an exam can be generated automatically a database of exam questions and answers has to be created. Despite a still limited application at Austrian universities we found that multiple-choice exams are well accepted by students. We propose to use questions with five options each, of which exactly one answer is correctly. An exam comprises approximately twenty questions with five possible answers each; thus the probability of a student passing the exam by chance is very low.

Once a database of approximately one hundred questions has been compiled we recommend proceeding to the first step and using automatically generated exams for in-class test.

	Question sheet	**Answer sheet**	**Correction sheet**
Step 1: Automatic class-wide paper based	Paper	Paper	Paper
Step 2: Individual paper-based	Paper	Paper	Paper
Step 3: Electronic answers	Paper	Electronic (and paper backup)	
Step 4: Web-based	Electronic (and paper backup)		
Step 5: Using software	Integration of 3rd party software such as Microsoft Excel		

Table 1: Overview of the 5-steps in the transition process.

	Disadvantages	**Advantages**
Step 0: Traditional exams	Within one exam, similar question. Therefore cheating is easy because everyone gets the same questions.	Instructor has full control over choosing questions Exams are fair as everyone gets the same questions.
Step 1: Automatic class-wide paper based	Within one exam, similar questions	Generating exams is fast Exams are fair.
Step 2: Individual paper-based	Exams might be considered unfair	Exams can be taken anytime because exams can be generated very fast.
Step 3: Electronic answers	Exams might be considered unfair	See above plus Correcting exams is faster and more accurate.
Step 4: Web-based	Exams might be considered unfair	See above plus Exams can be taken anywhere (at any test center)
Step 5: Using third party software	Exams might be considered unfair	See above plus Exams resemble real life tasks and realistic tools are used

Table 2: The rationale for continuing to step 5.

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3 Practical Experience

In this section we will present the tools we developed supporting the aforementioned stepwise migration. The main purpose is not to promote our solution but to show that every transition by itself requires only little development effort and the time between migration steps can be scheduled to match scarce resources of developers and faculty.

3.1 Database

The application presented in this section works with any ODBC database; we tested it with mySQL (www.mysql.com) and Oracle (www.oracle.com); as the current installation is mainly used by students to generate practice exams mySQL suffices as database. The drawback of mySQL is that concurrent write accesses to the database are slow; however, write accesses are only necessary for real exams.

3.2 Exam Creator

Teachers can specify what an exam (e.g. Test01) looks like by selecting different rules. For instance, the teacher wants that the exam contains 3 question that satisfy the condition mathStat=1. There are 48 questions that satisfy this criterion.

The rationale for choosing this complex specification is that all the teachers in the department prefer typing conditions (that can be quite complex) to limited GUIs. The green numbers on the right indicate how many questions really satisfy the condition. If an illegal condition is entered, a '0' highlights that no questions are available.

Each question has two mandatory values assigned: required time to complete and level of difficulty. An exam is composed of randomly selected questions that satisfy the aforementioned restrictions. For each exam a minimum and maximum time and difficulty are also specified. The sum of the values of all questions that are randomly selected should lie within the specified ranges. A tool helps teachers and checks how many randomly generated exams satisfy (green dots inside the shaded area) the time/difficulty bounds and how many do not (red dots outside of the shaded area). If there are a lot more red dots than green dots the generation of an exam might be slow because only "green" exams are really generated for students. "Red" exams might be too difficult or require too long to solve.

This user interface is used by faculty and staff in step 1 and 2 to automatically create paper-based exams.

3.3 Web-based Practice Exams

A very simple Web server allows publishing practice exams on the Web. It suffices to copy a small executable file which subsequently serves as a Web server. The advantage is that installation is very easy and even teachers without special IT knowledge can install and maintain the server without the help of IT staff. Students enter the system with a Web browser and can select an exam. Thereafter an exam will be automatically generated and both the questions and answers will be available to the student.

Students benefit considerably from practice exams since they can continuously assess whether they reached their learning goals [Woit and Mason 2000].

3.4 Computer-based Exams

From step 3 on a simple program is used by students to enter their answers. The focus was obviously placed on a simple design. After pressing 'OK', the student is asked whether she wants to hand in the exam or continue editing it. When she decides to hand in, a paper copy of the exam and the answer sheet is printed.

4 Conclusion

In this paper we explained how a multi-step approach can be used to minimize risks when introducing computer-based exams. The key issue is security and the option to "fall back" to previouses steps if problems occur. Moreover, as every new step brings benefits to the stakeholders, the chance of successfully completing the project, i.e. of going all the way to step 5, is high.

5 References

[Barsky and Shafarenko 1997] D.B. Barsky, A.V. Shafarenko, WWW and Java-based distributed examination system for distance learning applications, 356 – 363, Proceedings of the 2nd AIZU International Symposium on Parallel Algorithms / Architecture Synthesis (pAs '97), 1997 IEEE.

[Weippl 2001] Edgar Weippl, Countermeasures against Security Breaches in Web-based Training Environments, pp 2019 – 2024, Proceedings of EDMEDIA 2001, ISBN 1-880094-42-8, AACE, Tampere, Finland, June 2001.

[Woit and Mason 2000] Denise Woit, Dave Mason Enhancing student learning through on-line quizzes, Technical Symposium on Computer Science Education, Proceedings of the thirty-first ACM SIGCSE technical symposium on Computer science education, 367 – 371, Austin, TX, 2000.

The Transition from Computer-Based Training to eEducation

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Abstract: Navigation is one of the key aspects of eLearning environments that can make a difference when comparing new forms of learning to traditional ways of learning. In this paper we elaborate on the experience we gained while developing an eLearning solution and highlight the relevant issues giving screenshots.

1 From Computer-Based Training to E-Education

During the past few years the Web has fundamentally altered many people's work life. Businesses were transformed into e-businesses and the buzzword 'e-commerce' is now ubiquitous. There is, however, an industry that only gradually adopts these new technologies - teaching. Despite the fact that universities have significantly contributed to the development of the Web, it is still not fully used to improve academic teaching.

It was only last year that the term eLearning was defined by Lennox [Lennox 00] as "the use of e-business technologies to speed the flow of business information and knowledge from creator to learner in a highly personalized, on-demand fashion".

In this paper we will present two decisive factors for Web-based training (WBT) software in the context of e-education. We will focus our report on offline education, as real time communication (except chats) is not yet sufficiently reliable due to low bandwidth Internet access in most European rural areas. Moreover, one of the main advantages of WBT software is being able to study according to one's own schedule. Even if online communication was available, a large offline corpus of knowledge would be required too – just like textbooks are used in today's courses to support traditional in-class teaching. The techniques presented in this paper can help to organize the electronic equivalent of textbooks.

Compared to textbooks, correspondence-based distance learning programs and first generation computer-based training software, WBT offers many advantages. Two of them which we consider most important will constitute the main focus of this paper: First, *navigation* is no longer limited by serially flipping through pages and second, *interactive examples* are far more likely to actively involve students while studying. Throughout this paper we will give examples of how these features have been successfully implemented [Weippl 99] in WBT software called Teach/Me [Lohninger 99].

Dating back to the hype of the term "eCommerce" eLearning is widely used in different ways; for instance, [LineZine] understands eLearning ranging from "the convergence of the Internet and learning, or Internet-enabled learning" to "the use of network technologies to create, foster, deliver, and facilitate learning, anytime and anywhere" or "the delivery of individualized, comprehensive, dynamic learning content in real time, aiding the development of communities of knowledge, linking learners and practitioners with experts."

[ELearners Glossary] defines e-learning as any form of learning that utilizes a network for delivery, interaction, or facilitation.

According to [Learning Circuits Glossary] "E-learning covers a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio- and videotape, satellite broadcast, interactive TV, and CD-ROM."

2 Interactive Navigation

Based on the knowledge of how students learn, it seems obvious that the way of presenting knowledge and the options offered to navigate or access it, are essential for successful teaching. It is a commonly known fact that WBT offers the possibility to design teaching material that can be accessed in a non-linear way. However, a brief scan through existing course material reveals that a large number of today's courses are not designed for efficient navigation which is needed for learning. This is why it is essential, that when designing the navigation structure for WBT software one always has to keep in mind that the ultimate goal is to effectively convey knowledge.

In this section we will first discuss theoretical issues that are essential for designing ways to navigate WBT content. We will then continue by discussing various forms of navigation. Finally we will elaborate on the forms of navigation best suited for different targets of learning.

2.1 Learning Process

When studying, people usually create an internal representation of the topic they study. A cognitive map, i.e. a form of visualizing content structure, can aid in this process. Cognitive maps are two-dimensional representations of knowledge structures. They are based on the assumption that the relationships between ideas or concepts can be uncovered due to semantic proximity; that is, semantically related ideas will appear close in geometric representations of cognitive space whereas unrelated concepts will be separated by a greater distance.

Fenker [Fenker 75] states three assumptions about cognitive maps: First, information about a topic is organized and interpreted on the basis of a set of dimensions which represent organizational features of the topic. Second, these dimensions can be represented in n-dimension geometric space. Third, there are many relationships that can exist among concepts. Similarity, degree of association, and the extent to which one concept implies another are examples of these types of relationships. That is, the nature of the semantic relationship is implicit in the relationship but has to be interpreted.

During the learning process cognitive maps can be used to assess how well students have integrated recently acquired knowledge and whether they can position it within existing knowledge. The student draws a concept map representing his current knowledge; areas not well linked to other parts of knowledge may be identified and indicate the necessity of further studies.

Acquiring new knowledge, i.e. transforming external to internal representations preserves certain aspects of the representation, mainly the topology [Steiner 88]. Cognitive maps do not seem to be a full and continuous representation of the information stored in mind. They are fragmented and distorted on an individual basis. Since they change dynamically they cannot be easily copied onto an external representation. Each time an individual tries to output the interior cognitive map containing specific knowledge, it looks different. This implies that there is not only one 'correct' spatial representation of relations between topics.

Although the definition of cognitive maps varies in the literature, there seems to exist an agreement that cognitive maps are an appropriate way to represent relationships between different entities of knowledge [Driver 92], [Gergen 92], [Spiro 92], [Galsersfeld 92].

Some details seem especially important in the context of this paper. Certain points of interest and paths between these points are learned (i.e. external maps are internalized) when studying new concepts. Using those paths, the overall context of the knowledge can be understood easily because students can look at topics in the vicinity of those paths to find related concepts.

The first step in the process of teaching is that the attention is drawn to points of interest, i.e. important topics. Learners perceive these points of interest either because they are highlighted on the cognitive map and can therefore be easily spotted or due to their Importance. In a second step points of interest that are close to each other are used as starting or end points of paths. Knowledge of these paths seems to be more or less knowledge of starting- and endpoints and orientation in the map. This "learning of paths" is what can be achieved by using "Guided Tours" in a Knowledge Landscape, which will be discussed in greater detail in the next section.

2.2 Navigation Metaphors

Initially most CBT programs implemented the behaviorist paradigm. Since the days of behaviorism seem to have passed an increasing number of approaches in CBT try to adopt constructivist methods (overviews can be found in [Jonassen 93], [Brandt 95]).

Freeman [Freeman 96] tried to integrate the constructivist paradigm into a course enabling teachers to use the Internet for distance learning. Having taught the necessary basics, she gave the participants the opportunity "to build up their own internal knowledge base."

The visualization of a given field of knowledge should leave it up to the students how to explore the data, how to structure the contents, where to set priorities and to decide which chapters they consider as related. However, in order to avoid the experience of not knowing what to learn and not being able to structure the presented data, presenting some pre-defined structure to start with is useful.

The modes of navigation offered by Teach/Me [Lohninger 99] go far beyond those of other textbooks.

Pohl et al. [Pohl 95] have identified four main difficulties when creating educational hypertext. First, authors are used to structuring text in a linear or hierarchical way like in printed textbooks. Second, the texts are often too long and do not have enough words highlighted e.g. by bold typesetting. Third, scientific publications as well as textbooks have long argumentative strains that support one final solution for a certain problem. These parts have to be read in a fixed order determined by the author. Fourth, a large number of short texts may be confusing, especially if they are not suitably structured. This can result in the well-known phenomenon of 'Lost-in-Hyperspace'. Two of these issues, i.e. hierarchical text structure and potentially confusing hyperspace navigation can be addressed by providing multiple forms of navigation through WBT content. We will now present four different approaches to navigating hyperlinked textbooks.

2.2.1 Table of Contents

The oldest form of navigation through written information is the table of contents. It is still widely used in today's hyperlinked WBT. This is mainly due to the fact that everyone is familiar with this form of navigation. Most authors think that sequentially structuring content seems to be an efficient way. However, the fact that researchers and authors like a hierarchical-linear structure is to a great extent because it is the structure they have always used.

Despite the advantages offered by the navigation interfaces discussed later in this section, WBT courses should always include a table of contents because everyone expects it and knows how to use it.

2.2.2 Keywords – Indices

Similar to the table of contents, an index is a form of navigational interface commonly found in books. Nonetheless, software may offer a much greater flexibility. First, searches for keywords can be more expressive by using Boolean expressions. Second, by displaying an indexed expression in its context before actually opening the page users can quickly scan through a large number of matches. Compared to paper-based indices that sometimes refer to ten or more different pages for a single keyword the quicker access in a Web-based textbook is certainly an advantage.

2.2.3 Hyperlinks

Hyperlinks are commonly used to navigate through hypertext. Today's Web is linked by only one link type that can represent different forms of how a linked text is related. Rada [Rada 91] distinguishes three fundamentally different forms of links. (1) Sequence links connect pages in a linear sequence. Using 'Next' and 'Back' links helps especially first and second year undergraduate students to access all pages relevant for a lecture. (2) Outline links refer to pages that contain overview. (3) Reference and citation links point to pages that describe topics in greater detail.

When designing WBT software we recommend to clearly indicate (e.g. by a particular icon) the kind of link; this helps students to decide whether they want to follow a link or not. Figure 2, for example, shows two different links; one opens an interactive example to illustrate concepts explained in the HTML page, whereas the other link starts a calculation tool with preloaded exercises so that students can apply their newly acquired knowledge.

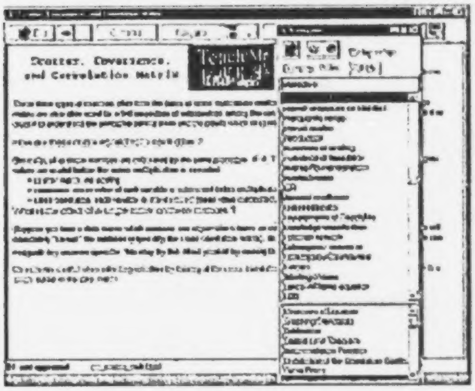

Figure 1: Teach/Me offers a simple but yet efficient index.

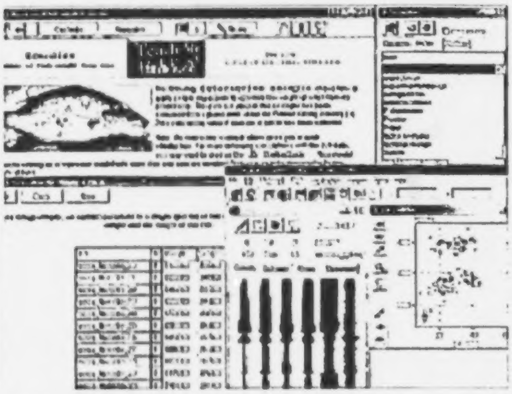

Figure 2: The Web page (top left) contains two different links. One link opens an interactive example (bottom left), whereas the other one starts a calculation program and preloads data for a certain exercise.

2.2.4 Knowledge Landscape

To provide a good overview and easy navigation we have chosen to visualize the textbook with the help of a Knowledge Landscape. A mountain in the landscape represents each page of the underlying textbook. The formation of the Knowledge Landscape is governed by two general rules: (1) In the 3D version, fundamental chapters, explaining basic concepts, are visualized by high mountains, whereas more specific lessons are displayed by smaller mountains. (2) The placement of the mountains is made according to the similarity of the contents of the corresponding lessons. Thus highly related texts are placed next to each other. The positions of the mountains on the 2D surface are computed automatically. This approach allows easy non-linear and non-hierarchical access to originally hierarchically structured documents.

Static objects in a landscape, whether they are real or virtual, have unique fixed positions in the spatial three-dimensional space. We all have experienced the exploration of unknown and the navigation in known territory since early childhood. Thus we are used to remembering the relative positions of objects in our environment and we can easily find objects again, even if they are not in our direct line of sight. Despite the fact that there is not only one 'correct' spatial representation of relations between topics we offer only one Knowledge Landscape as novice users may easily be confused if they are confronted with more than one spatial representation.

2.3 Learning Targets

In this subsection we will have a closer look at five learning targets and we will examine which forms of navigation are best suited for each of them.

2.3.1 Training – Drill and Practice

Drill and Practice training was one of the first applications for computer-based training. The computer was the perfect tool to teach highly standardized procedures such as preflight preparations for an aircraft's cabin crew. A major component of these simple CBT programs is testing the students' knowledge. Objective tests and quizzes are among the most widely used and well-developed tools in higher education. Each question assumes a simple answer that can be evaluated either as correct, incorrect, or partly correct. According to the expected type of answer, questions are often classified into eight types. There are four basic types: (1) yes/no questions, (2) multiple-choice/ single-answer (MC/SA) questions, (3) multiple-choice/multiple-answer (MC/MA) questions,

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and (4) fill-in questions with a string or numeric answer. More advanced type of questions include (5) matching-pairs questions, (6) ordering-questions, (7) pointing-questions – the answer is one or several areas on a figure – and (8) graphing-questions – the answer is a simple graph. Also, each topic area may have specific types of questions [Brusilovsky 99].

If CBT software is developed for drill and practice, the most important navigation tool is the table of contents. It gives students a clear outline of what will be covered. There is no need to support learning or understanding additional topics as the whole learning process is highly predefined. Referring to the example of training cabin crews, the CBT software does not need to help students understand which preflight checks a pilot would have to make.

2.3.2 Gaining an Overview

Especially in a professional working environment it is very important to be able to quickly gain an overview of a topic and to identify the main concepts. We think that this learning process is best supported by a combination of the Knowledge Landscape and a keyword search. The search results are highlighted in the Knowledge Landscape and one can therefore locate the main concepts and their relation with certain keywords.

2.3.3 Understanding In-depth Knowledge

Teachers generally agree that students must actively process and make sense of available information in order to gain an in-depth understanding of a topic. Therefore, expert teachers use many different techniques to ensure the active involvement of students. For example, classroom teachers rely on a number of visual cues from their students to enhance their delivery of instructional content. A quick glance, for example, reveals who is attentively taking notes, thinking about the lecture or a difficult concept, or trying to make a comment [Willis 93]). In contrast, pupils studying with WBT software may lose attention without anybody noticing.

One way to increase the probability that learners actively process information is to require answers to small quizzes and the use of interactive examples (see Section 3). Another option is to engage them in the process of exploring the knowledge domain. A knowledge landscape can be both motivating to navigate through and convey insight into how concepts are related. As understanding the connections between various topics is essential for gaining in-depth knowledge, the knowledge landscape is an important tool supporting this process.

2.3.4 Reference

Students often keep good textbooks as reference. Mainly because they have spent a considerable amount of time and effort to study the book, they are able to understand concepts they do not remember well very fast again. Therefore it is essential that good learning material is also designed to be used as a reference. Obviously, an index is the most important navigation interface for finding the required information. However, as indices are by definition word-based and not content-based one might miss highly related concepts, particularly if different domain experts use different terms for the same concepts. As the Knowledge Landscape is computed content-based and does not rely on keywords only, it can uncover such relationships.

2.3.5 Adding or Updating Content

The content of WBT software has to be periodically updated to ensure that it meets the demands of a changing syllabus. As most WBT projects are maintained by more than one author it is very difficult to make sure that links to all related topics exist– even if the author is required to set links to topics written by others. The Knowledge Landscape can support authors in finding relevant relations and it helps to ensure that the hypertext navigation structure, i.e. links, is built properly.

3 Conclusion

Navigation can be considered to be one of the decisive factors in determining whether eLearning software really supports the learning process of students. It is no longer limited by serially flipping through pages; we showed how Knowledge Landscapes can be used to provide another (flat) view of hierarchically organized content. The option to interactively manipulate the landscape increases the chance of actively involving students while studying. Throughout this paper we gave examples of how these features have been successfully implemented in existing WBT software.

4 References

[Brandt 95] D. Scott Brandt, Constructivist approaches to "teaching the Internet", Online Information Proceedings. *Learned Information*, 1995

[Brusilovsky 99] Peter Brusilovsky and Philip Miller, Web-based Testing for Distance Education, p. 149, *WebNet*, AACE, 1999

[Driver 92] Rosalind Driver, Constructivist Approaches to Science Teaching. *Constructivism in Education*. Lawrence Erlbaum, 1992

[Learning Circuits Glossary] Learning Circuits Glossary http://www.learningcircuits.org/glossary.html (last visited Dec 2001)

[ELearners Glossary] ELearners Glossary http://www.elearners.com/elearning/glossary.htm (last visited Dec 2001)

[LineZine] LineZine (http://www.linezine.com/elearning.htm) (last visited Dec 2001)

[Fenker 75] R. M. Fenker, The Organization of Conceptual Materials: A Methodology for Measuring ideal and actual cognitive structures, *Instructional Science*, 4:33-57, 1975

[Freeman 96] Molly Freeman, Global Distance Learning and the Transformation of Knowledge Construction. *WebNet 96*. AACE, 1996

[Gergen 92] Kenneth J. Gergen, Social Construction and the Educational Process. *Constructivism in Education*. Lawrence Erlbaum, 1992

[Glasersfeld 92] Ernst von Glasersfeld, *A Constructivist Approach to Teaching. Constructivism in Education*. Lawrence Erlbaum, 1992

[Jonassen 93] David H. Jonassen and Katherine Beissner and Michael Yacci, *Structure Knowledge: Techniques for Representing, Conveying, and Acquiring Structural Knowledge*. Lawrence Erlbaum Associates, Hillsdale, New Jersey. 1993

[Lennox 99] Duncan Lennox, Improving The Top Line Using e-Learning: The Convergence of Training, Business Communication and Performance Support. *http://www.wbtsystems.com/products/whitepaper1.html*. 2000.

[Lohninger 99] Hans Lohninger, *Teach/Me – Data Analysis*, Springer, 1999.

[Pohl 95] Margit Pohl and Peter Prenner and Peter Purgathofer, Hypermedia in Education – Monitoring the Developement of Hypermedia Documents, *Psychology Teaching Review*, 4:142-152, 1995

[Rada] R. Rada, *Hypertext: From Text to Expertext*. McGraw-Hill, Hamburg, New York, London, Paris, Tokio. 1991

[Spiro 92] Rand J. Spiro and Paul J. Feltovich and Michael J. Jacobson and Richard L. Coulson, Cognitive Flexibility, Constructivism, and Hypertext: Random Access Instruction for Advanced Knowledge Acquisition in Ill-Structures Domains. *Constructivism in Education*. Lawrence Erlbaum, 1992

[Steiner 88] Gerhard Steiner, *Wissensrepräsentation*. Psychologie Verlags Union, 1988

[Weippl 99] Edgar Weippl, PhD Thesis in Computer Science at the Institute of General Chemistry at the Vienna University of Technology, "Integration of Virtual Reality Knowledge Landscapes into Multimedia Teachware" (integrated into the project Teach/Me)

[Willis 93] B. Willis, *Distance education: A practical guide*. Englewood Cliffs, NJ.: Educational technology publications. 1993

XML Based Content and its Integration into Existing e-Learning Solutions: Results and Consequences of a Survey

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Abstract: Current courseware is often tightly coupled with a specific e-learning system for its access and presentation. We identify the system components and their interaction in creating, publishing, accessing and executing platform independent learning content. We present a system model aimed at using inexpensive of-the-shelf components to supply the core functionality while being ready to integrate flexible and powerful content management and e-learning support systems in future.

Introduction

In April 2001 12 German universities have started the project "WissensWerkstatt Rechensysteme" (engl. 'Knowledge Factory for Computing Systems') targeting the development of multimedia learning modules in the field of technical computer science. It was an essential task to find a suitable system to create, store, combine, and deliver these modules. Despite of the massive amount of teaching/learning support systems on the market as well as reports about selection criteria and evaluation results of e-learning platforms [B01], it was difficult to find a suitable platform. The scalability of the planned 150 modules (as discussed in [LT02]) will result in 18 potentially different *variants* per module. Thus our system needs to handle up to 2700 module variants in total, each of them referring a large amount of media objects (such as images, audio, video, animation, simulation, ...). Efficient construction of multiple variants and output formats is supported best by XML technology. That's why the platform needs to be able to handle XML-based content and output construction according to our specification. Furthermore the system should support and control the distributed development, evaluation and continuous maintenance of the modules by workflow and source control / versioning tools..

Based on these requirements we evaluated 13 Systems (among them Blackboard, WebCT, WBT Topclass, Lotus Learning Space, Time4You). None of the examined systems satisfied our core requirements [W01]. Since no financial and personal resources for system development are available within our project, it was necessary to develop a cost effective yet extensible concept of establishing a suitable access and management platform.

System Concept Requirements

Looking at existing e-Learning platforms the major problem is that most of them impose dependencies on content and system functionality. Following dependencies can be identified:

- *System component dependencies*: Modern e-learning platforms integrate functions such as authoring, asset/course/user/access management, content configuration/retrieval/presentation/execution. These functional components are often tightly coupled. As a result it is hard, for example, to integrate a new publication subsystem or personal learning environment.
- *Data format dependencies*: Many of the current e-learning systems organise and store the course structures tightly coupled to the specific functionality of the system. The courses are not platform independent. Packaging standards such as LTSC and SCORM [AD01] are forced to take up a rather abstract point of view on learning objects [K01]. The necessary platform-independent model of the fine grained internal semantics of e-learning content is topic of current research [K00] [K01] [SKF00] [LT02].

As platform independency of the developed content is one of the core requirements of the WWR project our strategy is to avoid data format as well as system component dependencies by applying *content management* concepts such as separation of specification (XML – code) and publication of course content (html, pdf). Of course there are more than content engineering related aspects to providing e-learning content (retrieval, online access, personal learning environment). These components are further objects in our system model.

System Model and Implementation Stages

Based on the requirements analysis of the WWR project we developed a system model identifying the dataflow between its major components: authoring environment, publishing environment, distribution platform, personal learning environment (fig. 1). We organize the implementation of this system model in 3 stages:

Stage 1: *Exploiting XML's authoring potential*. In this phase we use XML-technology to simplify the authoring process of multi variant content [LT02]. The source as well as the output documents (html, pdf) are constructed locally (using XSL transformations) and uploaded on a central repository facilitating source control / versioning. The system will adopt standard web server/browser software to support retrieval, online access, download, offline access and basic communication functionality (feedback). Additional output filters for integrating our content into the project partners' local e-learning systems will be implemented successively.

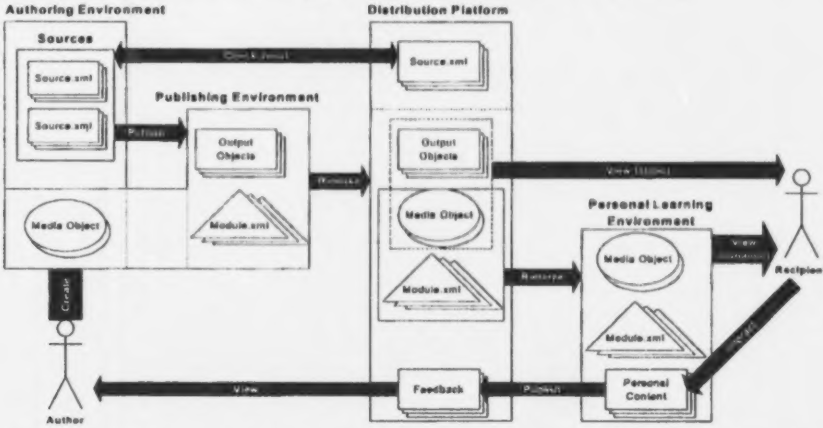

Figure 1: Data structures and dataflow across the systems major functional components (simplified)

Stage 2: *Exploiting XML's publishing potential.* A central content management system (CMS) will be adopted as part of the distribution platform to organize the content production and publication workflow. The publishing subsystem – in stage 1 implemented locally as part of the authoring environment – will be transferred to the central distribution platform. As output objects will automatically be rebuilt whenever changes to source files are released consistency and timeliness of the output documents are guaranteed. Ideally the CMS will even support live publishing driven by the recipient's request (personal script / course).

Stage 3: *Exploiting XML's run time potential.* The learner will be offered a dynamic personal online / offline learning environment as an additional subsystem. The learning environment will render the native XML content adaptively according to the learner's profile, preferences and learning situation, and will integrate personal content (annotations) as well as runtime data from interactive components (experiments, self tests).

Conclusion

As we specify our learning content in an open, platform independent format and decouple the functional components *authoring*, *publishing*, *distribution* and *personal learning* in our system design we are able to adopt standard components in central areas (document management and distribution) while keeping the system flexible and extensible in areas of current research and development. The next steps are the research of suitable components on the market and their integration into an overall system.

References

[AD01] Advanced Distributed Learning Initiative, Sharable Content Object Reference Model (SCORM) Version 1.2, The SCORM Content Aggregation Model, 2001

[B01] Bruce Landon: Online educational delivery applications: a webtool for comparative analysis, http://www.ctt.bc.ca/landonline/, Dec. 2001

[IS01] Ian Sommerville: Software Engineering, Addision-Wesley, München 2001

[J01] Robert H. Jackson: A web based learning resources library, http://www.outreach.utk.edu/weblearning/, Dec. 2001

[K01] Rob Koper: Modelling units of study from a pedagogical perspective: the pedagogical meta-model behind EML, Educational Technology Experise Center, Open University of the Netherlands, 2001: http://eml.ou.nl/introduction/articles.htm

[K00] Rob Koper: From change to renewal: Educational technology foundations of electronic learning Environments, Educational Technology Experise Center, Open University of the Netherlands, 2000, http://eml.ou.nl/introduction/articles.htm

[LT02] Ulrike Lucke, Djamshid Tavangarian: Turning a Current Trend into a Valuable Instrument: Multidimensional Educational Multimedia based on XML, Ed-Media 2002.

[SKF00] Christian Süß, Rudolf Kammerl, Burkhard Freitag: A Teachware Management Framework for Multiple Teaching Strategies. In: Proceedings of ED-MEDIA 2000, World Conference on Educational Multimedia, Hypermedia & Telecommunications, Montreal, Quebec, 2000

[W01] André Wiesner et al.: The ideal learning platform, results of a comparative analysis of 12 eLearning systems, University of Karlsruhe, http://www.aifb.uni-karlsruhe.de/wwr/survey/, Dec. 2001

[Z01] Nianjun Zhou et al. : XML Content Management: Challenges and Solutions, proceedings of the XML Europe Berlin, Germany, 2001

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Towards a Discipline Based Reflective Thinking Process for K-12 Students and Teachers Through On-line Discourse and Action Research

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Introduction

The California History-Social Science Project, a legislatively-mandated professional development program is administered out of the University of California, Office of the President. The Executive Offices are based at UCLA, and oversee seventeen local sites across California. CH-SSP's mission statement includes: a commitment to improving the teaching and learning of history-social science by strengthening disciplinary content knowledge for all students as outlined in the California History-Social Science Content Standards; enhancing instructional strategies in the teaching of history-social science to promote accessibility to the discipline; promoting collaboration across grade levels, kindergarten through university; and enhancing teachers' use of technology as an integral part of the instructional process.

As part of meeting this mission, CH-SSP engages teachers in action research on the use of technology-based discourse tools to support the development of a discipline based reflective thinking process, which promotes student ability to engage in historical thinking and understanding. This action research project grew out of a previous project in 1999 and 2000 in which teachers explored the uses of technology in K-12 history classrooms and developed lessons plans for statewide distribution. Although we felt that the work which emerged from that project was of a high quality, we did not feel teachers were exploring the issues involved in technology and the classroom at the depth that we were interested in. We modified the program in two ways. Instead of asking teachers to generate lesson plans, we asked them to engage in action research in the classroom. We felt this methodology was more likely to get teachers to think about their teaching in a reflective manner. The second change we made is we focused much more, although not exclusively, on online discourse tools. The reason for this was from the previous program – the teacher in that program expressed interest in the use of these tools in the history classroom. So, in 2001, twenty-six teachers from across California conducted research in grade 3-12 classrooms with diverse student populations, low performing and ESL students. The collective results of these research studies was surprisingly uniform. Students, particularly low performing and ESL students, engaged in significantly higher levels of discourse than in the traditional classroom; and they were either learning to engage in or engaging in discipline based activities ('doing history'). The interaction of these two – discourse and activities – lead to higher levels of historical thinking and understanding, as reported by the teachers. This result was only true when the teachers provided scaffolding in the form of discourse supports.

Purpose/Theoretical Perspective

The primary purpose of the professional development is to engage and support teachers to investigate instructional methods that support students' development of historical thinking and understanding through a discipline based reflective learning process, and to investigate using technology to support the instructional methodology in ways that could not be done without technology.

Fundamental to how we approach the professional development is our approach to history. We approach the teaching of K-12 history as a discipline as opposed to a subject (Stearn, 1993). As part of practicing history, historians engage in discourse about the discipline and in discipline based activities. We reflect this in the K-12 classroom. Discourse in the History/Social Science classroom supports students in externalizing thinking and in creating cultural supports for thinking (Bain, 1998). Discourse interacting with discipline based activities provides a basis for students to 'do the discipline' and engage in higher levels of thinking and historical understanding. For this to be successful, teachers must provide social assistance (scaffolding) to the learners to support the necessary competencies through which the historical thinking and understanding can emerge and be internalized (Vygotsky, 1978). There are many kinds of scaffolding that can be used. Technology based tools, and concomitant teacher supplied supports, are one kind of assistance (Salomon, 1988), which we focus on.

We model this approach with the professional development. We approach the teaching of history as a discipline. We engage in discourse with cultural supports to externalize the teachers' thinking. We use an action research model as it is an ideal vehicle to manifest this. Action research provides for inquiry through reflection, it brings the unconscious to a conscious level (Schon, 1993). The teachers' understandings can emerge and be internalized. And, once again, among many forms of scaffolding that are used, technology tools are used support this.

Interaction between discourse and action research are therefore, central to this professional development approach. We see discourse as a creative process in which a shared understanding is created (Bohm, 1996). To engage in discourse is to engage in both disciplines – history and education. It is reflective and iterative in nature. It involves social assistance and the use of tools. Scaffolding is provided by the professional developers (facilitators). Tools are non-electronic (small group discussion, writing) and electronic (email, bulletin boards, chat, threaded discussion, databased discussion, electronic annotation).

Action research is also a process. It is a way to engage with classroom teaching and bring more of it to a conscious level (Hopkins & Antes, 1990). It is reflective and iterative in nature. Reflection encourages the challenging of ones existing theories and preconceived views of teaching (Kettle & Sellars, 1996). Action research involves social assistance and the use of tools. As with discourse, scaffolding is provided by facilitators (coaches) and tools are both non-electronic and electronic.

As elements of both of these processes we engage in reflection, collaboration and inquiry.

Professional Development Model

We see our professional development model as a system of people, practices, and technologies. The human activities are served by the technology (Nardi & O'Day, 1998). Its parts consist of facilitators, teachers and students; the practices of discourse and action research, in the disciplines of history and education; and the supporting technologies.

Teachers participate in online pre-institute discourse activities, then spend three days at UCLA starting the research process (see below). Back in the classroom, they implement their action research. Finally, they write up their results for dissemination. In total, this is a five to six month commitment.

The action research process consists of six overlapping stages

- First, they question their assumptions about the disciplines. Through online discourse before the institute and in person discourse during the institute, the hidden assumptions that we all have are brought to the surface.
- Second, they pose a problem (research question). They will discuss these with the other teachers and give other teachers feedback on their problems.
- Three, as each teacher focuses on one problem, one aspect of their teaching, the plan for the solution should emerge (research plan) and worked out collaboratively.
- Four, they will implement the action research plan in their classroom.
- Five, both qualitative and quantitative data will be gathered by all teachers, analyzed and shared with peers to assure the highest level of reliability and validity possible.
- Six, the process and the results of the action research are documented, peer reviewed and disseminated.

The first three stages of this process are the most difficult for the teachers. Once they have a plan of action, implementing and following through on the plan has not posed too many problems. Because of this, and based on the research from the 2001 group, a proposed discourse/action interaction process has been developed as a scaffolding tool for the teachers through the action research process. This tool is used by the facilitators and can be used by the teachers in their own classroom. It is considered a tool-in-progress. With each iteration of professional development, it is anticipated that the tool will change in response to the teachers input and their experiences in the classroom. It is described in more detail below.

Other tools that both support the professional development and are the focus of the action research are primarily online. Blackboard was used as an online environment and we will be using it again. Within Blackboard, email, bulletin boards, threaded and non-threaded discussion, chat (and archived chat), posting and annotation of documents, the development of individual pages, and annotated links and resources all provide discourse tools for the action research.

The Discourse/Action Interaction (see diagram at end of paper)
As part of their action research, teachers are asked to engage in instruction which leads to students engaging in a discipline based reflective thinking process. Although we believe that there are a number of major components to this process – at a minimum discourse, visual thinking and experiential thinking – at this time we are focusing on discourse. As professional developers we are asking our teachers to engage in the same discourse/action interaction and discipline based reflective thinking process. We believe it is crucial to this professional development program that the teachers engage in the same kinds of learning activities we are asking them to use with their students. We will go over the discourse/action interaction we are using as it would be applied in a K-12 classroom, and then we will discuss how this differs for the professional development program.

When we are considering the role of discourse in a discipline based reflective learning process, we focus on four major areas. The students should engage in a continuous **discourse/action** process where discourse leads to action which leads to discourse and so on. So discourse and the activities are two of the areas. The third area, **teacher provided supports**, reflects the teacher's role in the students process. The teacher supplies a number of scaffolds or supports to the acquisition of the reflective learning process. All of these three areas feed and support the fourth area – the **student reflective process**. So, students develop a reflective learning process through the interaction of discourse with activities and the judicious and considered use of supports from the teacher.

In their action research, the teachers focus more specifically on the kinds of discourse, the kinds of activities, how technology supports those and an exploration of what teacher provided supports seem to provide the most assistance, in what context, to which students. This past year the focus was on chat rooms, threaded discussion groups, bulletin boards and database based discussion. Generated by the teachers, they focused on the questions outlined below:

- Do these tools provide greater opportunity to engage in discourse? Does this result in historical thinking and understanding?
- Do the students engage in more discourse with the technology tools? Are they more motivated to engage in discourse? Does the type of discourse that technology provides facilitate deeper historical thinking and understanding than other forms of discourse?
- Does the technology interfere in any way with the discourse process?
- What does the teacher have to provide in the form of scaffolding tools to facilitate optimal discourse?

We have used the results of the teachers' work in these areas to expand on the four major areas in discourse/action interaction. Some work has been done on the area of online discourse tools. This has been summarized by Sherry (2000) in a thorough article available online. We have drawn from many of the ideas in this article and combined it with our experience with our teachers to structure an approach to thinking about discourse in the classroom. We ask our teachers to first consider the structure of the discourse which currently exists in their classroom. Typically this will reflect a teacher asks question, student answers question, teacher provides feedback format with some minor variations. It will also typically involve only 10 – 15% of the students and virtually no ESL or low performing students (from our teachers). We proposed going in the direction of teacher questions, students question, students answer, students/teachers support/share and students/teacher comments where these may not occur in any particular order. The teachers' role in this form of discourse is to support the student to create, share, negotiate, interpret, expand, justify, question, summarize, clarify, predict, extend, and so on. As the students expertise increases, there can be more of a focus on framing questions appropriately, expanding on valid propositions, students being open to critical review of their point of view, students sharing understandings, working towards a common understanding, common knowledge construction, and so on. The environment should be constantly evolving, yet be organized.

There is room for teachers to focus action research questions in nearly every area of the discourse/action interaction. In particular, every teacher eventually gets around to exploring what kinds of teacher provided supports will best facilitate the discourse. As most of the discourse occurs in an online environment, the teacher support questions are not just about supporting discourse, but on how to use the technology to best advantage to support the discourse. These questions can range from – when do you use chat or threaded discussion? To what cultural implications are there to the introduction of technology on this scale in my classroom? This last question came up in post-research musings by the teachers last year. We will be tackling it in a more focused way with this years program.

The activity area of the discourse/action interaction involves discipline based activities – activities that are relevant, and authentic. These activities can be multidisciplinary, interactive, exploratory, performance based, involve advance skills, etc. These activities should interact with discourse activities in such a way as to enhance the development of both the new discourse process for the students and the process of developing the skills to 'do the discipline'.

As teachers think about the discourse/action interaction and develop their research questions, they will be themselves engage in discourse activities in the online environment. Here is the challenge for our facilitators. Many of these teachers do not have a well developed discourse process. We must provide the appropriate scaffolding to support these teachers in engaging in the process that they will be working with their own students to develop. Our research, other than reporting on the teachers' results, is to develop these scaffolds as the project progresses, and evaluate the results. The discourse/action interaction is one such scaffold. It is self-referential in this way – it scaffolds the teachers to help them scaffold their students by also using the discouse/action interaction.

Examples and Results from 2001

Teachers approached the implementation of the research in a number of different ways. The following three examples are illustrative of the projects as a whole.

At a high school near San Diego, CA, the participating teacher had a history class of 36 primarily ESL and low-performing students. He took advantage of a school with a block schedule to spend a 1.5 hour block for this class in the computer lab in a chatroom on Blackboard. All the students were still in the same room, but discussing history in a chatroom. This step alone allowed 100% participation from the students (instead of 15% in a traditional classroom). He then followed this discourse up with a 1.5 hour activity where the students wrote about their ideas. A higher level of historical thinking was evidenced in their writing. The most promising result however, were the gains made over time in the ability to write in English for these ESL students.

At a middle school near Riverside, CA a participating teacher used threaded discussion to supplement the classroom activity. At first, without adequate teacher supports, participation was poor and the level of the discussion was low. He instituted several teacher provided supports, such as more detailed instructions on writing entries, and he provided immediate (24 hours) and explicit feedback to the students. The results were an increase in participation (not quite 100%) and more thoughtful contributions. He found that a particularly useful byproduct of the use of the threaded discussion was his ability to diagnose and address misconceptions and preconceptions much more quickly than he could in the classroom.

At a middle school in Santa Monica, CA, a participating teacher developed her own database for student responses to open ended 'thought' questions on history. As each student responded to the question, they could also read the responses other students had entered. They can then respond to other students, develop arguments, which combine other student's points of view, or refute a student's point of view. She provided both discourse and content supports within this environment. Both motivation and participation increased dramatically over the traditional method. She was surprised at the level of participation from students who literally did not participate in any other way. She also found unexpected gains with her ESL students in their writing skills.

The following results were seen in every teacher's research study.
For teachers:

- The development of and use of discourse supports embedded in the classroom environment (technological and non-technological) was critical to promoting optimal engagement in the technology-based discourse activities.

- Increased opportunity to diagnose and correct misconceptions.

For students:

- Motivation to participate in technology-based discourse activities was much higher than to participate in non-technology discourse activities.
- Non-technology discourse activities were positively affected, both in the level and amount of participation.
- Low-performing students showed the greatest gains in both participation and understanding.
- English as a Second Language learners benefited significantly. Their interest in participating, their ability to express ideas and their writing skills all showed more than expected gains.
- Students who had previously excelled at non-technology based discourse were the least enthusiastic.
- Nearly 100% of students voiced their opinions, received feedback and responded to others' opinions.
- A significant percentage of students used historical thinking and understanding including citing historical fact, comparing differing primary sources, questioning others' interpretations, and citing each other.

In addition, many teachers had results from their research that weren't addressed in the other research studies. These included:

- Students did not adhere to 'clique' boundaries when using technology-based discourse tools.
- Students were using the tools to expand discussions beyond the classroom.

Discourse is an important methodology in History/Social Science classrooms. The traditional forms of discourse are the classroom discussion and the small group discussion. Teachers find that both of these forms are limited. The teachers who participated in this research believe that less than 15% of their students participated in these. The research these teachers conducted indicates that the use of technology-based discourse tools seems to increase both the participation in (to nearly 100%) and the level at which students are engaging in historical thinking and understanding. This increase gives the teacher a solid foundation on which to make the change from history as a subject which teachers teach and students take, to a discipline, where historical thinking and understanding are core processes.

This year, by providing more support in the form of the discourse/action interaction, we hope that teachers will be able to form more focused questions than they did last year and concentrate more specifically on issues such as the appropriate use of various forms of teacher provided support for different students (ESL and low-performing, in particular) different technologies, and different pathways to the development of a new discourse process for the students.

Conclusion

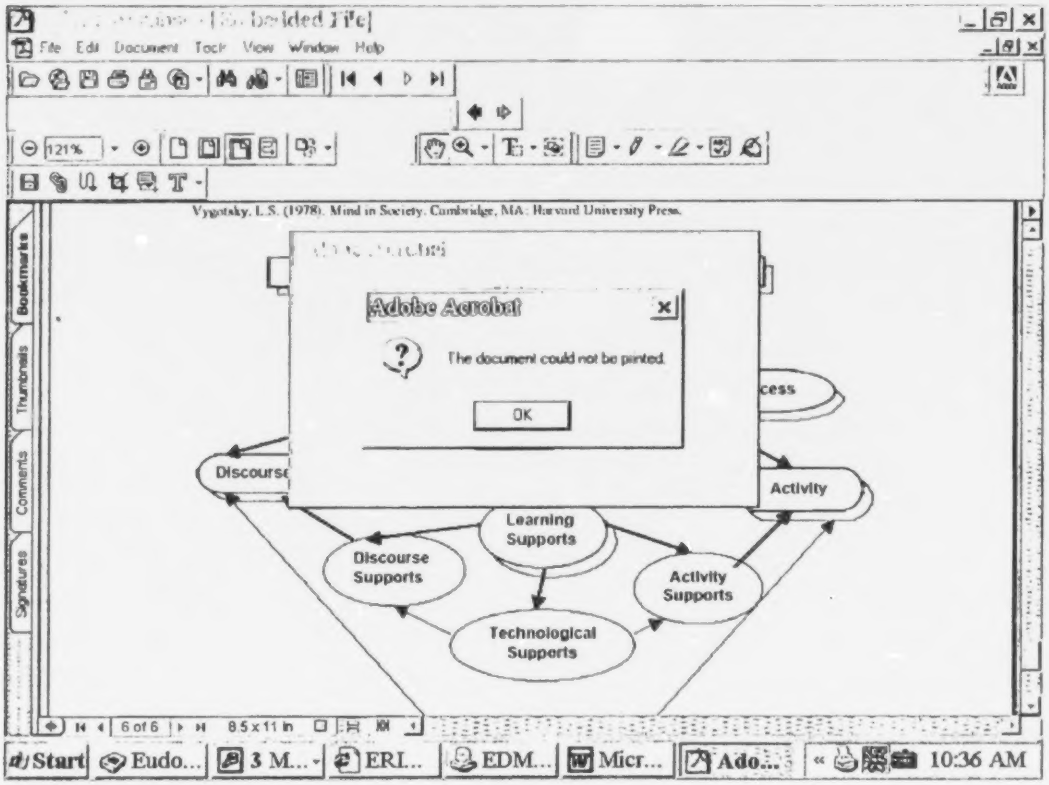
This is an action research project. As such, it has yielded rich information on the use of discourse and the use of technology to support discourse for the advancement of student historical thinking and understanding in History/Social Science classrooms. It is the intention of all the teachers in this project that action research on these issues, and on the issues that these studies brought up, be continued. It is also the hope of all the teachers' that a more formal treatment of these issues will be pursued within the professional community.

Bibliography

Bain, R. (1998). Into the Breach: Bridging the Gap Between History's Communities. Draft provided by author.

Bohn, D. (1996). On Dialogue. Routledge: New York.

Hopkins, C.D. & Antes, R.L. (1990). Educational research. Indiana: Peacock Publishers.



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Vygotsky, L.S. (1978). Mind in Society. Cambridge, MA: Harvard University Press.

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The SASK Mentor Project: Using Software and Socratic Methods to Foster Reflective Thought in a Learning Environment

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Abstract: We have developed SASK (Socratic ASK), a domain-independent architecture for implementing Socratic dialogs to foster deeper student reflections on well-defined tasks. In SASK we have built the Dialysis Mentor, a program that uses Socratic questioning to improve student performance and learning in an undergraduate biomedical engineering lab. Small usability tests and a pilot run in the actual lab suggests that Dialysis Mentor and SASK systems in general can improve the value of pre-defined learn-by-doing task experiences. We are now working on improving our SASK Mentors and building authoring tools for them.
SASK Mentor Project: http://www.cs.northwestern.edu/~riesbeck/sask/

Introduction

Dr. J. Walsh's Biomedical Engineering Laboratory course at Northwestern University includes a dialysis lab session in which students characterize how well an artificial kidney (a dialyzer) transports water, urea, and salt across its membrane. Students work together in groups of two or three for several hours on this lab. This lab typically uncovers a number of important gaps in student understanding, ranging from simple trouble using the lab devices, to misinterpretation of key measurements, to performing actions contradictory to the basic goal of the experiment. Dr. Walsh handles such problems not by telling the student what to do, but by asking a few penetrating questions, such as "What are you trying to do here?" followed by "What variables are you controlling?" These questions cause the students to quickly discover for themselves gaps in their understanding of the task. Without such attention, students tend to rush through their lab. Many fail to produce any useful results. Even those who do, likely miss many opportunities to reflect on their thinking while they are doing their lab work. Such reflection is known to increase students' ability to transfer their learning to new settings and events (Bransford et al. 2000).

This Socratic technique is facilitated by broad knowledge of the domain and how one's students best learn that particular domain. Often people with such expertise are a scarce resource. Most graduate assistants lack broad domain knowledge as well as experience in teaching it Socratically. Hence, groups in Dr. Walsh's lab would often wait 20 minutes for his guidance before they could make any progress. Sometimes groups had wasted time doing something unfruitful and would have to continue the lab during the next class session. Even worse, sometimes a group would get too much information from a graduate assistant and finish the lab without gaining the understanding Dr. Walsh had hoped they would.

Our project goal was to provide an artificial mentor (We use the term "mentor" instead of "tutor" because tutoring implies a teacher-centric, drill and practice activity. Mentoring implies that we are trying to provide a student centered, apprenticeship, inquiry activity.) capable of providing a service similar to that Dr. Walsh provides, at the time students need it. A Socratic system makes students active learners, leading them to debug their own thinking and knowledge, unlike alternatives such as Frequently Asked Questions (FAQ) lists and other systems that encourage passive learning.

The Project's Development

The Dialysis Mentor

The SASK engine and the Dialysis Mentor (DM) application were developed in summer and fall of 2001, using Java for the engine, XML for the domain content, and QuickTime for Java to play videos. When students start DM, they first see the "Overview" interface (Fig. 1), where they can watch a video of Dr. Walsh's lecture on the dialysis lab, and read a transcript of the lecture.

Students then switch to the "Lab Mentor" (Fig. 2) to interact with the program. This interface includes an annotated diagram of the laboratory set-up for reference (upper left), a dialog transcript (lower left), and, most importantly, a dialog interaction panel, upper right. In future, we plan to include video clips of Dr. Walsh speaking to the students in the role of the Dialysis Mentor.

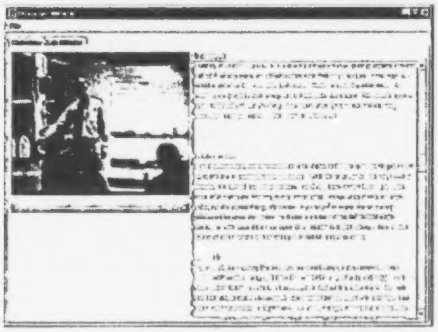

Figure 1: Overview Mode

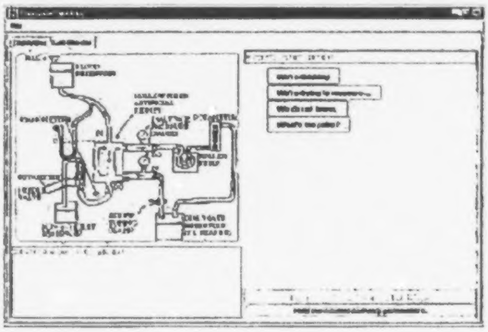

Figure 2: Lab Mentor Screen

The conversation panel was the key interface challenge, specifically the part where students answer questions such as "What are you trying to do?" On one hand, the interface had to avoid overly influencing or constraining what students say. What students say is the key window to their underlying misconceptions. On the other hand, an empty text box where anything can be written is both impossible for current programs to understand and intimidating to students.

Therefore, we use a mixed button and template approach. Simple answers with no variable content, such as "We're still thinking," are buttons. More complex answers with variable content are buttons that bring up structured "fill in the blanks" templates similar to web forms. For example, clicking on "We're trying to measure…" brings up a template of the form "We're trying to measure <empty text field> and control <empty text field>." (Fig. 3). The students can write anything they want in the text fields. This semi-structured approach lets students choose what to say and how to say it, but the program only has to deal with short phrases in well-defined contexts. This interface approach was successfully used in Creanimate, a program that used a question and answer dialog to help children learn and think about zoology (Edelson 1993).

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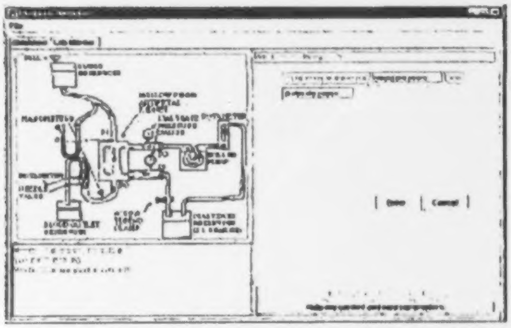

Figure 3: After students choose "We're trying to measure..."

The program's behavior is specified in the Dialog Graph Document, represented in XML, that contains all the Dialysis Mentor's questions, response options, and template patterns for selecting follow-up questions. The current DM graph has 89 utterance nodes and 153 edges (rules that link student responses to DM utterance nodes) in it. Figure 4 shows part of a small part of that graph in outline form. Student responses with underlined elements are template patterns, the other responses are buttons. This fragment Socratically asks students to test their assumption about what controls what, which will lead them to discover a mistake in their thinking.

Mentor's current goal: **Students seem to know the main goal. Lead student to realize that varying the flow does not help the goal**

Mentor: Remember that when you do an experiment you want to vary only one thing at a time. Then you graph Ultrafiltration (U) over Transmembrane Pressure (TMP).
Do you think you will see a relationship between Ultrafiltration (U) and flow rate(s)?
Students: Yes

- **Mentor:** What controls the Ultrafiltration (U), TMP or flow rate(s)?
- **Students:** The flow rate
  - **Mentor:** How do you know U is not controlled by the TMP?
    - **Students:** I do not know
      - **Mentor:** Please set up your experiment so you can tell me what controls U, TMP or flow rate.
    - **Students:** TMP directly controls U based on the equation you gave me.
      - **Mentor:** That's the theory we presented. You must use the lab to prove that TMP controls U and not flow rate. How do you change only TMP?
    - **Students:** *ANY OTHER ANSWER* directly controls U based on the *ANY OTHER ANSWER*.
      - **Mentor:** Please set up your experiment so you can prove what controls U, TMP or flow rate.

Figure 4: Partial Graph of Dialysis Mentor's Task Dialog Graph Document

Background

Socratic Intelligent Tutoring

A classic early Socratic intelligent tutoring system was WHY (Wenger 1987) created by Dr. Allan Collins. Collins analyzed the dialog between students and Socratic tutors and developed a theory for the implementation of a Socratic-tutoring program, including a set of 24 production rules to improve WHY's pedagogical component (Collins 1977). We used some of these rules as a formal way to understand Socratic techniques. For instance, the partial graph in Figure 4 is an example of Collins's Socratic Rule 15: "Request a test of the hypothesis about a factor".

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ASK Systems

ASK systems are a form of multimedia based on the metaphor of having a conversation with an expert, or a group of experts. An ASK system presents a user with a set of initial top-level questions. When the user selects one, the ASK system responds with an answer, either in video or text. In addition, the system displays a set of follow-up questions relevant to the answer given. The user can pursue one of these follow-ups, which will lead to a new answer and a new set of follow-ups, or return to an earlier answer and follow a different path (Cleary 1995). A number of ASK systems in a wide variety of domains were developed by the Institute for the Learning Sciences at Northwestern University, and later commercially by Cognitive Arts Corporation. The success of ASK systems in a number of domains leads us to believe that static dialog graphs are sufficient to provide performance and learning support in well-defined tasks.

Validation

Usability and Pilot Testing

A small usability test was performed with a biomedical engineering undergraduate student. We videotaped the student doing the dialysis lab under Dr. Walsh's tutelage. Her interactions were typical of those in the actual lab, and was used as a seedbed for the initial dialog graph. Several months later, we videotaped her interacting with the first version of the Dialysis Mentor. This test revealed a number of phrases that needed to be added, as well as some new dialog branches. It also showed that it was very easy for certain DM responses to lead the student to treat the system like a multiple choice guessing game. This was particularly true when the DM's immediate follow-up to a student response strongly implied that the response was incorrect or unwise. To avoid this unfortunate phenomenon, some follow-ups were changed to avoid immediate implications of any judgment. This made the dialogs more Socratic.

The Dialysis Mentor was then used in Dr. Walsh's dialysis lab in October 2001. Fifty-two biomedical engineering undergraduates were involved in two sections, a morning section and an afternoon section. Each section had nine groups of two to three students each. The DM logged all interactions for later analysis. Some interactions were video taped. A few weeks after the use of DM in the lab, 47 students completed a survey regarding their experience. Although the test in general is considered a success, preliminary analysis of the data revealed or emphasized issues for future research. In particular, Table 1 categorizes the DM's responses by whether the intended follow-ups to student responses were taken. "Missing phrase in task dialog graph document" meant that the DM had a relevant dialog branch internally, but did not recognize that a student response should take that branch. "Wait too long" meant that the DM told students that it would wait for them to do something but waited an improperly long period of time. "No existing branch" meant that the DM's dialog graph didn't include a relevant branch for the student's response. "Appropriate action" meant that the DM selected the dialog branch that we had intended for a given response.

Mentor Action Category	% Mentor Actions Across Groups	Count Across Groups	Mean Count per Group
Missing phrase in task dialog graph document	2.82%	25	2.27
Wait too long	3.83%	34	1.89
No existing branch	22.41%	199	10.47
Appropriate action	70.38%	625	27.17
TOTAL		**888**	**49.33**

Table 1: Dialysis Mentor's Categorized Actions with Students in Pilot Test

The following chart from the surveyed opinions of 47 of the 52 students who were in the pilot test shows that the vast majority felt that the DM was at least somewhat helpful to them. Given the rough preliminary nature of the DM, this is quite encouraging.

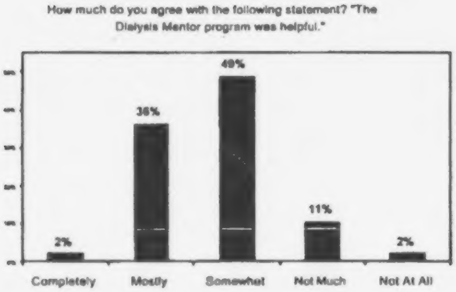

Chart 1: Student Opinions on the Helpfulness of the Dialysis Mentor

The following chart shows the results of the conceptual assessment question in the same survey. Answers to the question "What parameters should one vary when quantifying the hydraulic permeability and what parameters should one hold constant?" was scored by first noting who answered correctly to what parameters should be varied and then who answered correctly to what should be held constant. 9 students (19.15%) were incorrect about what to vary and 12 students (25.5%) were incorrect about what to control. 6 students (12.77%) were found incorrect about both parts of the question and 9 students (19.15%) were partially correct. 32 students (68.09 %) answered the question completely correct.

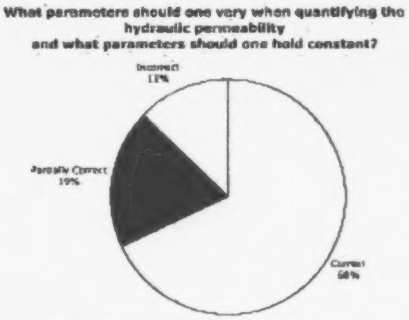

Chart 2: Student Responses to Conceptual Assessment Question

Future Work

Social Interaction and Interpretation Issues

Videotapes of the pilot tests show cases where a student group was at a loss for an answer to a question presented by the DM. When Dr. Walsh asked the students to pretend he had just asked them the same question, the students quickly came up with an answer. When they entered that answer into the DM, it was usually handled properly and the dialog progressed. In other words, students treated questions from the DM differently from the same questions from Dr. Walsh.

There are several possible explanations for this phenomenon. One is the difference between text and speech. Questions that are clear when spoken often become ambiguous in text form. Another factor is the difference in social relationships between a computer program and a faculty member. When a faculty member like Dr. Walsh says "Think about it. I'll ask you again in 5 minutes," students stop and think. When a lowly computer program like the DM said the same thing, students often do whatever they can to get around the delay, including restarting the program. Since getting students to stop and think is the main goal of a SASK system, overcoming this difference in response is a critical research problem.

For these reasons, we are planning to use video clips of Dr. Walsh asking the questions, in conjunction with the text version. The addition of audible speech may improve DM as a pedagogical agent and improve students' retention and problem-solving transfer abilities (Moreno et al. 2001). It may also

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increase students feeling like they are talking to Dr. Walsh, or someone like him, therefore reducing the differences in their response patterns.

We also need to make sure students do not guess at answers, because this is antithetical to learning. Guessing happens when students believe they can tell if their response choice was correct or not, based on the system's first follow-up. That makes it easy for students to try each response and see what happens. Therefore, we need to minimize two kinds of initial follow-ups: negative "no, because..." follow-ups, and "I don't understand, please rephrase" follow-ups. The latter happened approximately 25% of the time in the DM, either because of missing phrases (3%), or missing branches (22%). Fortunately, avoiding bad follow-ups is mostly a matter of expanding and refining the Dialog Graph Document.

Authoring Tools and Internet Accessibility

Another area of future design research will be the development of the authoring tool for dialog graphs. The Dialysis Mentor's XML files were authored with a text editor. Even with an XML editor, this is a tedious and technically complicated activity. We plan to design an authoring tool so that teachers such as Dr. Walsh can build the dialog graph document themselves. Of particular interest will be the development of "dialog sequence templates," based on Collins' Socratic rules and other useful dialog patterns we have discovered while designing the Dialysis Mentor.

Using Java Servlet technology, we also have a preliminary web interface to the SASK Mentor to ease deployment to many sites.

Conclusions

Overall, our SASK Dialysis Mentor has the potential to be an effective tool for improving students' learning experiences. We look forward to furthering its development and making other SASK Mentors for other learning environments and domains.

References

Bransford, Brown, Cocking (Eds.) (2000). *How people learn; brain, mind, experience, and school.* Washington, D.C.: National Academy Press

Cleary, C., & Schank, R. (1995). *Engines for Education.* Hillsdale, NJ: Lawrence Erlbaum.

Collins, A. (1977). Processes in acquiring knowledge. In Anderson, Spiro, & Montague (Eds.), *Schooling and the acquisition of knowledge.* Hillsdale, NJ: Lawrence Erlbaum.

Edelson, D. C. (1993). *Learning from stories: Indexing, reminding, and questioning in a case-based teaching system.* Ph.D. dissertation, Northwestern University.

Moreno, Mayer, Spires, & Lester (2001). The Case for Social Agency in Computer-Based teaching: Do Students Learn More Deeply When They Interact with Animated Pedagogical Agents? *Cognition and Instruction*, 19 (2), 177-213. Hillsdale, NJ: Lawrence Erlbaum.

Wenger, E. (1987). *Artificial Intelligence and Tutoring Systems.* Los Altos, CA: Morgan Kaufmann.

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Rejuvenating the Social Foundations of Education Course Using Digital Technology and the Case Method

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Abstract: This conceptual essay examines theoretical and methodological problems associated with teaching the Social Foundations of Education course and provides a framework on how to overcome these difficulties. Foundations of Education courses are notable for both their volume and the ambivalence with which students and instructors regard their role in preparation for teaching. The ambivalence is held because foundations courses generally suffer from instructors unknowingly devising incompatible goals for the course while the multidisciplinary nature of the course frequently leads to intellectual incoherence. One way to overcome these deficiencies is to have students acquire an "ironic" understanding using the case method. Case studies that use digital technology make this approach even more powerful because digital technology provides students with a cognitive tool that encourages the profound knowledge necessary to attain ironic understanding.

This conceptual essay examines theoretical and methodological problems associated with teaching the Social Foundations of Education course and provides a framework on how to overcome these difficulties. A staple of teacher education since the 1930's (Cohen 1999; Lagemann 2000), Foundations of Education courses are notable for both their volume and the ambivalence with which students and instructors regard their role in preparation for teaching. The ambivalence is rightfully held by both because foundations courses, from their inception, have suffered two significant shortcomings. First, instructors unknowingly have devised incompatible goals for the course. Second, the multidisciplinary nature of the course frequently leads to intellectual incoherence for all concerned.

As a teacher of Foundations courses, I have struggled with overcoming these embedded course deficiencies. Over time, I came to a realization that the course needed a new goal. I borrowed from Kieran Egan (1997) the idea of having students acquire an "ironic" understanding. Due to the multidimensional representation possible with cases, attaining ironic understanding is enhanced when case methods are employed (Merseth, 1996). Most recently, I have begun to supplement paper copies of case studies with digital technology and believe that the enriched learning experience provided by such an approach makes the case study method even more powerful. Digital technology provides students with a cognitive tool that encourages the profound knowledge necessary to attain ironic understanding.

Many instructors of foundations of education courses have grappled with ways to overcome the incompatible goals and the intellectual muddle of the course. An effective way to resolve the paradox is to create a course that seeks a new goal using new intellectual tools. Vygotsky (1978) argued that people make sense of the world using mediating intellectual tools. Intellectual development, then, is dependent not only on psychological stages, like those described by Piaget, or on the knowledge we accumulate, but also relies on the intellectual tools that society makes available. While Vygotsky focused on oral language, or sign systems, in his formulation, other intellectual tools are available. Using these tools in innovative ways can refashion the social foundations of education course.

For me, the way out of the teaching dilemma presented with a course that has at its core incompatible goals is to radically change the student outcome desired. Guided by the insights of Kieran Egan (1997) on the larger purposes of schooling, I seek to assist students in acquiring an ironic understanding of schools and teaching. Briefly, irony, as we know it today, is tied to a belief that the truth long sought in the western intellectual tradition is illusionary. In place of certainty, irony provides for the centrality of reflexiveness in thinking. Ironic understanding, then, leads to the removal of a commitment to simple truth of general schemes. The sophisticated ironist, instead, enjoys extensive ways of understanding and recognizes the value of a varied spectrum of perspectives.

Fostering multiple perspectives is at the heart of the articulate ironist. Gliding from perspective to perspective is valued and becomes second nature in such a person. The ironist applies the varying perspectives to make sense of their experiences. A teacher might ironically note, for example, that a new school policy designed to improve math performance in fact creates a wider gap between high math achievers and low achieving math students. A better identification of the problem and a clearer solution is then possible. One must take care, ironically enough, to make sure that the disciplinary incoherence of the social foundations course is not replaced with incoherence arising from seeing events with different perspectives. The value of a case study approach to teacher education is that while cases offer multiple perspectives, they are at the same time grounded in a specific narrative context. General theoretical principles flow from an array of possibilities that build on one another. Out of what seems to be chaos comes not only insight but also orderliness.

Emerging digital technology is allowing the case study method to develop into an even more powerful tool by permitting cases to become more contextually grounded. More specifically, an interactive course web site that supplements the text of a case with multimedia presentations and links to other data sources allows great flexibility in student construction of knowledge. To illustrate this, I shall borrow a metaphor from the world of art museums. Elizabeth Valance (1995) refers to a "public curriculum" inherent in the orderly images found in art museums. This public curriculum consists of the images displayed; the order in which the images are placed; the information provided for visitors; the tours, lectures and workshops and other programs offered to the public; and the publications produced. The curriculum is randomly accessed by visitors and is readily available to anyone who comes to the museum. All visitors, however, study" the curriculum on their own and make sense of the images in endless varieties of ways. While visitors may understand the curriculum in a variety of ways, the curriculum is deliberate. Images are arranged in some order (usually by culture chronology but such need not be case) with or without helpful labels. Some images are quite accessible to all but others are difficult, and visitors may even view an image with hostility. Visitors will frequently confront a museum worker with some sort of refrain along the lines of, "Is that really art?"

Similarly, a well-designed course website will be accessible and challenging. Depending on how images, text, video and audio are arranged, one can create different learning environments and attempt to frame relevant issues in key ways. Arranging course materials using digital technology into generative topics allows for students to respond to the realities of classroom practice and educational policy-making in multiple ways. What cannot be controlled, of course, is what students learn. The goal, instead, is to provide as many avenues as possible to allow students to make their own connections and to form their own categories. Like a well run art museum that helps novice visitors find accessible entry points into the world of art, an interactive website can assist the novice teacher into gaining access to the profession of teaching.

References

Cohen, S. (1999). *Challenging orthodoxies: Toward a new cultural history of education*. New York: Peter Lang.

Egan, K. (1997). *The educated mind: How cognitive tools shape our understanding*. Chicago: University of Chicago Press.

Lagemann, E. C. (2000). *An elusive science: The troubling history of education research*. Chicago: University of Chicago Press.

Merseth, K. K. (1996). Cases and case methods in teacher education. In J. Sikula (Sr. Ed.), and T. Buttery and E. Guyton (Eds.), *Handbook of research on teacher education: A project of the Association of Teacher Educators, 2nd edition*. New York: Macmillan Library Reference USA, Simon & Schuster Macmillan.

Vallance, E. (1995). The public curriculum of orderly images. *Educational Researcher*. (24), 4-13.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. M. Cole, V. John-Steiner, S. Scribner, and E. Souberman (Eds.). Cambridge: Harvard University Press.

EduBeans: Efficient development of interactive instructional exhibits leveraging a multi-layered, component based framework

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Abstract: While Java based applets have become commonplace in web based training, their development is still costly. We present a framework that uses the JavaBean component model in a layered approach using several abstraction levels to facilitate the reuse of development infrastructure. A reference implementation was successfully employed in teaching audio signal-processing to computer science students.

Introduction

Interactive exhibits constitute one of the major advantages of computer-based instruction. While dedicated authoring packages allow for high-quality animation, non-trivial domain specific functionality is hard to implement. On the other hand, all-purpose programming languages make way for sophisticated domain specific functionality at the price of considerable overhead for animation. Platform independence, built-in capabilities for audio-visual output, and its enormous installation base has made Java (applets) increasingly popular in the educational field. Unfortunately, the absence of software frameworks hindered code reuse; missing configuration options restricted applets to only one context. A need has emerged for a software framework, allowing reuse of interactive educational assets on a component level.

Christian (2000) successfully developed a set of generic physics related applets, named *Physlets*, that can be scripted and customized by the educator using JavaScript. While this considerably broadened the scope of possible uses, these applets are not intended to be used e.g. in conjunction with third-party APIs. Integrating software components into more complex projects requires well-defined interfaces between these components. Sun Microsystems introduced therefore the JavaBeans specification (1997). Praehofer (1998, 2000) and Benes (1999) presented two JavaBeans based frameworks helping to teach simulation based on the discrete event system specification formalism. In the field of image processing, Hanisch (1999) demonstrated an efficient approach to assemble applets by wrapping the Java Advanced Imaging API into JavaBean components.

A multi-layered, component based framework

Although JavaBeans have proved to be well suited for the creation of educational exhibits, there has been little reuse and exchange between different content authors. This astonishes, because the promise of reusability is one of the major drivers of component-based development. We identify missing access to only partial functionality of the existing bean-based exhibits as the primary reason for this: While they are built from components, they behave as monolithic entities. Therefore we introduce a framework, named EduBeans, that (1) employs the JavaBeans component model and (2) introduces a new abstraction layer hierarchy into the applet creation process and (3) provide a reference implementation of a web-enabled bean builder tool, the EduBeanBuilder.

JavaBeans component model

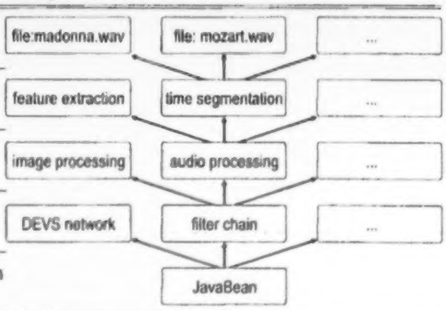
JavaBeans™ is the component model for the Java language endorsed by Sun Microsystems. Any Java class can act as JavaBean as long as the code follows a set of design patterns that expose semantic information of the component's properties. This information can be extracted by application development tools, referred as *bean builders* and displayed in a graphical user interface (GUI). Bean builders call the same methods to modify the internal state of a bean as a programmer would do in her source code. Therefore, a prospective user can familiarize herself with the properties of a certain bean using a GUI before employing the bean programmatically.

Abstraction layer hierarchy

Although there have been successful attempts to create JavaBean based educational software (see above), reuse and adaptation to other domains had to take place in a rather binary fashion: Either adopting the complete infrastructure or rewriting it from scratch. Differentiating several layers of abstraction in the building process facilitates a partial reuse of the code base. With increasing concreteness from level 1 to 5, these layers address different target groups: level 5-4 are geared towards the learner, level 5-3 towards the subject domain expert (teacher), level 2-1 towards the experienced Java framework developer. Table 1 depicts the layer hierarchy.

Table 1 abstraction layer hierarchy used in framework

Abstraction layer	Support offered by framework	Example
5 instance configuration	applications can be configured using localized text, images, specific experiment settings etc.	file:madonna.wav file: mozart.wav ...
4 application assembly	domain specific beans can be combined to form larger applications or "macro" beans	feature extraction time segmentation ...
3 subject domain	functionality can be extended by inheriting from existing classes or wrapping third-party APIs	image processing audio processing ...
2 interaction paradigm	paradigm specific communication mechanisms are provided (e.g. data push / pull in filter chains)	DEVS network filter chain ...
1 component interface	components can be employed in web-based bean builder tool or JavaBean compliant IDE	JavaBean



The most abstract *component interface layer (level 1)* purely requires that JavaBean compliant classes are used. This important assertion allows the use of components in IDEs and web-enabled bean builders. The *interaction paradigm layer (level 2)* provides support for typical interaction mechanisms from the subject domain. Our reference implementation uses a source-filter-sink paradigm. Other paradigms include structured algorithms or DEVS networks. The *subject domain layer (level 3)* contains domain specific beans. Authors can create sets of related beans, leveraging the interaction paradigms provided by layer 2. The *application assembly layer (level 4)* determines the connections between the beans from the subject domain into larger applications or "macro" beans. Usually the author will assemble these applications as preset demonstrations, but this can also be delegated to the learners as an exercise task. Finally, the *instance configuration layer (level 5)* configures applications by loading set-ups for specific experiments.

EduBeanBuilder

Most Java IDEs can load and display JavaBeans. But there are also situations in which detailed information on the inner workings of a bean is not necessary or even disturbing. We therefore extended a bean builder provided by Sun Microsystems Inc. into the web-enabled EduBeanBuilder. It allows launching pre-configured applications consisting of multiple beans in a web browser as well as providing an empty workbench onto which domain specific beans can be placed and "wired". The state of the applications can be serialized easily into an XML stream (Java Community Process, 2001), which is exploitable in educational settings.

Case study

Computer science students had to be trained to participate in the development of a Java audio signal-processing package. This software applies several cascaded filters on an audio input signal. Because this approach maps to the source-filter-sink paradigm provided in level 2 of our reference implementation, extending the existing code base to make it JavaBeans compliant allows the integration of the actual signal processing code into instructional applets. This avoids re-implementing functionality in "toy" classes solely for educational purposes. The students' feedback was very positive, especially because the chosen approach helped the students to bridge the gap between learning abstract concepts and applying implementation-level programming skills.

Conclusions

The presented EduBeans framework proved very useful in the development of interactive instructional applets. The JavaBeans component model allows using the same code base for demonstration purposes as well as "real world" tasks. At the time of writing the framework offers support for generic JavaBeans by the EduBeanBuilder on level 1, a source-filter-sink paradigm on level 2, audio processing functionality on level 3 and includes various assembly and configuration examples in level 4 and 5. The next development is oriented to extending the package with other problem domains and completing a comprehensive documentation.

References

Benes, M. (1999). JavaBeans Technology for Learning Discrete Simulation Methods. In *Proceedings of the International Conference on Engineering Education (ICEE)*.

Christian, W. (2000). Java Programming and Internet Technologies for Undergraduate Education. *Computer Physics Communications* (pp. 16-22), 127 (1)

Hanisch, F., Klein, R., and Strasser, W. (1999) Ein Web-basierter Computergraphik-Kurs im Baukastensystem. In Engelien, M., and Homann, J., (Eds.). *Virtuelle Organisation und Neue Medien - Workshop GeNeMe99*. Lohmar: Eul-Verlag..

Java Community Process. (2001). *JSR 57: Long-Term Persistence for JavaBeans Specification*. http://jcp.org/jsr/detail/057.jsp

Praehofer, H., Stritzinger A., and Johannes S. (1998). Using JavaBeans to teach Simulation and using Simulation to teach JavaBeans. In *Proceedings of the European Simulation Multiconference (ESM)*.

Praehofer, H., Johannes S., and Stritzinger A. (2000). Building Reusable Software Components. In *Proceedings of the Conference on Web-Based Modeling & Simulation (WEBSIM)*. San Diego: Society for Computer Simulation.

Sun Microsystems Inc. (1997). *JavaBeans API Specification V1.01*. http://java.sun.com/products/javabeans/docs/beans.101.pdf

Software Agents, Activity Theory, and Mentoring - A Preliminary Model

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Abstract: This paper is a report on the preliminary approach to creating a software agent based mentoring system for women in the Information Technology domains. It outlines the data collection and analysis methods and the proposed approach to the creation of the mentoring software agent.

Introduction

Mentoring has been widely used in educational and professional settings to help students become part of a community of learners, novices adapt to new work environments, and professionals advance their careers, however, current mentoring techniques are limited in scope (AEA, 2001; Super, 1984). This approach has been frequently used to encourage women and minorities to enter computer science(CS) and information technology(IT) degree programs and the workforce (CMU, 2001). The current approaches use other professionals, professors, advanced students, and members of the community to do the mentoring. While these mentoring programs have been effective on a small scale there are two issues with them (Lynem, 2001). First, there is already a shortage of women and minorities in the CS and IT fields, those few people can be overburdened with the need for mentors. Second, the mentoring depends heavily on the individual's ability to mentor a newcomer and rarely are there any guidelines or tips available on how to mentor.

The Approach

In order to create a more widely available mentoring system we are beginning a ***unique*** project to create an Activity Theory analysis of two IT projects that will be used to create a Software Agent based mentoring system. This system will be used in preparing students to enter IT internship programs as well as entering the IT workforce. In collaboration with two major software companies we are conducting an Activity Theory analysis of the design environment and will analyze the data to create a framework to program software agents. These agents will act as the mentors from the software companies to students in the Information Sciences and Technology program and help them learn about what they can expect when they go on an internship or join the workforce.

Preliminary Framework

Activity Theory (Engeström, 1991) is used as the theoretical framework for data collection, analysis, and programming of the software agent. It conveys the complexity of real world activity systems in manageable chunks. The data representation in the software agent will be done using multiple techniques including video, images, animated agents, and text. The retrieval of the data will be using production rules (Anderson et al. , 1995), and Latent Semantic Analysis(Landauer & Dumais, 1997). The agents will have a natural language interface (Person et al.,2001), synthesized speech (Cowley & Jones, 1992), and facial expressions (Link et al. , 2001).

Conclusions

Software agents are currently being used in many areas like Physics Tutoring, Current applications of these agents include Physics tutoring (Graesser et al. 1999; Van Lehn, 1999), learner feedback (Negroponte, 1997), promoting reflective thinking (Baylor, 1998), teaching biology (Moreno, 2001), and psychological counseling for families with terminally ill children (Johnson, 2001). The software agent technologies have also been used to provide workplace simulation (Work Sim) in schools (VanLehn, 2001).This approach is unique in the data collection method using Activity Theory and its application as a mentoring environment.

References

AEA (2001). American Economics Association. Available at http://www.vanderbilt.edu/AEA/mntr.htm, October 20, 2001.

CMU (2001) Women@SCS available at: http://www-2.cs.cmu.edu/~women/resources/aroundTheWeb/index.shtml, November 4, 2001.

Engeström, Y. (1991).Activity theory and individual and social transformation. *Multidisciplinary Newsletter for Activity Theory*, 7-8,6-17.

Landauer, T. K., & Dumais, S. T. (1997). A solution to Plato's problem: The latent semantic analysis theory of acquisition, induction, and representation of knowledge. *Psychological Review*.

Link, K. E., Kreuz, R. J., Graesser, A. C., & the Tutoring Research Group(2001). Factors that influence the perception of feedback delivered by a pedagogical agent. International Journal of Speech Technology

Lynem, J.N. (2001). Getting through the ceiling/Mentors help minority women rise to the top - but a good mentor can be very hard to find. *San Francisco Chronicle*, Sep 23, 2001.

Moreno,R. (2001)Contributions to Learning in an Agent-Based Multimedia Environment: A Methods-Media Distinction. *Proceedings of the IEEE International Conference on Advanced Learning Technologies: Issues*, Achievements, and Challenges. August, 2001. P. 464-466.

Negroponte, N. (1997). Agents: From direct manipulation to delegation, in *Software Agents*, J.M. Bradshaw (Ed). Menlo Park, CA: MIT Press.

Person, N. K., Graesser, A. C., Bautista, L., Mathews, E. C., & the Tutoring Research Group (2001). Evaluating Student Learning Gains in Two Versions of AutoTutor. In J. D. Moore, C. L. Redfield, & W. L. Johnson (Eds.) Artificial intelligence in education: AI-ED in the wired and wireless future (pp. 286-293). Amsterdam, IOS Press.

Super, D.E. (1984). Career and Life Development. In D. Brown & L. Brooks (Eds.). *Career Choices and Development* (pp.192-234). San Francisco: Jossey-Bass.

VanLehn, K. (2001). Personal web site available at http://www.pitt.edu/~vanlehn/mellon-sage.html on November 13, 2001

Making Web-based Academic and Student Services Section 508 Compliant: Whose Job Is It, Anyway?

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Abstract: Over the past few years, institutions of higher education have been rolling out a variety of Web-based services to their constituents. Registration, faculty grading, transcript management, general ledger inquiry, student advisement, and other critical service functions are available online to students, faculty, administrators, and alumni. But the rollout of online services is usually evolutionary, built on the tools and technologies available at the time. Online services launched prior to Section 508 must now be re-evaluated and re-worked, further stretching an institution's human and financial resources. This paper documents how an information management system vendor made those critical service functions accessible to **all** of its clients' constituents and provides a checklist against which to assess any information management system vendor's Web products.

Introduction

Section 508 is a statutory section of the 1973 Rehabilitation Act and was signed into law by President Clinton in 1998. Section 508 requires that electronic and information technology developed, procured, maintained, or used by Federal agencies – including Web sites – be accessible to people with disabilities, unless an undue burden would be imposed on that agency. Section 508 was enacted to enhance the ability of Federal employees with disabilities to have access to and use of information that is comparable to that provided to others. Similarly, by procuring accessible electronic and information technology, Federal agencies would be able to provide members of the general public with disabilities with information that is comparable to that provided to others. What constitutes *comparable access* under Section 508 is described in Subparts B, C, and D of the Access Board Standards issued in December, 2000 by the Architectural and Transportation Barriers Compliance Board, an independent Federal agency promoting accessibility for individuals with disabilities.

The scope of Section 508 is limited to the Federal sector and does not apply to the private sector, nor does it generally impose requirements on the recipients of Federal funds. However, states receiving assistance under the Assistive Technology Act State Grant program are required to comply with Section 508. Moreover, many institutions of higher education are committed to providing access to all their constituents, regardless of Federal guidelines. For example, in the State of California, the commitment to accessibility has been formalized into official policy to provide electronic access to the community colleges.

Institutions have already begun the task of checking their own Web sites for compliance. Some institutions have used *Bobby*, an automated accessibility checker offered by the Center for Applied Special Technology (CAST). *Bobby* functions like a spelling checker, to diagnose accessibility problems. A user can type the address of any Web site, and *Bobby* will respond with a review of the site, indicating areas of concern and suggestions for improving accessibility, or else awarding the site with a *Bobby Approved* badge for passing its test. *Bobby* rates accessibility based upon general requirements it looks for in the source code, such as alternate text for all images. The *Bobby* tool is also available to download, so that Web authors can use it to run accessibility tests on their own hard drives during the process of site design. However, Bobby Approved does not mean Section 508 compliant. The Web developer must still implement the proper code to make the site compliant with Section 508 requirements.

Another tool is *InSight/InFocus*, developed by SBB Technologies. *InSight* scans an institution's Web site and flags areas that could cause problems for disabled users, and *InFocus* fixes the flagged areas. The Equal Access to Software and Information (EASI) initiative also assists institutions with compliance issues through workshops, consulting services, and a resource-rich Web site.

The Challenge

What makes compliance checking somewhat painful is the lack of a single, agreed upon definition of compliance. The Electronic and Information Technology Access Advisory Committee (EITAAC) standards provide sixteen specific items for Web accessibility. The Web Content Accessibility Guidelines 1.0 produced by the WWW Consortium (W3C) define three priority levels, ranging from compliance of a specific piece of software on a specific operating system with specific assistive technology devices, to accessibility on a variety of applications, platforms and assistive devices.

Web-based academic and student services present a particular challenge for Section 508 compliance. The data sources for these services reside in the institution's information management systems, such as the Student Information System, Financial System, Human Resource System, and the Fund-Raising System. These enterprise-wide administrative application software systems are usually licensed from a vendor/manufacturer, with system maintenance, upgrades, and enhancements provided by the vendor. Vendors that provide pre-packaged Web workflows for academic and student services are responsible for testing its software for Section 508 compliance and making the necessary program changes. Because institutions pay the vendor an annual fee for system upgrades and maintenance, it is the job of that *vendor* to make the changes required to comply with Section 508, at *no additional cost* to the institution.

A Vendor-Client Partnership

Working in partnership with four client institutions in the forefront of universal Web accessibility – Springfield Technical College, The College of Southern Maryland, Dallas County Community College District, and Oakland Community College -- Datatel, Inc., a leading provider of information management solutions for higher education, launched an in-depth assessment and redesign project to produce WebAdvisor 2.0, a robust Web-based self-service solution that meets strict Section 508 compliance standards. Different institutions have different system configurations. For that reason, the project required testing on a broad and complex variety of configuration combinations. Testing was performed on all platforms: Windows 95, 98, ME, NT, 2000, XP, and MAC. Browser testing was conducted on Internet Explore 4, 5, 5.5, and 6, as well as Netscape 4, 4.7, 6, 6.2, and on Opera, Lynx, and Mosaic. Various computer brands and types were tested, as were various HTML versions. Assistive devices, including JAWS, ZoomText, Window Eyes and other screen readers, were used in the testing process. The objective was to take into account various disabilities, such as blindness, low vision, cognitive, and physical disabilities.

Some of the technical changes made to the Web product were:

- The addition of ALT tags to images and image maps, enabling screen readers to "read" the images in words
- Skip links, enabling the visually challenged to skip the navigational bar
- Clear and unique field labels
- Style sheets that follow the Section 508 HTML templates
- Shortcut keys
- An accessibility description page
- Tags for combination and Submit buttons
- Linear tables for ease of use

In a statement of accessibility compliance published in July 2001, Nu Visions Unlimited, Inc., an independent testing and auditing firm certified WebAdvisor 2.0 as compliant with the World Wide Web Consortium Level A Accessibility Guidelines and Section 508.

Partnering with Your Vendor

When working with your vendor, an excellent starting point is the 16-bullet checklist provided by the Access Board. The checklist covers layout, look and feel, navigation, the use of color, and other criteria set down in the Section 508 guidelines. Once compliance testing of the Web product has been completed and the areas for improvement identified, a development plan with major milestones, accessibility testing and verification, along with clearly defined roles and responsibilities for both client and vendor, should be crafted. The Web product should integrate seamlessly into the institution's overall Web presence. However, it should be flexible enough to enable some colleges within the institution – law, medicine, etc. – to have their own look and feel, if desired.

Thanks to a solid vendor-client partnership, WebAdvisor 2.0's compliance with Section 508 was a key milestone for Datatel, because it has a far-reaching impact on the ability of Datatel's clients to serve all of their constituents, including those with disabilities. In making Web-based academic and student services Section 508 compliant, the vendor does most of the work. But the success of the undertaking is the job of the vendor and the client institution working together.

Reference Web Sites

http://www.section508.gov
http://www.cast.org/udl/index.cfm?I=11
http://www.w3.org/WAI/
http://www.w3.org/tr/wai-webcontent-techs/
http://www.w3.org/wai/wcag1-conformance.html
http://www.cast.org/bobby/
http://aware.hwg.org
http://www.rit.edu/~easi
http://www.nuvisions.com

Web Based Learning Support for Experimental Design in Molecular Biology

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Abstract: An important learning goal of a molecular biology curriculum is a certain proficiency level in experimental design. Currently students are confronted with experimental approaches in textbooks, in lectures and in the laboratory. However most students do not reach a satisfactory level of competence in the design of experimental approaches. This paper describes the development of a web-based application, which supports the learning of this design skill. The application consists of an activating part and a library part. In the activating part, the student is presented with a biological question that must be solved experimentally. Therefore, the student has to make a set of coherent choices, execute steps in an experiment and interpret the experimental results. Furthermore, a DNA sequence has to be analyzed with web-based databases. The library consists of learning objects that present essential background information. A test with a small group of students yielded very promising results.

Introduction

The Food and Biotechnology (FBT) program aims at the creation of a rich body of digital learning material for university curricula related to food science and biotechnology. The FBT program was initiated at Wageningen University in September 2000. The program focuses on web based learning support for those learning goals where digital learning material is expected to have a clear added value. One of the FBT projects aims at the development of digital learning material for molecular biology. This paper describes the first stage of this project.

One of the important learning goals of a molecular biology curriculum is a certain proficiency level in designing an experimental approach. This involves the application of different techniques. Students are usually capable of understanding how these different techniques work, but they have difficulty in combining them in a useful way and in judging whether they are suitable to find an answer to a particular question. Moreover, students often do not realize that experiments are performed with biological systems. Consequently they do not use their knowledge of biology when designing experimental approaches, even though this is essential for the design of a useful approach. This lack of applying biological knowledge can also be observed during the analysis of experimental outcomes.

The indicated problems in experimental design may be inherent in the current educational setting. Currently students are confronted with experimental approaches in textbooks, in lectures and in laboratory courses. Each of these formats has its own drawbacks. Textbooks do describe many experiments and approaches, but this is not sufficient for students to learn to choose techniques and to schedule operations. One of the problems is that students usually focus on the mechanisms behind techniques, thereby losing sight of the uses of such techniques. In a lecture, more weight can be put on the actual designing of experimental approaches. It is however very hard to involve more than a limited number of students individually in such a way. Furthermore, the students that do get involved, can hardly get personal feedback due to considerations the lecturer has to take of the other students as well as the time allotted for the lecture. In a laboratory course finally, students have little freedom in choosing and scheduling operations. Moreover, they become preoccupied with the practical skills they still lack, such that the overview of even the specific experimental approach is lost. Thus the teaching of more general aspects of designing experiments is practically impossible. The possibilities of computer based learning support may offer a solution to the above problem. Apart from the well known argument that computer based learning support makes it possible to activate each student individually and generate personal feedback, many of the experimental results in molecular biology experiments are photographs or sequences and can thus be represented digitally. Moreover, the processing of results in molecular biology experiments requires computers and web access. Recently, many DNA and protein sequences have become available in web-based databases. In current molecular biology research, using these databases becomes increasingly important for the design of experimental approaches and the interpretation of experimental outcomes. Therefore, learning to use information from databases was added as new learning goal to an undergraduate course. For an effective use of the available data, database searches have to be performed and the data have to be integrated with biological knowledge and knowledge about molecular biology techniques.

Thus web-based learning support should improve the following skills:

- designing a basic experimental approach by selecting and combining suitable techniques;
- performing a database search;
- integrating information from biology, techniques and database searches.

These skills can only be improved when sufficient background knowledge can be used. Knowledge that the students have not mastered yet, has to be presented as well.

The material has to complement the lectures. As the lectures may change from time to time, the material should consist of modules that can be combined flexibly. It should also be possible to use these modules independently from the lectures.

In this paper we describe the development of the first module including the results of a first evaluation. The paper finishes with a discussion of the methods we applied to teach the skills mentioned above.

The Global Structure of the Site

To offer students the opportunity to practice the necessary skills, they are offered a case (see demo site) in which they have to design an experimental approach to solve a real (but basic) biological problem. Thereby the theory is placed in the proper context. This may be favorable for retrieving the theory from memory in a similar context (Anderson 2000), but this also makes its relevance more apparent, which may motivate students (Keller 1987). The background information that is needed to successfully go through the case is available to the students just when they need it. This just-in-time information presentation is, among others, recommended by the Four Component Instructional Design model (van Merriënboer 1997), which gives guidelines for teaching complex cognitive skills. Some background information may be needed several times, when going through the case. To be able to offer this information from one place, we constructed a library (see demo site) that contains all necessary background information. This library consists of independent self-explanatory learning objects. Because of this setup, it is possible to study only a selection of the learning objects and no specific study order is required. In case a student prefers this, he could also study all background information before starting with the case. The library also ensures that students with varying amounts of prior knowledge can in principle complete the case.

The Light Induction Case

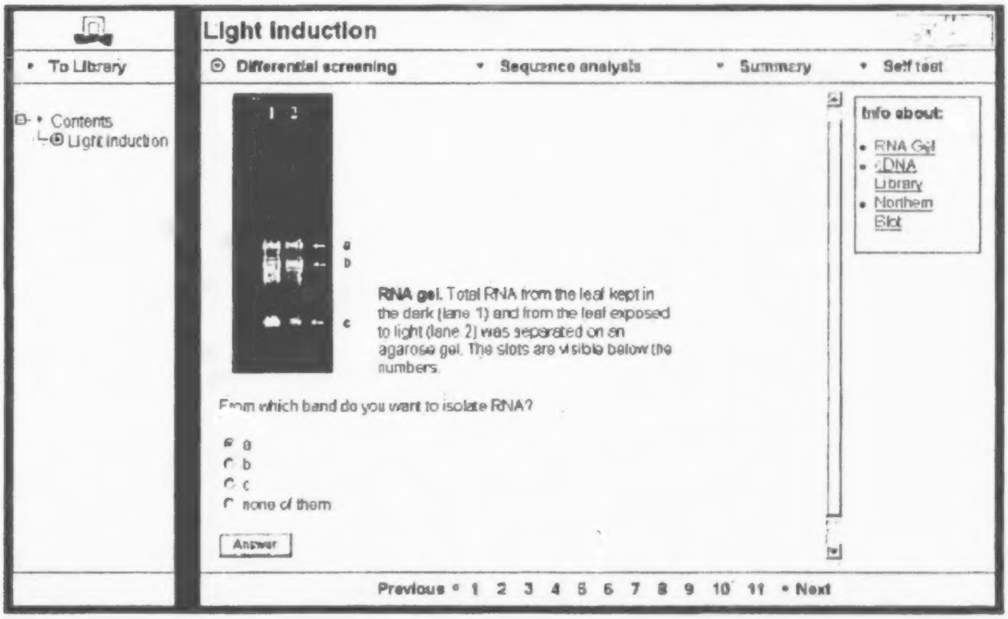
In the light induction case the student has to isolate a gene that is induced in plants upon light exposure and analyze its DNA sequence. The student is guided through the case by multiple-choice questions to prevent him from getting lost and frustrated. Sometimes a choice between different techniques is offered. In this way the student is stimulated to actively think about the possibilities of the techniques, which is essential for the design of an experimental approach.

After choosing a technique, the student is immediately confronted with the experimental result. This result has to be interpreted in order to find out whether applying the technique was indeed useful. Thereby it is essential to take biological aspects into account. This is illustrated by the screen dump from the demo site shown in figure 1. This shows the screen the student sees after choosing to analyze differences in mRNA concentrations on an RNA gel on which total RNA is loaded. This choice has led to a useless result because mRNA cannot be visualized with this method. This is partly due to the fact that mRNA, the RNA that needs to be studied, forms only a minor fraction of total RNA. Thus, it is necessary to use knowledge about biology to decide whether the technique is useful. The student will discover that the technique was not useful after selecting a band for analysis.

This format in which students are confronted with a result that they have to interpret has several advantages. Firstly, students probably remember better whether a technique is useful in a certain context when they discovered this themselves than when this would have been told. Secondly, if students do not use their biological knowledge, they are confronted with the consequence. This probably makes a stronger impression than when this is pointed out during a lecture. Thirdly, a picture of an experimental result contains implicitly much information about the precise use of a technique. By interpreting the results, students are stimulated to focus on and give meaning to these results. These include results of techniques that were not useful and that are usually not shown in a textbook. As people tend to have good memory for meaningful interpretations of an image (Anderson 2000) and easily make inferences from them (Larkin *et al.* 1987), the students are in this way again stimulated to remember the precise use of a technique.

Sometimes it is also necessary to interpret the result in order to continue with the procedure.

The gene can eventually be obtained by applying a method that is called "differential screening". This method was chosen for several reasons. Firstly, the problem is an example of a very common research question in molecular biology. In many instances, genes that are specifically induced under certain conditions have to be identified. Even though differential screening is a relatively old method it was chosen because it clearly illustrates the problems involved. Moreover, more advanced methods are still largely based upon the same principles. Therefore, understanding the differential screening method may facilitate the understanding and proper application of technologically more advanced methods, based on an analogy process (Anderson 2000).



RNA gel. Total RNA from the leaf kept in the dark (lane 1) and from the leaf exposed to light (lane 2) was separated on an agarose gel. The slots are visible below the numbers.

From which band do you want to isolate RNA?

● a
○ b
○ c
○ none of them

Figure 1. Screen dump of a screen a student see after selecting a technique. To be able to interpret this result, the student needs to use biological knowledge. Only after interpreting the result correctly, it becomes clear that this technique was not useful in this context.

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After isolating the desired gene, the DNA sequence of the gene has to be analyzed (see sequence analysis section at the demo site). The first sequence to be analyzed is not complete, as is usually the case in practice. Another reason why this partial sequence is offered is that the student has to discover for himself that it is not complete. Therefore, experimental findings have to be combined with knowledge from biology. The student has to perform an additional experiment to obtain the complete sequence. This sequence has to be analyzed by performing a database search. To perform this search it is again necessary to actively use biology knowledge as well as knowledge about the applied experimental techniques.

The interactive part of the case is followed by a summary. This summary contains overview pictures as well as information about why applying a technique in the given context was useful or not. The summary contains in principle all necessary theoretical information. Thus, the interactive part should support the training of extra skills, whereas the theory can be found in the summary.

Finally, a number of multiple-choice questions are implemented which serve as a self-test.

The Library

The library contains background information that is necessary to go through the case, so that the material can in principle be used by students with varying amounts of prior knowledge. The library contains information about techniques, database searches and processes that take place inside cells. As mentioned before the library contains independent and self-explanatory learning objects.

The explanation of a technique consists of 2 to 6 movies, because of our positive previous experiences with these types of movies. Figure 2 gives a screen dump (see demo site) of the introduction page for the technique, which is labeled DNA gel. The page contains pictures that give an impression of the content of the movie. The student can click on a picture in order to start a movie. The movies do not take more than 2 minutes. They consist of spoken text supported by photographs, annotations and animations. As stated before, it is essential for designing experimental approaches to know the different purposes of a technique. Therefore, this is stressed in the first movie. The second movie explains the principle of a technique.

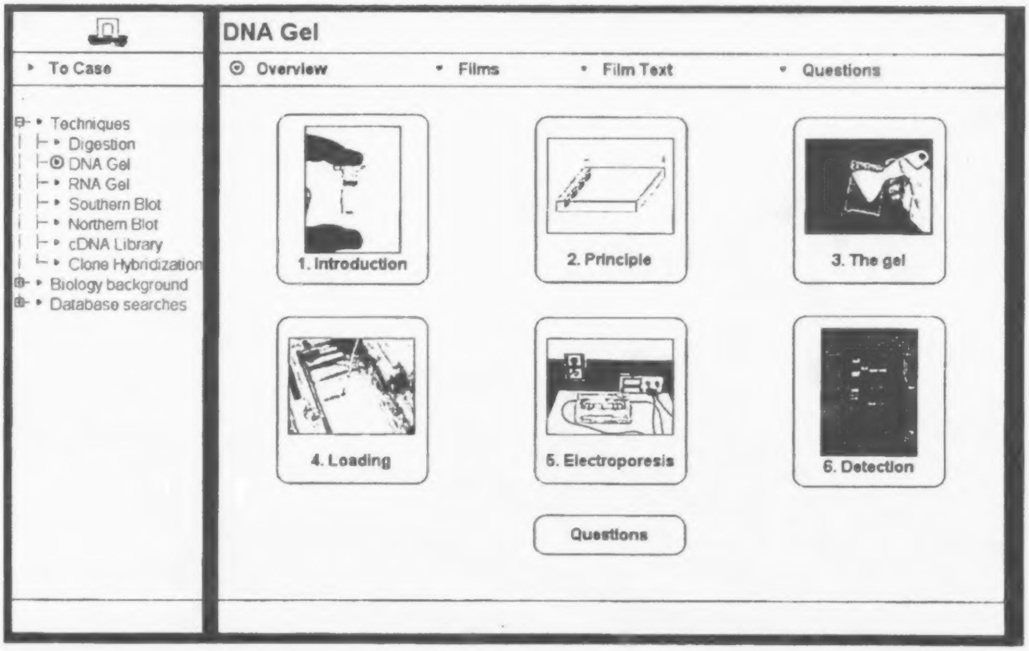

Figure 2. Typical introductory screen for a technique in the library. Pictures give an impression of the content of the movies. A student can click on a picture to start a movie. Questions are available as well.

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The explanation of some techniques also highlights specific steps of the technique to give the student an idea of its complexity and scale. A movie showing a typical experimental result is sometimes added as well, which makes it easier for the student to interpret results himself later on. The written text and the still images of each movie are available. Extensive experience with the use of movies at Wageningen University has shown that some students prefer to view the text when the pace of the movie is too slow for them. The written text is also better for students who just want to scan through the theory quickly (Hartog *et al.* 2000), for students whose mastery of the English language is insufficient to understand the audio and in situations when there is no sound available. Beside the movies, each learning object contains a couple of short questions to let the student internalize the newly acquired concepts. In case of similar techniques, movies that explain identical steps, are actually identical. If applicable, this is clearly indicated.

The learning object on the database search contains some text to explain the background and a simple simulation. In this simulation a search can be performed in controlled circumstances. When the student follows the instructions given on top of a page, he stays within the simulation and gets new instructions. It is however also possible to leave the simulation and find out what happens when another strategy is followed. This learning object also contains some multiple-choice questions.

The learning objects dealing with the biology background contain schematic drawings, tables etc. in which the most important information is summarized. These objects serve to refresh the student's memory and are not meant to teach them new information.

Evaluation Results

So far the material was evaluated with a group of 6 volunteers. This evaluation was carried out to identify ways to improve the site. By testing the site with a small number of users, most usability problems should become clear (Nielsen, 2000). The students first had to give an indication of their prior experiences and they had to make a short test. Next, the students worked in pairs through the site. Finally they performed a post-test that was similar to the first one and completed an evaluation form. The students judged the site on average with an 8.7 on a scale of 1 to 10. Thus, the students were very enthusiastic. Reactions on the evaluation forms include:

- "The overall impression is very positive. By performing a virtual experiment you become able to understand techniques, but more important, learn to combine different techniques to come to a good result."
- "I think it is a good idea showing some films because this helps to imagine the practical work and not only the theoretical explanation. And then, the possibility of listening the explanation is very appropriate because, in this way, it is not so tiring reading the whole text from the computer screen."

The evaluation also yielded ideas for improvement. Most importantly, students had problems to perform the database search. Therefore, the above mentioned simulation was added to the library. Further minor improvements include the addition of a clarifying figure, the reformulation of some feedback and the removal of a number of spelling mistakes.

An important test result is, that each student applied the concept of differential screening sufficiently well after studying the material whereas only one student already managed to apply this concept before studying the material. Furthermore, in the post test the students had to design an approach to solve a (basic) biological problem that was different from the problem they solved at the site and that required a different approach to be solved. The students performed better in the second test than in the first test, even though the problem was slightly more difficult. Overall, the results were encouraging.

Final Remarks

A web based application, which supports learning experimental design in molecular biology has been developed. The web site has been evaluated by a small group of volunteers. Currently the demo site is accessible worldwide for review. The site will be used in Wageningen in the course "gene technology" in spring 2002.

The ultimate goal will be that students can design experimental approaches in new, unfamiliar situations. The application confronts the students with situations and experimental results, which force them to actively use their knowledge of biology while designing a new approach. It is expected that applying their knowledge, while working with molecular biology techniques will eventually become habitual.

The web site teaches to design an experimental approach addressing a new question in molecular biology in three ways. Firstly, the differential screening method that students use in the case, can be used to address similar biological questions. Secondly, the differential screening method can also serve as a schema when designing an analogous, technically more advanced approach. Finally, the application forces the student to focus on the precise use of each technique in multiple ways. It is essential that the student becomes very much aware of what the use of a technique exactly is. Thus, it should become easier to design new approaches using the same techniques. Moreover, students will probably gradually learn to focus more on the use of a technique when studying new ones in the future. This may even lead to a better performance for designing approaches that consist of these new techniques as well.

Currently, several additional cases are being developed, covering the production of transgenic organisms. The research is progressing towards a qualitative simulation environment that will present the consequences of a student's choice in terms of experimental results based on programmed rules. The number of different options will be almost unlimited in the perception of the student. On the one hand this offers the students a more realistic situation and more opportunities to test their own ideas, but on the other hand students could easily flounder and show unstructured behavior (de Jong *et al.* 1998). The main challenge for the future will thus be to embed the simulation of experiments in an environment that guides and supports the students.

References

Anderson J.R. (2000). *Cognitive psychology and its implications.* Worth Publishers, NY

Hartog, R.J.M., de Gooijer, C.D., van der Schaaf, H., Sessink, O., Vonder, O.W. (2000). Comparing web based course development with and without a learning environment. *Proceedings of Webnet2000*, Association for the Advancement of Computing in Education, San Antonio, TX. 240-245

de Jong, T., & van Joolingen, W.R. (1998). Scientific discovery learning with computer simulations of conceptual domains. *Review of educational research*, 68 (2), 179-201

Keller J.M. (1987). Development and use of the ARCS model of motivational design. *Journal of instructional development*, 10(3), 2-11.

Larkin, H.J., & Simon, H.A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science*, 11, 65-99.

van Merriënboer, J.G. (1997). *Training complex cognitive skills: a four-component instructional design model for technical training.* Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Nielsen, J. (2000): http://www.useit.com/alertbox/20000319.html

Demo site: http://mbedu.fbt.eitn.wau.nl/edmedia_demo

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The Role of Group Development and Facilitative Teaching in Online Courses

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Abstract: In an effort to engage online students interactively, distance-learning guides emphasize group-based instructional strategies and the use of Internet communication tools in online instruction. Although some of these guides include a general discussion of group development and facilitation strategies (see, for example, Palloff & Pratt, 2001, p.125), none provide a concise, step-by-step approach to group facilitation for instructors who may be unfamiliar with these strategies. Using Lacoursiere's model of group development, this article will present an overview of the application of group development models and group facilitation in online courses, one that can provide instructional designers and instructors a practical framework for maintaining meaningful interactivity and group cohesion in online learning.

Research in distance learning emphasizes interactivity, especially learner-to-learner and learner-to-instructor interaction, as a key to engaging learners and achieving learning objectives in online courses (Moore, 1989; Hillman, Willis, & Gunawardena, 1994; Wagner, 1994). Accordingly, instructional designers and developers incorporate instructional strategies such as group projects into course design and encourage the use of discussion boards and e-mail in course implementation. But these provide only the technological *opportunity* to interact; they do not necessarily provide the motivation to do so. Group facilitation can help motivate students to interact but in order to be used effectively instructors must have at least an introductory knowledge of group development. Drawing from the observations and models of group development, this article presents a step-by-step approach for the application of group facilitation strategies in online courses.

Group Development and Online Learning

Researchers of group development use models to study the behavior of groups and maintain that groups are usually better able to accomplish a given task if group leaders use facilitation skills to help the group establish a sense of cohesion. In this way, understanding group behavior provides a framework for group leaders so they can learn which specific interventions may help foster and maintain this cohesion throughout group development. Although Tuckman's model is the best known (1965), Lacoursiere's group development model (1980) may be more helpful for instructors and designers who have never been exposed to group development because it demonstrates the relationship of morale to productivity, suggesting that group cohesiveness may affect the achievement of learning outcomes. According to Lacoursiere's model, there are five stages of group development: Orientation, Dissatisfaction, Resolution, Production, and Termination, with each stage characterized by measurements of morale and productivity. Lacoursiere's developmental stages are presented briefly below, along with suggested online facilitation strategies for each stage.

In the Orientation stage, group members have high expectations about the task they are undertaking but lack the requisite skills to fulfill the task. Members experience anxiety over the purpose of the group and group roles and are highly dependent on the leader. Overall, orientation is marked by high morale but low group work. During this stage, the instructor should initiate low risk activities such as icebreakers, help group members gain key technical and content skills, and clarify group roles and purpose. It is important that the instructor establish communication protocols and behavioral norms. Finally, the instructor should maintain a high presence, use a conversational tone, and role model risk-taking through personal disclosure to encourage students to do likewise (Cutler, 1995).

During Dissatisfaction, group members experience conflict between their initial expectations and the reality of the group and its task. Morale drops but work increases as group members attain the necessary skills to undertake the task. If conflict is mostly low-level frustration, the instructor can continue to help clarify group goals, reminding the group that conflict is a natural byproduct of the process that can be productive if managed successfully. If conflict is highly charged and personal, the instructor should contact members privately and consider more formal conflict resolution strategies. Generally, the instructor should maintain a high presence, be directive, and act quickly to address and resolve any negativity. Interventions in this stage are highly variable and situational.

In the Resolution stage, reality is accepted and reconciled with expectations so there is decreasing negativity. Morale and work both increase. The instructor can begin to let go, but it is important that students know he/she is still active and a content resource for them. For example, in online discussions the instructor might deflect questions, redirecting them back to the group or to specific members of the group. In addition, the instructor should summarize and refocus discussions if they digress. As the group begins to develop cohesiveness, he/she can initiate higher risk activities such as peer-to-peer critiquing.

In the Production stage, the group is working well, is satisfied with group member relationships, and group members have positive feelings. The group is now able to work autonomously so the instructor can step back and allow the group to function independently, but he/she should remain ready to intervene if group cohesion begins to impede work on the task, for example, if the social interaction threatens to impede learning objectives. Since morale has regained some ground and group members are more skilled, this is a time that the instructor might introduce discussions around controversial topics, or some similarly challenging activities.

Termination is characterized by a sense of loss and concerns about completion. Group members either pull together to finish with positive results or disintegrate early, impeding group work. Although morale is fairly high, it may dip if the group begins to break apart. The instructor should use closure activities to bring the group to completion on a high note. This can be done formally with traditional activities such as posting final projects and evaluations, or informally, for example, through discussions about completed learning objectives.

Conclusions

The ideas presented above are a simplified overview of group development and facilitation. In reality, both are highly dependent on the context of both the group and the task, and they can be quite complex. By understanding the stages of group development, faculty may become better able to determine which facilitation strategies will help develop group cohesion and provide the motivation for online interaction. Learning group development will help faculty see the context for facilitation strategies they may already be using, for example, icebreakers and communication guidelines. Finally, introducing group development in the planning and implementation of online learning may help instructors see that they have dual roles in online teaching, that of the traditional content expert and that of a group leader. Meaningful and productive online interactivity depends on the successful deployment of both roles in a learner-centered instructional context.

References

Cutler, R.H. (1995). Distributed Presence and Community in Cyberspace. *Interpersonal Communication and Technology: A Journal for the 21st Century*, 1 (2), 17.

Hillman, D.C.A., Willis, D.J., & Gunawardena, C.N. (1994). Learner-interface Interaction in Distance Education: An Extension of Contemporary Models and Strategies for Practitioners. *The American Journal of Distance Education*, 8, 30-42.

Lacoursiere, R. (1980). *The Life Cycle of Groups: Group Developmental Stage Theory.* New York: Human Sciences Press, 19-56.

Moore, M.G. (1989). Three Types of Interaction. *The American Journal of Distance Education*, 3, 106.

Palloff, R. and Pratt, K. (2001). *Lessons from the Cyberspace Classroom: The Realities of Online Teaching* (125-151). San Francisco: Jossey-Bass Publishers.

Tuckman, B.W. (1965). Developmental Sequence in Small Groups. *Psychological Bulletin*, 63, 384-399.

Wagner, E.D. (1997). In Support of a Functional Definition of Interaction. *The American Journal of Distance Education*, 8, 6-29.

Completing a Life: Content and Design Challenges in Creating Educational Multimedia Addressing End-of-Life Care

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Abstract: There is a noted shortage of educational resources to help people facing terminal illness. *Completing a Life* is an interactive multimedia CD-ROM and web site developed to address this issue. Many content and design challenges were addressed during development. The resulting product includes a carefully crafted interplay of content, navigation, interactivity, and look-and-feel to create an approachable, empowering resource for a subject that is emotionally difficult for most people to address. *Completing a Life* serves as a model for medical education, combining personal stories with task-based information contained within a virtual environment.

Introduction

Modern medical science allows people to live for prolonged periods, even with the onset of a terminal illness. This has led to an increase in the issues related to end-of-life care. Given that the subject of dying is often viewed as taboo in our society, frequently individuals do not talk openly about it with their health care provider or are not "ready" to do so when the opportunity presents itself (Yang, 2000).

The major goal of *Completing a Life* is to give a comprehensive overview of a subject that is emotionally difficult for most people to address and to do so in a way that is comfortable, reassuring and instructive. The project took on the complementary task of opening up the users to make them receptive to the information. If we could achieve this, it was our hope that *Completing a Life* would give users control over a situation in which they may have felt none before, resulting in a sense of empowerment. In the case of users with an advanced illness, this empowerment would provide the ability to take charge of their lives for the time they have remaining. In the case of users who are friends or family members, this empowerment should give them access to much needed information to answer their questions and help them empathize with the needs and desires of the patient.

Objectives

To achieve these goals, the core team, composed of three content experts, two multimedia designers, a writer/researcher, and an artist, spent much time investigating and brainstorming to arrive at the following objectives:

- Educate users on end-of-life issues not readily available elsewhere;
- Identify and organize the content to reflect the tasks faced by the target audience;
- Design navigation that empowers users to find and explore the information to address their own personal questions and concerns;
- Communicate the information in a clear, inviting tone without being authoritarian;
- Develop a look-and-feel that is welcoming and comforting while maintaining the emphasis on the content itself;
- Integrate stories of others facing similar issues to create a "virtual" support group;
- Create a multimedia product that is viewable, printable and accessible on the majority of modern computer systems, while still being innovative in its design.

In order to achieve the desired objectives, several content and design challenges had to be identified and resolved.

Completing a Life
[redacted]
Completing
a Life

Figure 1: Opening screen of *Completing a Life*
http://www.completingalife.msu.edu

Content and Design Challenges

Completing a Life (see Figure 1) was developed through a process of iterative design. User involvement was an integral part of this process. Focus groups helped define and structure the content. Prototypes were tested on the target audience to help determine an appropriate writing style, effective navigation, and a welcoming look-and-feel.

Content Research

The first task in the development of *Completing a Life* was to determine what resources were currently available for patients and families and what information was needed. We conducted focus groups with health care providers, hospice workers, religious figures and family members of the recently deceased and interviewed content experts to aid in this process. Printed material, videos, Internet-resources and information gathered from discussions with support groups were also examined. This research provided us with the foundation to begin the iterative process of gathering, writing, and structuring information. It also led to the creation of a list of resources that would ultimately be highlighted throughout *Completing a Life* as additional support materials that users could seek out.

Information Architecture

The organization of content was very important in making the project approachable and useful. After much discussion and consideration the decision was made to divide all the content into three major areas: *Taking Charge, Finding Comfort* and *Reaching Closure* related to the tasks our target audience generally face. Each of these tasks contains several topics. Each of the topics contained several levels of subtopics. This hierarchy defined a logical structuring of a complex information space and ultimately became the basis for the primary navigation.

Navigation

Completing a Life is built on a user-centered model. Reflecting awareness that not every user will want to or be ready to investigate all the content, the navigation allows users to develop their own paths, exploring the information they want when they want it. This user initiated nonlinearity, coupled with a variety of secondary hyperlinks throughout the content, was designed to keep the user actively engaged in the content, which studies have shown promotes learning (Brandsford, Brown, & Cocking, 2000).

The navigational hierarchy parallels the information architecture. However, we did not want to overwhelm the user with too many choices onscreen at one time. Therefore, the hierarchy was compressed. Several subtopics were merged together to limit both the number of subtopics for each topic and to limit the maximum depth of the hierarchy. Further, it was decided to display only the depth of the hierarchy and the current topic's immediate subtopics at any one time. Overall, the visual design of the navigation orients users to their location in the information space and promotes active exploration and discovery of subtopics, while providing an immediate method to navigate back through the hierarchy.

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Writing Style

Given the delicate nature of the subject matter, we knew that how the content was presented was just as important as what was actually said. We experimented with a variety of "voices" in the writing style. It was decided to use a "voice" that spoke directly to the person facing the terminal illness. This approach supported our goal of empowerment. The tone was positive, friendly and experienced. It was appropriate for family members and health care workers who, as informal testing demonstrated, had no problem empathizing.

The writing also had to adhere to the nonlinear accessibility of the content. That is, since a user may have arrived at the page via a direct hyperlink from another part of the product, we could not assume that the pages were read in any particular order. Therefore, each page of information had to be written to make sense on its own.

Reading Comprehension

The content was written in a concise manner. This kept the information straightforward while minimizing the amount of vertical scrolling. We consulted with a literacy and reading expert to improve accessibility of content and keep the material at an upper elementary school reading level. It was also decided to supplement the onscreen text with an optional audio narration that made the content accessible to visually impaired users who represent a high percentage of our target audience. And, since listening comprehension is higher than reading comprehension, it further reduced literacy barriers (Lynch, 1988).

Look-and-Feel

The look-and-feel of the project was a major concern. We wanted to present the content in an approachable, comfortable fashion. Early in the development several artistic styles were prototyped. After some user testing and feedback from other multimedia designers, we decided to go with a watercolor style because we felt it conveyed the sense of softness and delicacy of the subject matter.

The visual metaphor we decided upon was that of a back porch overlooking a lushly vegetated yard. The visual metaphor links the four primary locations in the original watercolor scene to the four primary content sections in the product. The porch represents the location of the personal stories, as people often sit and talk on porches. A gazebo with a table and chairs represents the *Taking Charge* content. A comfortable looking tree swing represents the *Finding Comfort* content. And a bench overlooking a calm pond represents the *Reaching Closure* content. The metaphor between the visuals and the content was very subtle and intended only as a subliminal cue as the user browsed the content, not as a navigational metaphor.

User testing verified the watercolor style and visual metaphor were effective. However, we found some users did not respond to the look-and-feel positively or negatively. They were, in fact only interested in the information itself. For this group, we added a listing of *Topics* to be used to navigate directly to the desired information.

Personal Stories

A defining element of the project was the integration of "personal stories." Personal stories are told firsthand through video interviews. The interviews document the real-life experience of people who have confronted advanced illness in one way or another. Rather than use actors and scripts, it was decided that true stories told by those who were experiencing a life threatening illness were much more powerful and effective. However, the process of finding and interviewing candidates willing to tell their stories was challenging. It was found that there was a limited time between the point when individuals were ready to share their stories and when they were still in a physical state suitable to be interviewed. Our team had to work closely with hospice and a variety of doctors to help identify appropriate candidates. The team also had to respond quickly when a candidate agreed to be interviewed.

An effort was made to include interviews from a diverse group of individuals to increase the likelihood that the user would identify closely with one of them. Fifteen interviews were conducted. However, several of the interviews were not included in the final product. The primary reasons for exclusion were either the individuals were not ready to discuss issues related to completing their lives or, because of their advanced illness, they were very difficult to understand and follow. Ultimately, nine individuals were included in *Completing a Life*, representing multiple demographic groups, illnesses, and personalities.

Overall, there are more than three hours of interviews in *Completing a Life*. Each interview was arranged in the same task-based categories as the content: *Taking Charge*, *Finding Comfort* and *Reaching*

Closure. Within each category, the user can watch segments of the interview. Therefore, a user can listen to the parts of the stories that are interesting and relevant to them.

These video narratives illuminate many of the topics addressed in the content sections and are extensively cross-linked with that content to enhance the user's interactive multimedia experience. Links to topics relevant to the individual's story are available below the video interviews. By following the link, users can explore the topic in more depth. In addition, content pages have links to related personal stories.

Page Design

At the beginning of the project in 1999, Web usage statistics showed that over 80 percent of monitors were at least 800x600 pixels in size (Nielsen, 2000). Given that this percentage would assuredly increase over time, we designed the pages within *Completing a Life* for viewing on 800x600 pixel displays or larger. This allowed for optimal layout of navigation and content with no horizontal and minimal vertical scrolling.

Following Jakob Nielsen's premise that "navigation is a necessary evil that is not a goal in itself and should be minimized" (Nielsen, 2000), we kept navigation to a minimum. The average page in *Completing a Life* has less than 25 percent of its real estate dedicated to navigation. The largest amount of real estate is dedicated to the content. Ample space is also given to "white space". White space is used to segment the page into meaningful areas that the user can quickly identify.

The pages were designed to be conducive to printing. Most individuals, particularly the elderly who represent a sizeable portion of our target audience, find it difficult to read a large amount of text on the computer screen. Further, we have found that users often enter an "information gathering" mode in which they browse through the content rapidly skimming it. When they find something of interest they often prefer to print it to be read in detail at a later time so they can continue in their information gathering. They also may want to print content to share it with others who do not have computer access readily available. For these reasons, we avoided such page design features as frames and popup windows.

Delivery

Despite the recent downturn in the dot-com industry, Internet use is still on the rise, especially among home users (Roberts & Crump, 2001). The so-called "digital divide" between those who have access and those who traditionally do not, including the ethnic minorities, rural populations, and the elderly, is rapidly shrinking (Fox & Rainie, 2000; Eng, Maxfield, Patrick, Deering, Ratzan & Gustafson, 1998). Today, one of the most common uses of the Internet by consumers is to obtain health information (Fox & Rainie, 2000; Horrigan & Rainie, 2002). With this in mind, we developed *Completing a Life* with Web-enabled technologies. However, we did not want to limit our audience to those with just Internet-access. Therefore, we utilized only client-side technologies that do not require a server. This provided us the flexibility to deliver the product on the Internet, within Intranets, such as local hospitals' networks, or on CD-ROM.

The design of *Completing a Life* demanded cutting-edge multimedia technologies. Audio, video, animation, interactivity and the ability to print complex medical forms could not be handled by HTML alone. Flash, QuickTime and PDF were chosen to address these multimedia needs. These technologies have become de facto standards on the Web. They are available as free downloads and work identically on both Macintosh and Windows platforms. Further, a high percentage of typical Web users already have these technologies installed and configured on their machines. For those without the required technologies, *Completing a Life* guides users through the download and installation process.

Another delivery decision was to target broadband connections rather than slower phone-modem connections. This choice was made for several reasons. First, broadband availability is on the rise. It is estimated that 1/3 of household Internet users and 2/3 of business users will have a broadband connection by 2002 (Rose & Warren, 2001). Second, it was our goal to produce an engaging, rich multimedia experience. It would be very difficult to do this with the bandwidth that a 56K modem provides. Third, we wanted the personal story videos to convey the personality and emotions the individuals expressed in their interviews. This would not be possible with thumbnail-size video at slow frame rates and poor audio quality.

The site was made available on the Internet in October 2001. Broadband users can access the content in real-time with little or no wait time. Modem users can access the content. However, in most cases, they may have to wait for the multimedia elements to load. We also made the product available on CD-ROM for those wanting immediate access without broadband connections and those without Internet connections altogether.

An Evolving Model

Completing a Life is the third in a series of medical products developed at Michigan State University. *Breast Cancer Lighthouse* (Greene & Heeter,1996) released in 1996, pioneered the model of combining medical information with personal stories in a virtual environment. *Easing Cancer Pain* (Greene, Ogle & Winn,1998) followed in 1998 further refining the model. Lessons learned from both products aided in the design of *Completing a Life*.

Combining Personal Stories with Medical Information

In *Breast Cancer Lighthouse*, personal stories were shown to be an effective approach to creating a "virtual support group" (Greene & Heeter,1998). *Easing Cancer Pain* extended the personal stories model by linking from medical information in the product to related segments of the personal stories. This was found to "humanize" the information by tying it to the individuals' actual experiences (Greene, 1998). In *Completing a Life*, this interlinking of content with the personal stories was enhanced to go both ways. That is, personal stories segments also linked to content related to the issues being discussed in the stories. This added validity to the personal stories. Further, it provided "just-in-time" information as users heard topics discussed within the personal stories.

Virtual Environments

Another hallmark of the model developed in *Breast Cancer Lighthouse* was the use of a virtual environment to disseminate the medical information. In the product, information was tied to locations on an island. In one area the user could walk along a beach, by navigating with a mouse. On the beach, they were introduced to women who have survived breast cancer. The user could click on a woman to share in her personal story. In another area of the product, the user could walk along a garden path, containing a variety of signs. When the user clicked on a sign, they were presented with information about the given topic. A similar navigational metaphor was employed in *Easing Cancer Pain*. The user navigated along a path at a virtual retreat grounds, locating information in kiosks found along the path. Personal stories were told around a campfire. The virtual environments were shown to create a relaxing mood among users, increasing their receptiveness to learning (Greene & Heeter,1998).

The information space in *Easing Cancer Pain* was much more complicated than *Breast Cancer Lighthouse*. Testing found that some users had a difficult time making meaningful associations between the information and the virtual locations; this lead to some disorientation when navigating. The information space in *Completing a Life*, containing a wide variety of topics, was even more complex than *Easing Cancer Pain*. Therefore, rather than using a virtual environment as a direct navigational metaphor, we decided to employ a more traditional, hierarchical menu system to navigate the information. However, a virtual environment was utilized as a visual metaphor to achieve the benefits found in *Breast Cancer Lighthouse* without the confusion found by some in *Easing Cancer Pain*.

User Testing

An evaluation study of a target group of 50 patients has begun in an inner city hospital setting. The study seeks to determine if people facing life-threatening illnesses are comfortable using computers as a way to learn about end-of-life issues and if our project objective of creating a comforting, empowering, easy to use product is obtained. To date, a small group of chemotherapy patients, three men and six women with an average age 62 years, have participated in the study. While this sample is small, the preliminary data has so far validated our approach.

After viewing the CD-ROM, five patients said they were very comfortable using the computer to learn, three were somewhat comfortable and one was not comfortable. All the patients felt comfortable with the information found in *Completing a Life*. Two of the patients said they felt somewhat more empowered to talk with their physician about end-of-life issues. Another indication of empowerment was three of the five patients that did not currently have an Advance Directive said they were somewhat likely to complete one after spending time with the CD-ROM. Overall, six of the nine were interested in spending more time with the CD-ROM and seven said they would recommend it to others. All of them found the CD-ROM to be somewhat easy to very easy to use.

Summary

Completing a Life represents a model for a kind of medical education that did not exist before interactive multimedia. It delivers a wealth of learning resources in a form that is not intimidating or overwhelming and that places control of the learning experience in the hands of the learner. It also brings the power of multimedia to bear in the use of the personal stories whose immediacy and emotional resonance add meaning and accessibility to the material.

The development of *Completing a Life* demonstrates the tight interplay between content and design in educational multimedia. To achieve the desired learning goals, the content and design challenges must be addressed simultaneously and harmoniously.

References

Brandsford, J., Brown, A., & Cocking, R. (Ed.). (2000). *How People Learn: Brain, Mind, Experience, and School: Expanded Edition.* Retrieved Dec. 15, 2001, from http://search.nap.edu/books/0309070368/html/

Eng, T., Maxfield, A., Patrick, K., Deering, M., Ratzan, S., & Gustafson, D. (1998) Access to Health Information and Support: A Public Highway or a Private Road? *Journal of the American Medical Association,* 280. 1371-1375.

Fox, S., & Rainie, L. (2000) The Online Health Care Revolution: How the Web Helps Americans Take Better Care of Themselves. *Pew Internet & American Life Project: Online Life Report,* 23.

Greene D. (1998). Personal Stories within Virtual Environments: Creating Three Experiences in Cancer Information Software. In G. Riva, B.K. Widerhold, & E. Molinari (Eds.), *Virtual Environments in Clinical Psychology and Neuroscience.* (pp. 151-160). Amsterdam, The Netherlands: IOS Press.

Greene D, & Heeter C. (1998). Personal Stories Within Virtual Environments: A Cancer Patient Information Software Case Study. *CyberPsychology and Behavior,* 1(3), 201-212.

Greene, D., & Heeter, C. (1996). *Breast Cancer Lighthouse.* [CD-ROM and Web site].
East Lansing, MI: Michigan State University.

Greene, D., Ogle, K., & Winn, B. (1998). *Easing Cancer Pain.* [CD-ROM and Web site].
East Lansing, MI: Michigan State University.

Horrigan, J., & Rainie, L. (2002) Getting Serious Online. *Pew Internet & American Life Project: Online Life Report,* 55.

Lynch, D. J. (1988, Summer). Reading comprehension under listening, silent, and round robin conditions as a function of text difficulty and working memory. *Reading Improvement,* 25(2), 98-104.

Nielsen, J. (2000). *Designing Web Usability: The Practice of Simplicity.* Indianapolis: New Riders Publishing.

Roberts, L., Crump, C., (2001, August). U.S. Internet IP Traffic Growth.
Retrieved Sept. 6, 2001, from http://www.caspiannetworks.com/pressroom/press/08.15.01.shtml

Rose, B., Warren, K. (2001). Broadband Revolution 2 – The Media World of Speedies. Retrieved Nov. 23, 2001, Retrieved Dec.1, 2001, from http://www.arbitron.com/webcast_ratings/freestudies.htm

Yang, S. (2000, June 5). Doctors Struggle to Deal With Death and Dying. *WebMD Medical News.* Retrieved Dec. 1, 2001, from http://my.webmd.com/content/article/2791.141

E-Learning, Semantic Web Services and Competency Ontologies

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Abstract: This paper describes a proposed system for competency-based just-in-time learning that uses competency ontologies and semantic web services to deliver learning objects to learners. A competency ontology is a semantic description of the competencies needed in order to participate in the business processes of a company. Semantic web services are web services with semantic descriptions that enable people and software agents to more efficiently identify services that can provide the proper learning objects.

1. Competency-Based Just-in-Time Learning

A goal of corporate e-learning is to increase efficiency and effectiveness by identifying precisely the training that an employee needs to do their job and providing that training in the context of day to day job activities of the employee. (Fig. 1) illustrates the flow of activity to implement competency-based just-in-time learning services in an enterprise environment. In the lower right hand corner is a representation of a couple of the business processes of the enterprise. In the upper left hand corner are the ontologies that capture knowledge about the products, organizations, competitors, etc. of the enterprise. A competency ontology is included that captures the competencies that an employee must possess to participate in specific activities of the business processes. The lower left hand corner illustrates the learning resources such as learning objects, courses, email, etc. Each of these learning resources has been manually or automatically linked to various parts of one or more of the enterprise ontologies to enable people and software agents to more efficiently discover the correct learning resources. The upper right hand corner illustrates the learner profile for an employee that contains preferences, experiences and assessments of the employee's competencies. The box in the upper middle of the figure is a competency gap analysis that calculates what competencies the employee lacks to effectively carry out their job responsibilities. This calculation is based on what the employee needs to know and what they already know. Once the competency gap has been identified, a learning model is selected either manually or automatically. This establishes the best way for the employee to attain the competency and enables the system to create the personalized learning process at the lower middle of the figure. The personalized learning process may be created and stored for later use or it may be created whenever it is needed, thus enabling dynamic access to learning objects based on the most recent information about the learner and the environment. The results of the personalized learning process are then returned to the learner's profile.

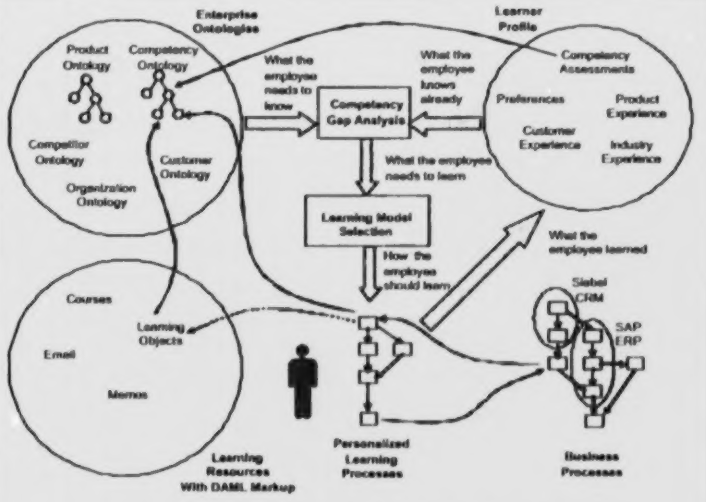
Enterprise Ontologies
Product Ontology
Competency Ontology
Competitor Ontology
Customer Ontology
Organization Ontology
What the employee needs to know
Competency Gap Analysis
What the employee knows already
Learner Profile
Competency Assessments
Preferences
Product Experience
Customer Experience
Industry Experience
What the employee needs to learn
Learning Model Selection
How the employee should learn
What the employee learned
Courses
Learning Objects
Email
Memos
Learning Resources With DAML Markup
Personalized Learning Processes
Siebel CRM
SAP ERP
Business Processes

Figure 1: Competency-Based Just-In-Time Learning

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2. Advanced Technology Support

Each box in the business processes and the personalized learning processes in (Fig. 1) is an activity. These activities might be implemented as existing legacy applications or new applications on a variety of hardware and software systems. In the past, it would have been difficult to integrate applications executing on such heterogeneous systems. But the development of a set of technologies referred to as *web services* (W3C 2002) is simplifying this integration. The most important of these technologies are SOAP, UDDI and WSDL. IBM, Microsoft and others are agreeing on the these specifications. SOAP is a technology for sending messages between two systems using XML for representing the messages and HTTP as the most common transport. UDDI is a specification for an online registry that enables publishing and discovery of web services. WSDL is an XML representation used for describing the services registered with a UDDI registry. Vendors of enterprise applications such as ERP and CRM have announced support for web service interfaces to their products.

However, UDDI and WSDL have limited capability for representing semantic descriptions of web services. The World Wide Web consortium has initiated an effort to develop specifications for a *semantic web* (W3C 2002) where web pages will include semantic descriptions of their content. The US Defense Advanced Research Projects Agency (DARPA) Agent Markup Language program (DAML 2002) has focused on the development of a semantic markup language DAML+OIL for web pages that will enable software agents to understand and reason about the content of web pages. The program has also developed a markup language for web services called DAML-S (Ankolekar 2001) that enables an improved semantic description of a web service. The e-learning industry has developed metadata standards for describing the semantics of learning objects (IEEE 2001). The Advanced Distributed Learning Lab has developed an XML representation of this metadata as part of the Shared Content Object Reference Model (SCORM)specification (SCORM 2002). The system in Figure 1 requires a representation for business processes so that competencies can be mapped to activities in a business process and a representation of personalized learning processes to enable integration of these learning processes with business processes. There have been attempts to standardize the representation of business processes (WFMC 2002). There are now efforts underway to standardize on a process representation for web services.

A few commercially available e-learning products use competency hierarchies to capture the skills necessary for various job types. The competencies in these hierarchies are then mapped to courses that can improve an employee's competency in a certain area. There is no industry standard representation for these competency hierarchies and they do not capture the rich semantics of competencies. The concepts, relationships and processes of an enterprise can be captured in a set of enterprise ontologies. Ontology representation and reasoning systems are available (Lenat 1995) and the DARPA DAML program has also done significant research on the representation of ontologies. Intelligent software agents can be used effectively in a system such as the one described in (Fig. 1). There has been research into the use of software agents for discovery of information (Woelk 1994), collaboration planning and automation of processes (Tate 1996) and numerous other applications (Bradshaw 1997). This research is now focusing on the use of software agents with web services (Hendler 2001). These agents can proactively search for learning objects both that are needed to meet dynamically changing learning requirements.

References

Ankolekar, A. etal. (2001). "DAML-S: Semantic Markup for Web Services", http://www.daml.org/services/SWWS.pdf

Bradshaw, J. (1997). *Software Agents*, MIT Press.

DAML (2002). DARPA Agent Markup Language Program www.daml.org

Hendler, J. (2001). "Agents and the Semantic Web", IEEE Intelligent Systems Journal, March/April 2001.

IEEE (2001). IEEE LTSC, 2001 "Draft Standard for Learning Object Metadata" IEEE P1484.12/D6.0

Lenat, D. (1995). "CYC: A Large-Scale Investment in Knowledge Infrastructure", Nov. 1995, Communications of the ACM.

SCORM (2002). Advanced Distributed Systems Lab, Sharable Content Object Reference Model (SCORM), www.adlnet.org

Tate, A. (1996). "Representing Plans as a Set of Constaints – the <I-N-OVA> Model", Proc of the Third Intl Conference on Artificial Intelligence Planning Systems (AIPS-96), 221-228, AAAI Press, Menlo Park, CA

WFMC (2002). Workflow Management Coalition, www.wfmc.org

Woelk, D. (1994). "The InfoSleuth Project: Intelligent Search Management via Semantic Agents", Second International World Wide Web Conference, October, 1994.

W3C (2002). World Wide Web Consortium, www.w3c.org

TECHNOLOGY &
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Ed-Media 2002 Conference Proceedings, June 2002

Title

It takes a village: Cultivating effective online instruction

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Abstract

For three years, the Technology and Learning Team (TLT) has supported the campus at University of Colorado at Denver (UCD) with integration of technology in instruction. In this role, TLT works with UCD faculty in the use of a variety of technologies for instruction, research, and service. TLT brings a holistic or integrated approach that stresses pedagogical considerations over technical ones. A 5-part support model describes this approach for technology integration at the UCD campus. Skill development, community building, product development, support, and vision casting comprise the five elements of the model.

Faculty Support at UCD Campus

Since its inception in 1999, the Technology and Learning Team has grown in member numbers and collective experience. With that experience comes the knowledge that access to technology for faculty is not enough for successful integration. It requires a team effort, with diverse skills, and a focus on multiple areas of support. TLT brings a holistic and integrated approach that stresses pedagogical considerations over technical ones. A 5-part model describes this approach for technology integration. Skill development, community building, product development, support, and vision casting comprise the five elements of the model.

TLT team supports faculty in 5 areas:

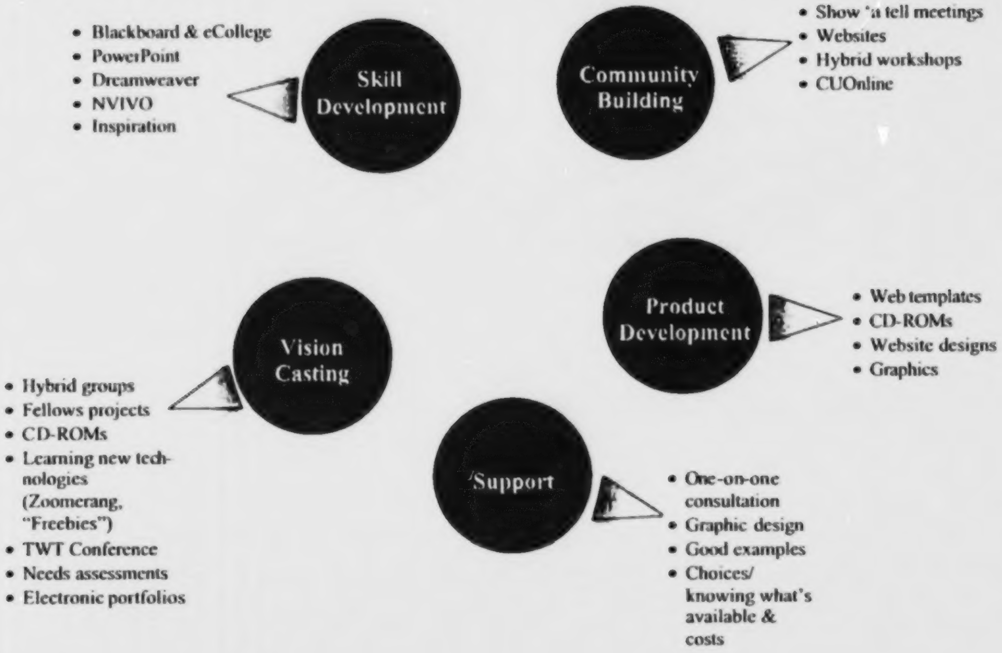
1. **Skill development**

Purpose: to develop the technical skills of faculty. This was provided individually and collectively through workshops on a variety of topics including Blackboard, eCollege, PowerPoint, Dreamweaver, NVIVO, and Inspiration.

2. **Community building**
   Purpose: to bring faculty together to share their experiences, challenges, successes, and war stories. This was accomplished through show 'n tell meetings, workshops, websites, and a common faculty technology lab.

3. **Product development**
   Purpose: for TLT members to develop products that were experimental and/or required advanced technical skills. Examples include website templates, CD-ROMs, website design, and graphic creation.
4. **Support**
   Purpose: to stress pedagogical considerations over the needs of the technology. Support included one-on-one consultation and participation in departmental task force meetings. TLT contributes graphic design considerations, potential technical solutions, estimated costs, and implementation issues.
5. **Vision casting**
   Purpose: to lead technology integration on the UCD campus. This means that TLT sought out the latest technology and tested its limits, researched what other campuses were doing, found good examples, participated in conferences, and conducted needs assessments.

Faculty Support Model



Skill Development

- Blackboard & eCollege
- PowerPoint
- Dreamweaver
- NVIVO
- Inspiration

Community Building

- Show 'n tell meetings
- Websites
- Hybrid workshops
- CUOnline

Vision Casting

- Hybrid groups
- Fellows projects
- CD-ROMs
- Learning new technologies (Zoomerang, "Freebies")
- TWT Conference
- Needs assessments
- Electronic portfolios

Product Development

- Web templates
- CD-ROMs
- Website designs
- Graphics

Support

- One-on-one consultation
- Graphic design
- Good examples
- Choices/ knowing what's available & costs

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MASTER: A Computer–Mediated Tool for the Development of Probability Mental Models

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Abstract: This paper describes the development of *Master* - a computer-mediated tool for learning and research in probability reasoning. The objectives of this software are 1) to explore how levels of interactivity and dynamism of representations in probability influence levels of dynamism in student mental models of probability and 2) whether levels of dynamism in mental models influence probability reasoning. We expect that there is a relationship between levels of interactivity and dynamic movement of representational resources and flexible and dynamic mental models that allow for better reasoning about probability. Hence, we are developing a computer program to investigate this issue. Not only will *Master* support learning in probability, but it will also help us investigate whether and how dynamic and interactive representations are more influential than others in improving probabilistic thinking.

Introduction

Many studies have been conducted to investigate the effects of computer animations in different instructional environments (Chipman, 1993; Park, 1994; Schank & Cleary, 1995; Snir et al., 1995). Dynamical, graphical representations are considered to be effective modes of depicting information in instructional technology environments. Mental model theory offers a useful lens for examining how and why dynamic representations lead to better reasoning ability. Dynamic representations could be instigating development of dynamic mental models, allowing for better reasoning about probability.

Park and Gittelman (1992) suggest that animation is more effective and efficient than static graphics and help students form useful mental models about the system structure and troubleshooting procedures. Mayer (1997) claims that well designed visual representations allow students to simulate the system mentally. Gentner and Stevens (1983), examining how analogical comparisons influence thinking, and Schwartz and Black (1996), studying using analog imagery as the paradigm to investigate mental models and reasoning, discover that imagery serves as the basis for depiction, which allows for simulation and reasoning. Kaplan (2001) found that dynamically suggestive visuals of system components encourage students to form mental depictions, allowing for mental simulation, thus leading to improvements in reasoning. Russell and Corter (in prep) examined the uses of visual devices in probabilistic reasoning. The experiment revealed a significant relationship between drawing an outcome tree and determining a correct solution.

Statistics is not often presented in visual or dynamic formats. A problem-solver would have to generate mental movements in their minds themselves, perhaps scaffolding their thinking by creating an external representation of the problem. Many students of statistics either generate an inefficient representation or are not able to generate a mental model. We've designed *Master* to provide multiple visual representations of probability to not only support learning in probability, but help us investigate whether certain representations are more influential than others in improving probabilistic thinking. Furthermore, *Master* is designed for graduate students studying statistics towards the fulfillment of their research requirement. It helps students comprehend abstract concepts of statistics through visual representations and authentic tasks in a computer-mediated environment. By adapted to online settings, *Master* will be also available for distance learners.

Master – Software Design

The objectives of *Master* are to explore how levels of interactivity and dynamism of representational resources in probability influence levels of dynamism in student mental models of probability and whether levels of dynamism in mental models influence reasoning. *Master* presents probability problems in five representations – Standard Text (ST), Static Visual Displays (SVD), Static Visual Displays with Motion Cues (SVD-MC), Dynamic Visual Displays (DVD), and Interactive Dynamic Visual Displays (IDVD). Comparisons among representational use will allow us to make several discoveries. First, we would like to find out whether an external representation that is visual and dynamic encourages students to visualize the problem dynamically and have higher levels of dynamism in mental models. To explore this possibility, we can compare learning with the standard problem format to learning in a static visual format or a dynamic visual format. Second, we will be able to determine whether all forms of dynamic displays are equally conducive to generating a more effective mental model. It is possible that a more dynamic mental model, which is more conducive to reasoning, is created by the generation of the dynamism in the mental model. This leads us to examine whether static visual displays with motion cues which encourage mental movement would be superior to dynamic visual displays because static visual displays with adequate motional cues support students to think in higher degrees of dynamism. Third, we believe that a student constructs information dynamically when he/she manipulates an object. We expect that software which requires students to manually move objects would be better than software which automatically moves objects for them. Comparison of Interactive Dynamic Visual Display, which allows students to manipulate screen objects, to Dynamic Visual Displays will further reveal whether we should be moving representations for students or encouraging students to make mental movements.

An Example – If a pair of dice is rolled, find the probability of a match or getting a sum of 7.

Event A: Getting a Match = {(1,1),(2,2),(3,3),(4,4),(5,5),(6,6)}

Event B: Getting a sum of 7 = {(6,1),(5,2),(4,3),(3,4),(2,5),(1,6)}

?[ST]

{(1,1)	(2,1)	(3,1)	(4,1)	(5,1)	(6,1)
(1,2)	(2,2)	(3,2)	(4,2)	(5,2)	(6,2)
(1,3)	(2,3)	(3,3)	(4,3)	(5,3)	(6,3)
(1,4)	(2,4)	(3,4)	(4,4)	(5,4)	(6,4)
(1,5)	(2,5)	(3,5)	(4,5)	(5,5)	(6,5)
(1,6)	(2,6)	(3,6)	(4,6)	(5,6)	(6,6)}

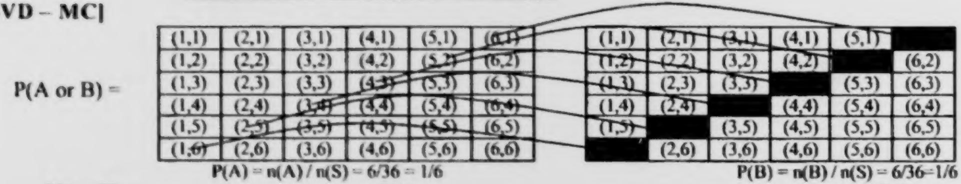
P(A) = n(A) / n(S) = 6 / 36 = 1 /6
P(B) = n(B) / n(S) = 6 / 36 = 1 /6
P(A or B) = P(A) + P(B) = 1/ 6 +1 / 6 = 1 / 3

? [SVD]

(1,1)	(2,1)	(3,1)	(4,1)	(5,1)	■
(1,2)	(2,2)	(3,2)	(4,2)	■	(6,2)
(1,3)	(2,3)	(3,3)	■	(5,3)	(6,3)
(1,4)	(2,4)	■	(4,4)	(5,4)	(6,4)
(1,5)	■	(3,5)	(4,5)	(5,5)	(6,5)
■	(2,6)	(3,6)	(4,6)	(5,6)	(6,6)

P(A) = n(A) / n(S) = 6 / 36 = 1 /6
P(B) = n(B) / n(S) = 6 / 36 = 1 /6
P(A or B) = P(A) + P(B) = 1/ 6 +1 / 6 = 1 / 3

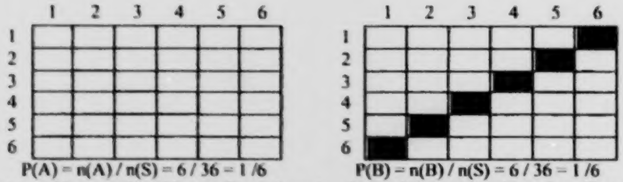
? [SVD – MC]



P(A) = n(A) / n(S) = 6/36 = 1/6 P(B) = n(B) / n(S) = 6/36=1/6

P(A or B) = P(A) + P(B)
= 1/ 6 + 1 / 6
= 1/3

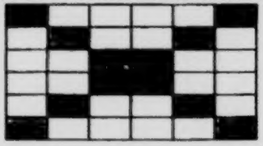
? [DVD]



P(A) = n(A) / n(S) = 6 / 36 = 1 /6 P(B) = n(B) / n(S) = 6 / 36 = 1 /6

Master moves two tables together. Users will see the animation and the overlapping color effect.

P(A or B) =



= P(A) + P(B) = 1/ 6 +1 / 6 = 1 / 3

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? **[IDVD]** The screen design is similar to the DVD screen design. Differently, in IDVD, users are able to manipulate these two tables and then observe the overlapping color effect.

Research Expectations and Implications for the Future

Master research permits us to make the following investigations while promoting probability learning. We believe students will develop more dynamic mental models and be able to solve probability problems better if the information is either presented or encouraged to develop in higher levels of interactivity and dynamism. We expect students in Dynamic-Visual-Display group will demonstrate more dynamic mental models and better reasoning than students in the SVD group. We expect all students presented with visual representation will form stronger mental models and develop better reasoning strategies than students learning in a standard text format. We suspect that software which requires students to manually move objects would allow students to build greater dynamism in their mental models than the software which automatically moves objects for them. Thus, we expect that students in the IDVD group will demonstrate more dynamic mental models and better reasoning than the students in the Dynamic-Visual-Display group. As stated by Park (1998), that static graphics with adequate motional cues representing the dynamic aspects of the task would accomplish results similar to those of animation. We are not certain of the comparison of levels of dynamism in mental models and learning performance of the students in SVD-MC group, Dynamic-Visual-Display group, and IDVD group. If the result shows that the students in SVD-MC group actually do better than the students in Dynamic-Visual-Display group or in IDVD group, it could lead us to consider that static visual displays with motion cues could support students to conceive a problem through generating mental movements themselves, which promotes students for better probability reasoning and improves probabilistic thinking.

Master research will reveal how representation influences reasoning about probability. Results will provide evidence for how to design software for teaching probability and suggestions for how to design educational technology in general. In development of *Master* we framed the basis of our designs in the way people think versus the way the technology looks. Basing our instructional technology research questions from the perceptive of how the mind is working led to the development of new media representations. The overall goal is to initiate further studies in diverse disciplines, and discover a tool that is flexible and adaptable enough to promote multi-representational displays across disciplines.

References

Chipman, S. F. (1993). Gazing once more into the silicon chip: Who's revolutionary now? In S. P. Lajoie & S. J. Derry (Eds.), *Computers as cognitive tools* (Vol. 12, pp. 341-367). Hillsdale, New Jersey: Lawrence Erlbaum Associations, Publisher.

Gentner, D. & Stevens, A.L. (Eds.) (1983). Mental Models. Hillsdale, NJ: Lawrence Erlbaum Associates.

Johnson-Laird, P. N. (1998). Imagery, visualization, and thinking. In J. Hochberg (Ed.), *Perception and Cognition at Century's End* . San Diego, CA: Academic Press.

Kaplan, D. E., & Black, J. B. (2001). *Computer-based Tools for the Development and Investigation of Mental Model Reasoning about Causal Systems.* Paper presented at the Proceedings of the World Conference on Educational Multimedia and Hypermedia, Tampere, Finland.

Mayer, R. E. (1997). Multimedia in learning: Are we asking the right question? *Educational Psychologist, 32*(1), 1-19.

Park, O., & Gittelman, S. S. (1992). Selective use of animation and feedback in computer-based instruction. *ETR&D, 40*(4), 27-38.

Park, O. (1994). Dynamic visual displays in media-based instruction. *Educational Technology, 34*(4), 21-25.

Park, O. (1998). Visual displays and contextual presentations in computer-based instruction. *ETR&D, 46*(3), 37-50.

Russell, W. E., & Corter, J. E. (in prep). The use of visual devices in probability problem solving.

Schank, R. C., & Cleary, C. (1995). *Engines for education.* (Vol. 5). Hillsdale, New Jersey: Lawrence Erlbaum Associates, Publishers.

Schwartz, D. L., & Black, J. B. (1996). Shuttling between depictive models and abstract rules. *Cognitive Science, 20*, 457-497.

Snir, J., Smith, C., & Grosslight, L. (1995). Conceptually enhanced simulations: A computer tool for science teaching. In D. N. Perkins, J. L. Schwartz, M. M. West, & M. S. Wiske (Eds.), *Software goes to school* (Vol. 7, pp. 106-129). New York Oxford: Oxford University Press.

IDIOMA-TIC © A CALL authoring system for web and cd-rom with intelligent feedback and half-open questions

Tension between knowledge and competence in second language acquisition (SLA)

« Skills oriented learning » is the new buzz word in SLA. In many language classes, comprehension and oral expression are now the core didactic activities, instead of the "out-dated" knowledge oriented activities. This phenomenon can be observed in all levels of education (from primary to university) and, consequently, in computer assisted language learning (CALL) software.

1. The need in SLA to focus on knowledge

The raised interest for skills training is especially profitable for starting language learners, who have great interest in being "sub-merged" in the new language, because their knowledge base is very small. Things are different with intermediate and advanced language learners, whose learning problems cannot be resolved by more skills training. Those learners present two kinds of problems. The first phenomenon is known as the "ceiling" problem (Gass & Selinker, 1994, *Second Language Acquisition: An Introductory Course.* Lawrence Erlbaum, Inc): it is the incapacity of language learners to move from an intermediate level to an expert level. The second phenomenon is linked with errors: research shows that intermediate level language learners keep making the same mistakes, persistent, difficult-to-correct errors. This is known as "linguistic fossilisation", demonstrated by Germain and Séguin in *Le point sur la grammaire* (1998, Paris : CLE International).

2. Tools for knowledge building and deepening

Knowledge is generally divided into three types : cultural knowledge, literacy knowledge and grammatical and lexical knowledge. In this context, the grammatical and lexical knowledge is at stake. **Exercises** are crucial in this component of the language learning process (Hulstijn 2001, *Intentional and incidental second language vocabulary learning: A reappraisal of elaboration, rehearsal and automaticity,* In P. Robinson (ed.), Cognition and Second Language Instruction (pp 258-286). Cambridge: Cambridge University Press, 2001). Second, it is important to mention the "pedagogy of errors" which does not consider errors as ending points obstructing the acquisition of a language, but, on the contrary, as an interesting symptom of the "interlingua", characterizing any learning process.

Finally, a third set of findings relates to the ratio which exists between task and transfer. Thus, Solomon and Perkins (1989, *Rocky roads to transfer. Rethinking mechanisms of a neglected phenomenon.* Educational Psychologist 24, 113-142) noted that the more complex the cognitive assimilation of a task is, the more language learning and the transfer of knowledge to competences will have succeeded. One of the most complex tasks is undoubtedly translation.

To make profitable use of these assets, we need relatively complex applications that confront learners with the differences between their mother tongue and the foreign language and that formulate an adequate response to the errors generated by the contact between languages.

3. And what about keeping a place to new technologies in the choice of learning tools ?

It is true that, today, there is already (lexical and grammatical) knowledge oriented software, but most of it presents some considerable disadvantages.

They are generally limited to closed activities (such as multiple choice questions) that activate only a minimum of high level cognitive processes. Another disadvantage is that the generated exercises are almost exclusively of the "structuro-global" type, i.e. the only objective is to memorize forms, mostly by repetition (drill). Furthermore, feedback is crucial in language software. To be effective, feedback must be personalized. It must refer as much as possible to the input of the learners. In other words, it must provide feedback to the errors committed by the learner and not with the errors that he or she could possibly make. Moreover, the feedback must be intelligent: it should explain the observed rule, show why the answer is not correct and thus allow the learner how to avoid the same mistakes in the future. Finally, to prevent learners from memorizing their mistakes, feedback must be immediate.

4. IDIOMA-TIC : a concrete tool

IDIOMA-TIC is a language learning software developed at KULAK by a team led by prof.dr. Piet Desmet. It is both an "authoring tool" and a "language learning environment": it allows a (language) teacher to create exercises that can then be presented to learners. Idioma-tic is composed of two modules: an input module and an output or learner's module.

The first module is made for the input of exercises and tests. Input is user friendly and requires very little time, thanks to some system functions, like the intelligent encoding of answers and the reuse of input.

From a technological point of view, the number of question types has been reduced to three. But, actually, each of these three types allows to create various and very different exercises. We more concretely distinguish multiple choice, fill-in-the-blank or correction and translation exercises.

A navigation tree is provided (or created by the teacher) to attach the exercises to. By attaching the exercises to several "branches" of the tree, the author allows learners to consult the Idioma-tic database in various ways. The student can then choose freely between exercises sets according to themes (like exercises on "On a journey", or "Family and relations"), to the grammar (grammar in general or specific grammatical problems), to specific languages domains (like legal or business language) or to lexical difficulties (such as homonyms and expressions) etc. The tree facilitates also the exchange of exercises among colleagues.

The majority of these exercises created are translation exercises and corrections or fill-in-the-blanks, exercises which support by their half-open character the transfer of knowledge to competences.

In the case of the fill-in-the-blanks, students can make two attempts before being confronted with the correct answer, which is not the case for the multiple choice exercises where the correct answer already appears after the first attempt. In the case of the translation exercises, the number of attempts is theoretically unlimited: after each incorrect answer, the system indicates which words do not correspond to the possible answers. The student decides himself on the number of attempts he makes.

For the three exercises types, the teacher can provide hints. A hint is presented in the form of asterisk. Student who want to see the hint just needs to click the asterisk.

For the moment, correction of exercises always uses the comparison (matching) method, which implies that the authors of the exercises must provide all the possible correct answers. Currently, we are evaluating the analysis (parsing) method. We expect this method to be able to give more accurate feedback to unpredicted errors.

Let us note finally that the errors made by students are automatically saved by the program, so that the learner can repeat the exercises which he had not answered correctly. The exercises qualified by the learner as stumbling blocks can also be remade.

Please refer to http://impuls.kulak.ac.be/idioma-tic

A New Model for Teachers' Development in the Information Age

Teaching Together and Apart-With a Direct Link to the Open University

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The Open University Of ISRAEL

Information and communication technologies are obviously much more than a delivery tool. They are definitely changing the way we teach and learn.

Whatever direction these changes will take, teachers and educators will be at the heart of it and thus should have the opportunities to take part in this revolution from the start.

A generic model -The TAMID Model- for the professional development of in-service teachers has been developed for this purpose by the Open University of Israel. (Yaffe, 1996, 1998, 2002). This model focuses on teachers as professionals who are obliged, not only for knowledge and expertise in subject matter and didactics, but in the new technologies. They have to master them not by learning on them, but by using them for their on-going professional needs.

TAMID is base on the Internet as the leading technology and distance teaching strategies as the core methodology for teachers development.

It operates simultaneously as a **Virtual School** for teachers, and as their **Professional Club**. In this way it is offering teachers an innovative framework for professional growth which facilitates and encourages continuous learning and proper preparation for teaching in the classes.

As a virtual school TAMID offers to the teachers on-line distance-learning courses in a variety of Curriculum-based topics and a variety of educational means: Text, video, audio, face - to -face meetings, satellite lectures etc, are used to deliver on-line courses.

As a professional club TAMID offers the teachers on-going access to experts from the open University and other Universities, presenting them with authoritative, expert advice on the various subjects relevant for their teaching. In addition TAMID provides the teachers with a framework for peer discussions and cooperative constraction of a bank of activities and ideas, the help of an information specialist, and access to new updated and relevant information.

A typical on-line TAMID course usually includes:

F2F Meetings: Dedicated to enrichment lectures, workshops and hands on activities.

The Courses Web Site containing relevant materials : reading materials , bibliography, current news, a bank of class activities and ideas, discussion groups etc.

Assignments: Relevant to the course's goals and to the teachers' needs.

On-line Discussion Groups: for ongoing discourse with the course's tutors, with colleagues and with academic experts for the exchange and the dissemination of information, ideas and other enlightening information, which can be integrated into teaching.

TAMID is operating since the last year as a joint venture with the Center of Educational Technology (CET) and the Ministry of Education . Six communities of teachers are presently active in this program: Science teachers, Democracy and Civic education teachers, English teachers, History teachers, Reading skills, and teachers who focus on New Pedagogy. Each of the communities has its own needs for professional development and its own learning environment and training agenda, however the underling model remained basically the same.

Within this framework, different models of on-line courses aiming to facilitate professional growth of teachers have been developed and examined:

A."Teaching Together But Apart". Teachers in this program selected a specific subject for teaching in their classes during the time of the course, (Astronomy and Civic studies were the candidates in this case study), and constantly reported to the course's web-site on progress, success and difficulties encountered in the classroom. The teachers taught their own program to meet their pupils' needs, and the conditions in his classroom. However they enjoyed the benefits of belonging to a group of peers similarly engaged, and of receiving professional expert information, subject-related aid , support and much empathy.

B. Teachers as Developers. In this model teachers developed, along with the guidance and support from distant experts, sets of Internet-based, learning activities for their students.

C. Pedagogy of Science Education. Using the network to discuss theory and practice of Science Education.

One of the main advantages and specialties of the TAMID model is the direct and ongoing access to University Faculty who act as the academic experts of the teachers' center. They are responsible for the academic aspects of the on-line courses, for the academic control of the teaching materials delivered to the teachers and they are giving the teachers an academic backing on subject matter issues.

These aspects of faculty involvement in teachers development will be demonstrated by examples from two fields of teaching: Astronomy and Microbiology. Those two fields are putting special demands on the teachers as they are both:

1. Rapidly changing and call for regular updating of knowledge.
2. Conceptually difficult for the students and teachers might need help in their teaching.
3. Widely represented in the news and over the Web and call for classroom discussions as well as for an expert's eye.

Another aspect of the accesses to experts is the asking and answering of questions. It is a continuous, evolving process that involves, on the students' side, the overcoming of social barriers ("my ignorance displayed for all to see"). The type of questions may vary form requiring factual information to asking for additional explanations and may range from purely subject matter to general pedagogy. On the expert side, answering requires the adaptation of a different writing and teaching style. Answers should not relate only to the subject-matter per-se, but should also reflect a broader view of the course content, the school curriculum and the classroom application. Answers should always include the broad aspects of the topic involved and ideally would become a resource for the course participants to use.

An additional aspect of being an on-line expert is the ability to update and involve teachers in the latest scientific information available that is relevant to subjects they teach in schools. Images from spacecrafts, reports of new discoveries in the genome project, on-line articles and publications in major journals are all bringing "out-of-the-oven" materials. Summaries, explanations and experts' "did you know that" approach enable the teachers to feel that they are being brought up to date in all the important scientific discoveries. While most of the text books used in schools are usually a couple of years old, the contact with on-line experts of various fields helps the teachers to keep abreast of the rapidly changing knowledge that they must transfer to their pupils. The ability to receive immediate replies from a reliable experts helps the teachers to encourage their students to ask "any question hey can think of" knowing that even if they will not be able to give the right answer on the spot, they will be able to return with an answer from a first class experts within days.

By using concrete examples from the teachers' center we will demonstrate how this model of linking the teachers to faculty is actually working, and put forward some of the questions that we are facing: What are the added values of such contacts? Who benefits from them? What are the conditions for a fruitful connection? what are the expectations of the "connected experts"? What are their obligations? How to choose an on-line expert, what should be his profile? And what are the implications of these option within the formal educational framework?

Our underlying premise of these models, which has been confirmed over the past six years, is that teaching individually yet together with a group of colleagues and with support from experts, is potentially more meaningful, more interesting and more enjoyable both to teachers and to their pupils.

We believe that this new paradigm for Teachers' training which is in high relevance to teacher's work and offering strong connections to colleagues and experts, is highly advantageous, and most suitable for the professional growth of teachers.

Reference:

Darling-Hammond, L. & Wise, A.E. (1992). Teacher Professionalism, in M.C. Alkin (ed.), **Encyclopedia of Educational Research** (6th ed.) (pp. 1359-1366). New York, Macmillan.

Fullan, M.G. & Steigelbauer, S. (1991). **The New Meaning of Educational Change.** Columbia University: Oise Press and Teachers College Press.

Yaffe, E. (1996, 1997, 1998,) **Project TAMID: Interim Reports**

Yaffe, E. (1998) **Teachers On-Line: A Model for a Virtual Teachers Center**, Proceedings of ICCE 98, vol.2, 633-636

Yaffe, E. (forthcoming) **Model TAMID: A New Methodology for Teachers development in the information age.** In Guri-Rosenblit, S. (Ed.) Teachers in a changing World: Trends and challenges, Tel-Aviv: The Open University Press (in Hebrew).

Digital Video as an Educational Tool in Distance Education

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Abstract: Video films have pedagogical strength as they can provide instruction through sound, motion, and visuals. However, the volatile nature of live distance lessons as well as the rigidity of analog and linear video has limited its effective use for teaching and learning. Digital video, allows for a shift from a linear and passive mode of use, to a modular, and interactive mode. The Open University of Israel (OUI) has developed simple user-friendly tools and interfaces, which hold the promise for more effective teaching and learning. Several different formats of using digital video will be demonstrated in this presentation and discussed in the light of their pedagogical potential for Distance Learning.

Introduction

Video has special strengths. It usually contains a combination of motion, sound and visuals and is thus particularly suitable for teaching and learning. It is accepted that video can help students envision new ideas, help them perceive the reality around them, and increase motivation for learning. Moreover, video can serve to capture lectures and lessons for later distribution and use.

Video indeed has been used for many years as a teaching tool at all levels to transmit and describe processes, events, objects, experiments, ideas etc.

The Open University of Israel (OUI), which is a distance learning institution, has been using video almost from its start. Academic video films are quite commonly sent to students as part of the learning package. In addition, interactive video lessons are transmitted via satellite to classes all over the country to convene first class lessons to all students. These lessons are recorded for students who could not attend the live satellite lesson. However, both modes have severe weakness that limits their contribution to the learning process. Analog videos are linear, non-interactive, and expensive to produce and distribute. Analog video-films do not encourage active learning neither interaction with the learning materials, which is so important for learning. On the other hand, interactive video is volatile and fades away after the lesson is completed.

Digital video has many advantages in regard to teaching and learning. Payne, H (2002). It is easy to produce, to index, to segment and to distribute, and might encourage active and interactive learning. Digital videos can be used for sessions of varying length and different settings. Combining digital video, the Internet and other media opens up a new avenue for teaching and learning. (Storm 2001)

During the last year the Open University of Israel has been utilizing digital video, combined with suitable software and a user-friendly interface, which have been developed at the OUI. These videos serve not only to convey the learning material, but also to add a human face to the teacher-student communication along the course, through the web-site of the course. This human face, called by others intimacy and immediacy was found to be positively connected with students' motivation and cognitive learning (LaRose, R. &Whitten, P. (2000), Rodriguez, J. I., Plax,T. G., & Kearney, P. (1996).

Thus a set of tools is embedded with the video into the students working space which enables the student to search the video, move between topics, add personal annotations, and bookmarks, and move using hyperlinks to other resources.

Several different formats of using digital video in distance teaching will be presented and discussed:

Digital Video Formats

The following families of video formats are tested at the OUI at present:

Long Video Lessons, are produced as substitutes of the live face-to-face lectures or tutorials. The face-to-face encounter and dialogue between the expert and the student has, since the beginning of education, been a central feature in the learning process. Besides the imparting of knowledge by the expert, a "live" encounter can, at its best, produce productive intellectual brainstorming, in-depth thinking and inspiration and offer a personal example and social support for the learning process.

However the "live" encounter has also inherent limitations. They are limited by time and location which is problematic for distance learners, and they are volatile. Once deliverd they are gone. The aim of the video lessons is to overcome this limitations.

Teaching Clips are short video segments (1-10 minutes long). Most of these are short "talking head" clips of a faculty member discussing some aspect of his course or just greeting his students. The main purpose of these clips is to convey elements of intimacy and immediacy to the teacher-student communication along the course through the web-site of the course.

Video-Rich Multimedia Lessons are complex constructs containing an integrated combination of video, text, graphics and animations, tools for active learning annotations, bookmarking, links to discussion groups etc.

All types of video might be used in a single program.

The digital video with or without the Web-based materials can also be stored and distributed on a CD-ROM. Then Internet users could also employ the CD-ROM and Web material in an integrated way.

In our presentation we will demonstrate this formats and discuss some of options for what the video media might look like in the educational framework. We will also sort out and analyze families of products that might prove both valuable and viable (as evidenced by extensive, long term use).

By using these formats, it is possible to engage the student in active learning. Students can annotate, summarize and search through a video film, construct their own path of learning

From the instructor's point of view , digital video technologies enable simple production of video lessons, which can be connected simply to other media (text, Internet, multimedia). The tool also allows instructors to prepare interactive questions and assignments pertaining to the film watched.

From the students point of view digital video can be used as a self-study modular and interactive resource. Linearity is broken by allowing immediate access to relevant sections in the film by clicking on the list of segments Attaching annotations provides for reflection on important points in the film.

We believe that integrating digital video into teaching, according to the formats that will be described in our presentation, can improve teaching and learning, and will affect students' motivation attitudes and achievements. Several experiments are planed aiming to evaluate the various formats of digital video that have been developed. The evaluation plan and considerations will be discussed elsewhere.

Primary results show that students are very satisfied with the integration of video elements into the teaching package. In particular they expressed satisfaction of the possibility to return to recorded live lessons and used them mainly to prepare for final examination. Satisfaction was also noticed whenever short video clips containing greetings, explanations and clarifications were integrated into the courses' web-sites.

We believe that the shift from analog to digital video and the rapid changes in information technology, which supports video hosting and distribution, are about to intensify the use of video in education.

References

Payne, H (2002), Interctive Video Teletraining in Distance Learning Courses: A review of the Literature.

USDLA:

LaRose, R. &Whitten, P. (2000). Re-thinking instructional immediacy for web courses: A social cognitive exploration. *Communication Education:* Annandale:

Rodriguez, J. I., Plax,T. G., & Kearney, P. (1996). Clarifying the relationship between teacher nonverbal immediacy and student cognitive learning: Affective learning as the central causal mediator. Communication Education, 45, 293-305.

Storm, J. Young, Clive. (2001), Developing A Stearming Video Methodology. On-Line EDUCA BERLIN,

The Development of The Learning Object Standard Using A Pedagogic Approach: A Comparative Study.

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Abstract: Education is moving towards revenue generation from such channels as electronic learning, distance learning and virtual education. Hence learning technology standards are critical to the sector's success. Existing learning technology standards have focused on various topics such as meta-data, question and test interoperability and others. However it is believed that the meta-data standards play an important role in the success of electronic learnin g. This is due to the fact that meta-data is the standard for learning object; which is the main concept that allows interoperability and reusability to occur. Although bodies or consortia such as IEEE LTSC (*Learning Technology Standards Committee*), IMS (*Instructional Management System*) and others had developed the meta-data standards, there is concern about the features embedded in the meta-data standards. It is believed that to achieve a more meaningful learning process, a learning object needs to comprehend more than technical features. Features such as pedagogic, community and context are important, as they will provide a more far-reaching description of what the learning object is about. Thus the objective of the research is to obtain the detail elements of the meta-data standards and enhance it by inserting the necessary elements related to the above features. The learning theories such as Instructional Design Theory, Constructivism Instructional Design Theory and Design Potential Approach were used to derive the elements associated to the above features. The results of this study are in the form of elements, which can be embedded into the existing standards.

Introduction

The key to make e-learning successful is depending in the thriving of learning object design. This is due to the fact that learning object is the core concept of electronic learning where it is regarded as the basic ingredients that allows flexibility, customisation and interoperability to take place. With the use of learning object, recombination of material at any level may occur thus increases the value of the content and facilitates the competency-based learning. The learning object definition abound: *Learning object is any entity, digital, non digital which can be used, reused or referenced during technology supported learning (IEEE Standards, 2000); Learning object is any digital resources that can be reused to support learning (Wiley, 2000)*

We propose the following working definition: *Learning objects are discrete, focused, interactive digital entities, which can be used, reused, searched, referenced to support the learning process.*

Realising the importance of learning object, various consortia such as IMS, IEEE LTSC, ARIADNE (*Alliance Of Remote Instructional Authoring And Distribution Networks For Europe)* and others had made an effort to develop the learning object standards or better known as meta-data standards. The standards derived by these consortia define the conceptual structure for meta-data. Most of these standards provides the technical overview of what learning object should contained and aspects of how meta-data should be structured. For example, IMS defines the conceptual structure for meta-data where it's information model was based on a structure of defined elements that describes or catalogues the learning resource. The model was formed on a hierarchy manner and has nine main components, which are (IMS, 2001): general, lifecycle, meta meta-data, technical, educational, rights, relation, annotation, classification Each of this main component has it's sub-components. For example, the general component has the identifier, title, catalogentry, language, description, keyword and others as it's sub-component. The structure of the meta-data information model is given below (IMS, 2001):

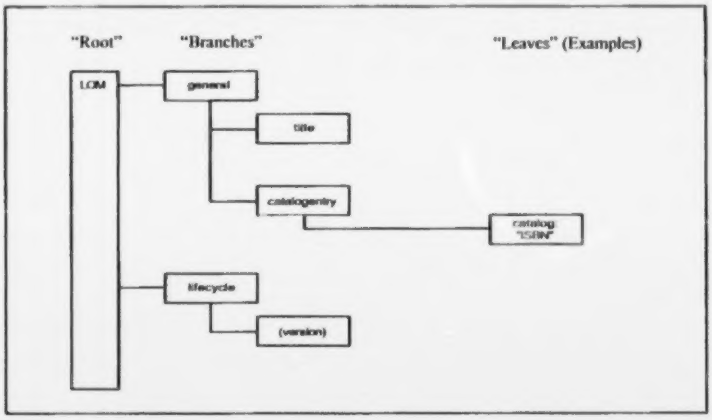

Figure 1: Root to leaf tree view of meta-data

Most of the other standards had similar edifice like the above; although some might have a slight different structure depending on the primary goal of the standards. ARIADNE (2001) for example, is more focused to the educational needs.

Looking at the structure and its sub-elements it is apprehend that the standards are more focused towards the technical aspects of the learning object. Although the standards had put emphasis on the pedagogic portion; where they have the educational and pedagogic elements but little was given. The prominence was more towards describing the interactivity type, intended user role, age range, difficulty level, context, learning time and others. Less emphasis was given on how a learning object may assist effective learning, how it may provide the specific community users and how it may impart the context of instructional use of the object. Apart from that, there is lack of description regarding the learning activities surrounding the learning object and the support for the reuse of the object within specific instructional context (Recker, 2000). These short-comings are the basis that initiates the work.

Current Work.

The work carried out is focusing on how elements such as context, pedagogy and community can be embedded into the learning object standards. Recker (2000), Wiley (2000), Boyle (2001), Suthers (2001), and others had carried out similar work, which shows the importance of having context and pedagogic aspects attached to the meta-data structure. However the details of each element and examples of what can be included into the standards were not given. The aim of the study was to provide details of the elements that need to be attached to the meta-data standards in order to make them more efficient. The work used a comparative approach which involved looking into several learning theories to derive the elements related to context, pedagogy and community. The elements derived are then compared to the existing elements in the standards to see whether the standards had the procured elements. The method carried out in this research is as below (figure 2).

The elements mentioned are believed to be important as without context, learning object is nothing more than a clip art item, it can be misleading, confusing and utterly meaningless (Longmire, 2000). Gillroy (2001) had stated that learning is fundamentally both social and experiential.

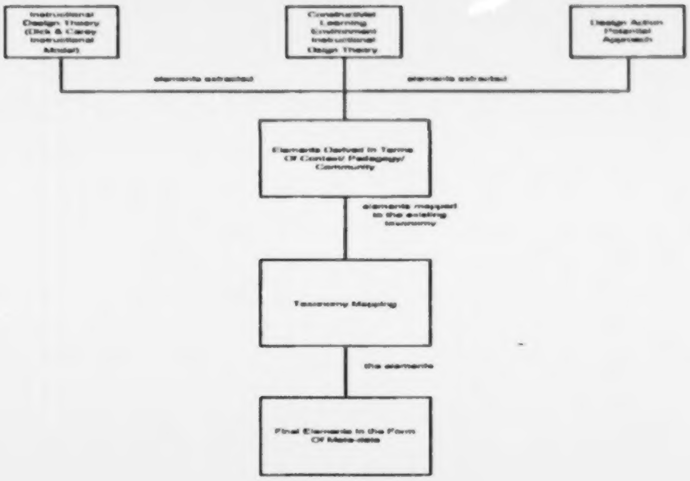
Instructional Design Theory (Dick & Carey Instructional Model)
Constructivist Learning Environment Instructional Design Theory
Design Action Potential Approach
elements extracted
elements extracted
Elements Derived In Terms Of Context/ Pedagogy/ Community
elements mapped to the existing taxonomy
Taxonomy Mapping
the elements
Final Elements In the Form Of Meta-data

Figure 2: Research Process

Therefore to make learning more pleasurable, the focus should not only be on content but also on the organisation of learning experience. As a result the pedagogical process becomes the most important factor in the design of learning. To have a full understanding on why these elements are believed to be important we need to look at the basis of each element.

Context

Context is a difficult term to explain: basically it means the environment in which the learning unit is situated. It portrays the situation from the learner's point of view. It is an abstract representation of the relevant environment. It then guides adaptive action in that environment, i.e. what type of learning actions to undertake (Boyle, 2000). The context consists of the framing of content along with associated interactivity and it is important in making learning happen within activity rich, interaction rich and culturally rich social environments (Afonso, 2000; Boyle, 2000). Hence in order to construct learning context, it is believed that it will involve content struduring, interactivity, compositional framework and usage of content. As mentioned without context, learning objects can be confusing, misleading or utterly meaningless. Therefore it is important to have context embedded as one of the elements in the learning object.

Pedagogy

Pedagogy means the science of teaching or educating children and is used as a synonym for teaching (Oxford Dictionary, 2002; Wave Technologies, 1996). It is the approach that the teacher/tutor use in constructing the courses to aid cognition through different learning styles. Consequently it embodies teacher focused education. In the pedagogic model, teacher assume responsibility for making decisions about what will be learned, how it will be learned and when it will be learned (Conner, 1996). Pedagogy is important as it shows and directs on what can be learned, how to learn and when to learn. As a result this needs to be included in the learning object as it will help the learners to appreciate the learning process, to be able to use the learning object effectively, to mark the choices of content structuring. With pedagogy embedded in it, it is believed that the learning object can be customised to the individual needs.

Community

A community is a group of individuals who have common values, norms and meanings, a shared history and identifications within a particular culture. The bonds that exist between communities are believed to go

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beyond the instrumental into the realm of affection and exclusive (Gillroy, 2001). Consequently it is significant to have a community feel when using the learning object in order to make the learning process more effective.

Looking at the above facts all the components (context, pedagogy, community) are believed to add value to learning object and it will help to make learning through electronic medium more successful. It would greatly enhanced the educational use of learning objects which are presently pedagogically limited (Cowley, 2000) and context limited (Gillroy, 2000; Boyle, 2000)

Outcome

The learning theories, which were used in the work were the Instructional Design Theory - Dick and Carey Systems Approach Model For Designing Instruction (Dick et al, 2001), The Constructivism Instructional Design (Jonassen, 2001) and the Design Action Potential Approach (Boyle, 1998).The theories were chosen due to the fact that they are the basic theory to the design of instruction in the computer environment and each of them takes a different approach to model the instruction. Dick and Carey ID Theory for instance provide a system approach model for the design, development, implementation and evaluation of instruction. The theory is less complex than the others such as theories by Reigeluth (1999) and Jonassen (1997) to name a few. On the other hand, the Constructivism Instructional Design uses the constructivist conception, which is believed to be the learning theory behind e-learning. The Design Action Potential Approach uses an 'action potential' approach distinguishing it from the other theories. It provides a method for formalising scattered knowledge without constraining individual design decisions. Each of these theories was then looked into and analysed and the elements related to the above elements were extracted. Below are the elements extracted.

Context	Pedagogy	Community
1. Types of learner/level 2. Information about the learner	1. Objective of the learning object 2. Factors to motivate learners 3. Required skills needed 4. Language and vocabulary needed	-Nil

Table 1: Dick and Carey Systems Approach Model Elements

Context	Pedagogy	Community
- Nil	1. Presentation of the learning object 2. Structure of the presentation	- Nil

Table 2: Design Action Potential Approach Elements

Context	Pedagogy	Community
1. Types of learner/level 2. Related cases that support understanding of the problem/ access to a set of related experience 3. Problem context 4. Problem representation 5. Problem manipulation 6. Activity done to the learning object	1. A list of objectives 2. Level of complexity of the learning object 3. Pre-requisite requirements 4. Information resources	1.knowledge building communities

Table 3: Constructivism Instructional Design Elements

Each of these elements are then looked into and compared to the existing standards. This is accomplished by giving definition to each elements and examples. The next step taken is by matching up the definition and the examples obtained to the similar sub-elements in the standards. Some of the elements are already existed in the standards but it is believed that it needs further clarification. For example:

Example 1:

Current work: The type of learner element-This element is the classification of the learner. It is to distinguish specific type of learner for a specific type of learning object..Example: beginner/ intermediate/ expert

Existing Standards (IMS, IEEE and ARIADNE): The intended user role element-This element is described as the principal user for which the learning object was design. Example: teacher, author, manager and learner.

It appears that although the same type of element were designed for learners there is different definition to it thus providing different examples. The standard bodies might want to consider another feature, which could be added to the existing standards that might resemble the current work type of learner element.

Example 2:

Current work: Related cases and information resources that support understanding of the problem -This element is the access to a set of experience that the learner can refer to as this will provide the learners with a set of experience to compare *to the current learning object*

Existing Standard (IMS, IEEE and ARIADNE): The existing standards do not embed this element.

Example 3:

Current work Information about the learner-This element is the information about the learner, who may access or use the learning object. It is consider that each learning object has it's target users and the target user's needs to have certain educational levels and prior knowledge before they are able to use the learning object. Thus the learner information must be described in terms of prior knowledge needed and skills required.

Existing standards (IMS, IEEE and ARIADNE): The closest element that can be compared to is the intended user role element. The intended user role element-This element is described as the principal user for which the learning object was design. Example: teacher, author, manager and learner.

From the above examples, it is clearly shown that although the elements might share the same designation; definition differs between them, hence providing different types of examples. It is realised that the definition and the example play a crucial role for each element. This is to provide a clearer picture of the element and allows a thorough comparison to be carried out. Further analysis is also needed for the meta-data standards in order for it to comprehend the pedagogic needs therefore making the learning object more useful and more meaningful to the learners. Apart from that, from the work carried out, it is apprehend that there are more elements, which needs to be added to the meta-data standards. If all of these elements were taken into consideration and be added to the existing standards, learning object will be able to reach it's maximum value; where it does not only make electronic learning a reality but it also allows learning to take place efficiently.

Conclusion

There are more features apart from technical, which needs to be considered when deriving the meta-data standards. Features such as related cases, types of learners, problem manipulation and others need to be considered as to achieve a more comprehensive learning object structure. By adding these elements, which belongs to the context, pedagogy and community elements into the existing standards, it will certainly make the learning object more meaningful to the learners in the future.

References:

Afonso, A.P and Figueiredo, A.D. (2000) *Web-Based Learning And The Role Of Context.* International Workshop On Advanced Learning Technologies IWALT 2000. 4-6 December 2000. Palmerston North, New Zealand

ARIADNE (2001). *ARIADNE: Educational Meta-data Recommendation Version 3.1.* www.ariadne-eu.org/5_RD/5.1_AFRefDocs/ariadne_meta-data_v31.htm (29/08/2001)

Boyle, T. and Cook, J. (2001). Towards a pedagogically sound basis for learning object portability and re-use. *Proceedings of ASCILITE*. The 18th Annual Conference of The Australasian Society For Computers In Learning Tertiary Education.Dec 9-12 2001. Melbourne, Australia. pp.101-109. www.medfac.unimelb.edu.au/ascilite2001 (19/12/2001)

Boyle, T. (2000). Towards A Theoretical Base For Educational Multimedia Design. *JIME Journal Of Interactive Media In Education*. Special Issues On Theory For Learning Technologies. www-jime.open.ac.uk (19/12/2001)

Boyle, T (1998). *Design For Multimedia Learning* . Prentice Hall: London.

Conner, M.L, Wright, E, Curry, K et al. (1996). Learning: The Critical Technology. A Whitepaper on adult education in the information age. Wave Technologies International, Inc. www.wavetech.com (24/08/2000)

Cowley, L and Wesson ,J. (2000). Design Patterns For Web Based Instruction *In J. Bourdeau and R. Heller (eds). Proceeding Of ED-MEDIA 2000, World Conference On Educational Multimedia, Hypermedia & Telecommunications, Montreal, Canada* June 26-July 1, 2000.

Dick, W.; Carey, W and Carey, J.O. (2001) *The Systematic Design Of Instruction*. Fifth Edition. Addison Wesley Longman. New York

Gillroy, K (2001). Collaborative ELearning: The Right Approach A Destination KM.com White paper. www.destinationcrm.com/dcrm_ni_article.print.asp?id=432&art=mag(15/06/2001)

IEEE Standards (2000). Draft Standard For Learning Object Meta-Data IEEE P1484.12/D6.1 http://ltsc.ieee.org/doc/wg12/LOM_Wp6.1_1.doc (19/12/2001)

IMS (2001). IMS Learning Resource Meta-data Information Model V1.2.1. Final Specification. www.imsproject/specifications.html (20/11/2001)

Jonassen D.H et al. (1997). Certainty, Determinism And Predictability In Thoeries Of Instructional Design: Lessons From Science. *Educational Technology* (37)1, 27-34.

Jonassen, D.H. (2001) Constructivist Learning Environments on the Web: Engaging Students in Meaningful Learning. *Proceedings of Information Communication Technology*. Malmo, Sweden. www.elearningpost.com/elthemes/jonassen.asp (6/11/2001)

Longmire, W. (2000). A Primer On Learning Objects. ASTD Learning Circuits. www.learningcircuits.org/mar2000/primer.html (24/08/2001)

Oxford English Dictionary (2002). John Simpson and Edmund Wiener (Editor). Oxford University Press.

Recker, M.M and Wiley, D.A. (2000). A non-authoritative educational meta-data ontology for filtering and recommending learning object. Submitted For Publication To The Journal Of Interactive Learning Environments. Special Issues On Meta-data. http://rclt.usu.edu/docs/2000recker003.pdf (25/09/2000)

Reigeluth, C.M (1999). *Instructional Design Theories and Models: A New Paradigm Of Instructional Theory*. Mahwah NJ. Lawrence Erlbaum Associates.

Suthers, D.D. (2001). Evaluating the Learning Object Meta-data For K-12 Educational Resources. *Proceedings Of The IEEE International Conference on Advanced Learning Technologies (ICALT 2001)*, 6-8 August 2001, Madison, Wisconsin. Pp: 371-374.

Wave Technologies (1996). Learning: The Critical Technology. A Whitepaper On Adult In The Information Age. www.learnativity.com/download/Learning-Whitepaper96.pdf (26/04.2001)

Wiley, D.A. (2000). *Learning Object Design and Sequencing Theory*. Phd Thesis. Brigham Young University.

Integration of Laptops into a K-12 Learning Environment: A Case Study of a Science Teacher in the Middle School

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Abstract: This case study identifies the feasible approaches to integrate laptops into a science learning environment in the middle school. The observation of learning activities and teaching strategies took place in the 8th grade science classroom with seventeen students for five class periods and the data from teacher's opinion gathered by interview. The results report the strategies the teacher used with laptop in the classroom including problem-based learning, project-based learning, collaborative learning, hands-on activities, and have students to use laptop as a cognitive tool. With appropriate strategies, laptop can be used as a cognitive tool and enhance the possibility of shifting teacher's role from a lecturer to a facilitator. Integrating laptops into classroom should consider the following issues: make use of laptop as cognitive tool, employ constructivism approach, provide curriculum support, manage logistics of classroom, and reduce distraction.

Pervasive computing can enable learners, teachers, and parents to have continuous access to computing technology. By taking the advantage of portable technologies such as laptops to establish a pervasive computing environment, students can be empowered to learn with technology anytime, anywhere. Recognizing the potential benefits of pervasive computing, a coeducational, independent, college preparatory day school in the southeastern region of the United States has worked for two years to integrate laptop computers into middle grade core subjects (language arts, social studies, math, and science) with a wireless networking infrastructure.

Information technology has been shown to motivate students and, computer-assisted learning can make a notable addition to learning and understanding science concepts but its value will lie in apt use and this will depend upon teacher judgment and expertise (Rodrigues, 1997). Successful implementation of technology in an education setting requires more than merely providing resources and a hospitable environment. Collaboration among the participants is an essential feature of the formula. Collaboration in itself does not lead to success in achieving change if those involved do not embrace a shared vision or a perceived need of technology implementation. Moreover, integrating technologies with education requires a reconceptualization of the classroom environment and the teaching and learning strategies employed therein (Woodrow et al., 1996).

Aware of the laptop successes and challenges documented at other schools, the technology leaders at the school used in this study contacted external evaluators to conduct a long-term evaluation of the use of portable technologies in their school (Hill, et al., 2001). The findings of the evaluation from the last two years indicates that even though teachers were enthusiastic about using laptop into their classroom, some of them felt frustrated because they perceived a need for more practical strategies about how to integrate the laptop into the learning environment. As a component of the overall evaluation project, this study sought to: 1) identify learning activities that use the laptop, and 2) identify the strategies the teacher uses during the learning activities in the learning environment to integrate the laptop.

The description of the problem

During the Spring of 2000, the school offered a series of workshops (known as 20-Minute Modules) to prepare middle school teachers and administrators to participate in a wireless laptop learning environment. While the workshops were useful, several suggestions were offered during the teacher interviews at the end of the year. One teacher suggested that the technology training and the strategies of teaching learning should be separated. Another teacher mentioned a need for personalized training to match her/his curriculum. Yet another teacher stated they needed training on technology integration. While training received to date has been useful, it appears that the teachers are still trying to figure out the feasible approaches to integrate the new portable technology into the learning environment.

One area that holds particular promise in terms of technology integration is science computer applications in science education could include word-processing reports, using data-loggers, spreadsheets, databases, simulations, multimedia and the Internet, for data collection and analysis (Rodrigues, 1997). For example, by allowing pupils to carry out complex calculations and present the results quickly and easily, they are able to concentrate on the important scientific principles underlying their work rather than on the tedium of the number crunching that can so often get in the way of understanding (Carson, 1997). In addition, modeling could be used for investigations and multimedia authoring for communication information. For example, by creating a dynamic computer model of the thing to be studied, and manipulating that model to changes and new influences, student gain a sense of how the thing itself works (Carter, 1998).

Research design

Based on the many opportunities of integrating the laptop into the science learning environment, this study sought to develop a strategy to help teachers systematically and successfully integrate the laptop in the middle school to enhance student learning. This study focused on one classroom of one eighth grade science. Students and the teacher have their own laptops and they can access to the Internet anytime, anywhere with their laptops. The classroom context is a science class covering ecology, earth science, and physics. The class meets five days a week during the semester. Participants study astronomy unit when the researcher doing observation. Seventeen 8th grade students from the same classroom of the science teacher were selected to participate in this study. The majority of the students received their laptops two years ago and are computer literate. (note: some students are new to the academy so have not had their computers for two years) The teacher has 7 years experience of teaching science and two years experience of using the laptop into the learning environment.

The design of this study is a case study, utilizing qualitative research methods because the researcher wants to generate data rich in detail and embedded in the context. According to Stake (1994), in the intrinsic case study, no attempt is made to generalize beyond the single case or even to build theories. However, as Jennifer Mason puts it:

> *I do not think qualitative researchers should be satisfied with producing explanations which are idiosyncratic or particular to the limited empirical parameters of their study...Qualitative research should [therefore] produce explanations which are generalizable in some way, or which have a wider resonance (1996:6).*

Purposive sampling guided by time and resources is a positive answer to the question of how we can obtain generalizability. Purposive sampling allows us to choose a case because it illustrates some feature or process in which we are interested (Silverman, 2000). As Denzin and Lincoln put it:

> *Many qualitative researchers employ...purposive, and not random, sampling methods. They seek out groups, settings and individuals where...the processes being studied are most likely to occur (1994:202).*

The researcher focused on a single case by purposive sampling because unique qualities of the learning environment can promote understanding, inform practice for similar situation and allow access. Due to identify the teaching strategies the teacher employs in the learning environment, on-site observation of the activities with the laptop and interview with the teacher are selected.

This study gathered the qualitative data by two primary methods: 1) conducted observation in the classroom to see how the middle school science teacher integrates the laptop into the learning environment and the reactions of students with observation protocol, and 2) an interview with the middle school science teacher to gather detailed information about the experience. Other sources of data were also used to inform the results of the study; including surveys from the overall evaluation effort and informal discussions with the overall evaluation team.

Data analysis

The researcher used descriptive statistics to include frequency of activities occurred in the learning environment and activity structure. The data from field observations were analyzed based on the categories in the observation checklist. The interview session was recorded on audiotape. The transcribed teacher interview protocol was compared with the data drawn from observations and surveys. The interview was analyzed by the inductive approach and themes were identified. The data of surveys done by the external evaluation team from the last two years of the four-year longitudinal evaluation about the science teacher's view on teaching and learning, computer use for teaching, and the descriptions of his teaching and learning environment were synthesized with the data from observations of actual using the laptop in the learning environment. The teacher's self-description of the experience was gathered from the interview.

There are some limitations might limit the validity and reliability of the results of this study. First, the observation time was limited due to limited personnel; the researcher was not able to participate in each science. Second, any possible generalization of the results is limit to the middle school in science. Third, the results may not apply to the teacher who is not equipped with the high computer literacy because the teacher in this middle school has been through training in using a laptop.

Results

The case study revealed some interesting results. One key to successfully integrating the laptop into learning environment is how the strategies are being employed. In this study, the strategies the teacher used with the laptop included problem-based learning, project-based learning, collaborative learning, and hands-on activities. The teacher also had students using the laptop as a cognitive tool, representing their knowledge with some application such as creating a Webpage, or a PowerPoint presentation, or spreadsheet graphics. Most of the strategies that the teacher used also clarified the result of literature review (Wiesenmayer & Koul, 1998; Woodrow et al., 1996; Scanlon, 1997; Devitt, 1997) including the value of an inquiry-based approach, project-based activities, collaborate learning, and using a variety of resources available through the Internet to integrate technology.

Another key to successfully integrating the laptop appears to be the role of the teacher. The teacher's role changed from that of a lecturer and transmitter of knowledge to that of a facilitator, guiding students to take advantage of opportunities to develop their inquiry skills; from being a conclusion-drawer to becoming a curriculum planner and initiator, while using the computer and other resources to provide science information (Levine & Donitsa-Schmidt, 1996). The particular advantage for science educators is that there is a teaching point to be made in using a collaborative context for science learning, stressing that scientists usually work in teams and that science is a social activity (Scanlon, 1997).

Yet another key to successful laptop integration is the curriculum support to come up the ideas about how to integrate laptop into the learning environment. Between grading and making test and keeping up with their lessons, there is no time for teachers to be able to sit and look for valuable and valid resources. Providing resources that will assist teachers with generating the ideas is important, as is providing time to tryout and revise the ideas.

Classroom logistics is another key in successful integration of the laptop in the learning environment. Even though they have wireless Internet connection, the laptop still needs a power cord to operate. Currently, the cords are all over the floor and create challenges for moving around the classroom. Set up or the learning space needs to be considered.

A final factor revealed in this study relates to student attention. Students can configure laptops with their own personal interest. For instance, they can setup different wallpaper for desktop, install fancy screensavers and entertainment applications. While important, these can also become sources of distraction. Balancing personalization of the tools while maintaining a focus on use for learning is another key factor to the successful integration of the laptops.

Implications

The data gathered suggests a number of recommendations that are applicable in the learning environment with laptop. Implementation of these strategies may assist with the successful integration of the laptops.

1. *Make use of laptop as cognitive tool:* Using software like spreadsheet, PowerPoint, image processing, web construction and multimedia authoring tools enable student to create charts, graphics, presentations, projects, and websites easily. They can use these tools to represent and construct their knowledge toward concepts and enhance their cognition. Therefore, laptop can be used as a cognitive tool (Jonasson & Reeves, 1996) with appropriate strategies and enhance the possibility of shifting teacher's role from a lecturer and transmitter of knowledge to a facilitator.
2. *Employ constructivism approach:* learning and instructional practices in science classrooms should be flexible and form a constructivism learning environment. (Levine & Donitsa-Schmidt, 1996). To enable a constructivist learning environment and switch the structure from teacher-centered to learner-centered, teacher should provide students chances to construct their own knowledge representations with laptop.
3. *Provide curriculum support or formal channel to share instructional ideas*: Teachers don't have enough time to develop appropriate tools for laptop in each unit is a problem for integration. Laptop just becomes a tool to replace pen and paper. Having someone who is good with computers and laptops, understand teaching techniques, pedagogy and familiar with curriculum to design the ready-to-use activities as resources for teacher to adapt is a strong need to implement the laptop environment. Or create an official website for sharing valuable resources that can provide teachers a channel to access to all kinds of tool for specific units.
4. *Logistics of classroom*: Although the learning environment is wireless for access to the Internet, laptop still needs cord to get power because kids seldom remember that they have to recharge laptops everyday. Ideally there would be enough plugs under every desk in the floor or a desk with plus. Considering the arrangement of desks, plugs, and cords before using laptop in the classroom is a primary work.
5. *Reduce distraction*: students can configure laptops with their own personal interest; for instance, install fancy screensaver and entertaining applications. They may miss the lecture and put attention to these distractions. Teacher may needs to set up classroom rule to prevent students browsing unrelated information in class.

Conclusion

Bringing wireless laptop into learning environment has some strength. The capability of accessing to the Internet anytime anywhere and being portable extends the learning environment beyond the boundary. This advantage makes the learning environment turns into classroom, lab, library, and the authentic context based on the instructional goals without the physical limitation. Carter (1998) indicated that in the ecology class, students enter the full ecological context, doing it as a biologist or ecologist would, gather data and convene to discuss the data and patterns, formulating conclusions and new questions about the ecological relationship in the environment that supports it. This kind of real experience is most powerful, because the learning is situated in the most authentic context possible. Moreover, teacher can collect ready-to-use tools for laptop from the Internet and share that easily with other teachers. Teachers perceived Internet as a major tool for teaching collaborative and investigative practices of science and scientists and they also became aware of the possibilities and the problems created by both the nearly unlimited quantity of information available on the Internet and the limited quality and relevance of much of that information (Wiesenmayer & Koul, 1998; Jackson et al., 1997). Students can seek information on the Internet and email peers to share their knowledge and accumulate resources collaboratively. Besides, with the laptops in the classroom, it saves lots of time because they don't have to go back and forth between media center and classroom.

The strategies of integrating laptop into learning environment depend on the feature of learners and subjects, learning goal and objectives. There is no reason that laptop should be involved in each activity. Teacher should use laptop for meaningful purposes. For example, for middle school kids, it's better to use mixed up strategies with and without laptop because it's impossible to ask kids sit in front of laptop all day even these tools are excellent. The ideal situation is not over and not under use. It has to be integrated but there still things have to stay, not total transition. Finding a balance in use and house remains a challenge for further research.

Reference

Carson, S. R. (1997). The use of spreadsheets in science - An overview. *School Science Review*, 79(287), p. 69-80

Carter, M. W. (1998). A portable paradox? Laptop computers and outdoor learning. *The Journal of Experiential Education*, 21(1), p. 14-21

Denzin, N. & Lincoln, Y. (Eds) (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage

Devitt, T. (1997). Six reasons to infuse science with technology. *Electronic Learning*, 16(5), p. 40-44,46,61

Hill, J. R., Reeves, T. C., Grant, M., & Wang, S. (2001). *Ubiquitous computing in a day school: Initial results from a longitudinal evaluation*. Paper Presented at The Annual Convention of the Association for Educational Communications and Technology (AECT), Atlanta, GA

Jackson, D. F., Bourdeau, G., Sampson, A., & Hagen, T. J. (1997). Internet resources for middle school science: golden opportunity or "silicon snake oil"? *Journal of Science Education and Technology*, 6(1), p. 49-57

Jonassen, D. H., & Reeves, T. C. (1996). Learning *with* technology: Using computers as cognitive tools. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (pp. 693-719). New York: Macmillan.

Levine, T., & Donitsa-Schmidt, S. (1996). Classroom environment in computer-integrated science classes: Effects of gender and computer ownership. *Research in science and technology education*, 14(2), p. 163-78

Mason, J. (1996). *Qualitative researching*, London: Sage

Rockman, S. (2002). Rockman laptop project. Available [online]: http://rockman.com/projects/laptop

Rodrigues, S. (1997). The role of IT in secondary school science: An illustrative review. *School Science Review*, 79(287), p. 35-39

Scanlon, E. (1997). Learning science on-line. *Studies in Science Education*, 30, p. 57-92

Silverman, D. (2000). *Doing qualitative research: A practical handbook*. London: Sage

Stake, R. (1994). 'Case studies', in N, Denzin and Y. Lincoln (Ed.), *Handbook of qualitative research*, Thousand Oaks, CA: Sage, p. 236-47

Wiesenmayer, R. L., & Koul, R. (1998). Integrating Internet resources into the science classroom: Teachers' perspectives. *Journal of Science Education and Technology*, 7(3), p. 271-277

Woodrow, J. E. J., Mayer-Smith, J. A., & Pedretti, E. G. (1996). The impact of technology enhanced science instruction on pedagogical beliefs and practices. *Journal of Science Education and Technology*, 5(3), p. 241-252

Asynchronous On-Line Discussions: Facilitating Critical Thinking Skills in Distance Education

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Abstract: In distance education, students and instructors rarely meet face-to-face and interactive discussions are infrequent, if they take place at all. Such challenges make it difficult to model thinking skills or guide students through the thinking process. An asynchronous online forum is a promising tool to cope with this problem. This paper reports an ongoing project that examines the effects of asynchronous online forums on critical thinking and overall learning performance, and also probes students' overall perspectives toward the effect and function of using asynchronous discussion forums in the context of distance education. The research design, participants, instruments, and data analysis of this project are described.

Problem Statement and Research Objective

A primary function of education is not only to help students build knowledge base but to teach and develop their critical thinking skills as well. In many cases this occurs through class discussions (Bloom, 1956; Newman & Wehlage, 1993). Yet, in distance education, learners are separated by distance and/or time from the instructor and their peers; discussions are often hindered since students and instructors rarely meet face-to-face. Besides, since the population of distance learners tends to be older or have career/family obligations, learners have less flexible time and fewer opportunities to engage in the class discussion with each other synchronously. If collaborative inquiry tasks are assigned, it is difficult, if not impossible, for the instructor to facilitate interaction, monitor collaborative discussions and critical thinking in a distance. Such challenges make it difficult to model thinking skills or guide students through the thinking process.

Asynchronous online forums (i.e., text-based computer-mediated communication tools) are promising tools that offer an opportunity for interactive discussions independent of time and place, and also provide an opportunity for the instructor to moderate such discussions (Duffy, Dueber, & Hawley, 1998). However, like face-to-face discussions, online discussions can deviate from intended pathways, and facilitators need to continually monitor the discussion and provide input at appropriate moments. Instructors need more guidelines from educational researchers about integrating electronic collaboration and communication tools into their classrooms (Bonk & King, 1998). Some studies have compared the effectiveness of online forums to face-to-face forums; however, verbally based face-to-face forums and textually based asynchronous forums make direct comparisons difficult (Anderson & Kanuka, 1997). In essence, the core issue should be whether asynchronous discussions supplement instruction to facilitate more interactive discussions, foster critical thinking, and/or enhance overall student learning performance. The question, "Are asynchronous online forums effective in higher education?" still remains largely unanswered.

The purpose of this research project is to examine the effects of asynchronous online forums on critical thinking and overall learning performance and, in addition, to probe students' overall reactions and perspectives toward the effect and function of using asynchronous discussion forums in distance learning environments.

Research Design

The research design is a pre- and post-test quasi-experimental design. The independent variable is the use of the structured asynchronous online forum. Students in a control group class only use their regular communication mode (via e-mails) to ask their instructor or peers course-related questions. Students in an experimental group class will use an asynchronous online forum (threaded discussion bulletin board) as a supplement to their Web-based classes; a series of discussion topics will be posted on the class bulletin board and facilitated by the instructor. The students taking BMS 235, an undergraduate distance learning course at Purdue University, in spring 2001 are the subjects in the control group; the students taking BMS 235 in fall 2001 and spring 2002 will be the subjects in the experimental group. There are two dependent variables examined in the study: students' learning achievement and attitude. The first dependent variable is the learning achievement of the students that is measured at two levels—declarative knowledge and critical thinking skills. Declarative knowledge refers to the concepts, principles, issues, and facts presented in a learning situation. It is measured as the scores on the four quizzes and two exams on course content. Learning in terms of critical thinking is measured via California Critical Thinking Skills Test, class discussions on asynchronous online forums, and essay questions that go beyond declarative knowledge acquisition and involve analysis, synthesis, reasoning, interpretation, and induction. The second dependent variable is students' attitudes towards asynchronous online forums, class discussion, and the course in general. Students' attitude has been defined as scores on the attitude pre-and post-course Likert-type surveys developed by the researcher. The interview questionnaire will also be administered to probe students' attitude toward the study.

ANOVA will be performed to justify whether there is a difference among the subjects in terms of age, educational backgrounds, attitudes toward asynchronous forums and the course, and knowledge of content at the beginning of the class. The dependent variables, including students' learning achievement and attitudes toward the course and the asynchronous online forum, will be analyzed using a one-way ANOVA at the end of the class. In addition, the qualitatively analytic procedure that organizes the data, generates categories, themes, and patterns, and searches for alternative explanations for the data is adopted to analyze the data from the interview questionnaire to generalize themes regarding students' perspectives about the study. In order to pilot test the efficacy and reliability of the proposed research design, BMS 236 class in summer 2001 was used as a pilot study for the experimental group.

Implications of Results

The importance of class discussion has been highlighted by a host of research studies; to move students beyond assimilating inert facts into generating better mental models, teachers must structure leaning experiences that highlight how new ideas can provide insights in intriguing, challenging situations (Dede, 1996). This research speculates about how an increasing important tool—asynchronous online forum, can afford educators great pedagogical opportunities to reshape distance education. It is our anticipation that asynchronous online forums are the means that afford students the time for thoughtful analysis, reflection, and composition as their discussion of an issue evolves and that allow instructors to mentor and evaluate the critical thinking skills exhibited during out-of-classroom discussions. It is this potential of asynchronous online forums that we find so exciting. However, the actual impact and effectiveness of the asynchronous forum as a supplement to distance instruction is still insufficiently researched. Thus, this research project will identify and experimentally examine asynchronous online forums in a constructivist paradigm, and provide useful information as to the overall reactions and perspectives of students toward the effect and function of using asynchronous discussion forums in the distance education environments.

References

Anderson, T. & Kanuka, H. (1997). *On-line forums: New platforms for professional development and group collaboration.* (ERIC Document Reproduction Service No. ED418693)

Bloom, B. S. (Ed.). (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain.* New York: David McKay.

Bonk, C. J., & King, K. S. (1998). Introduction to electronic collaborators. In C. J. Bonk & K. S. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. xxv-xxxv). Hillsdale, NJ: Lawrence Erlbaum.

Dede, C. (1996). Emerging technologies and distributed learning. *The American Journal of Distance Education, 10*(2), 4-36.

Duffy, T., Dueber, B., & Hawley, C. (1998). Critical thinking in a distributed environment: A pedagogical base for the design of conferencing systems. In C. J. Bonk & K.S (Eds.), *Electronic collaborators* (pp. 51-78). New Jersey: Lawrence Erlbaum Associates.

Newmann, F. M., & Wehlage, G. G. (1993). Five standards of authentic instruction. *Educational Leadership, 50*(7), 8-12.

Instructional Strategies for Web-Based Bulletin Boards to Stimulate Interaction and Improve Student Learning Performance in Distance Education

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Abstract: History has shown that interaction is an essential component in the learning process. Integrating interaction into a traditional classroom is relatively easy; however, moving that interaction into several time zones is much more difficult. Web-based bulletin boards (WBBs) are promising tools that offer such an opportunity for interactive discussions and collaboration in distance education. Thus, a set of theoretically-based instructional strategies for the instructor will be developed to help promote active interaction and help students make the most use of WBBs. The proposed instructional strategies for WBBs will be implemented in experimental settings to evaluate for their effectiveness.

Numerous studies (Romiszowski, 1988; Schaffer & Hannafin, 1993) have provided evidence that interaction may be the missing link in a successful distance education course. Computer-mediated communication (CMC) has been utilized to fill this gap for the past two decades to increase interaction between learners and the instructor and among learners. CMC can be used to facilitate both synchronous (real-time) and asynchronous (delayed time) discussion. Asynchronous discussion, such as e-mails, listservers and electronic bulletin boards are usually viewed as least costly, most flexible, and effective ways to facilitate discussions in today's distance education. Students can read, follow, and participate in discussions as they wish. They can exit and reenter as their schedules allow without missing conversation or an opportunity to contribute their ideas. However, researchers, such as Jonassen (1996), have indicated that many technology-based innovations have failed because they were not properly implemented and, without due care, this trend will continue into future. No matter how high our expectations are for computer-supported collaborative learning, only the careful development and implementation of these tools will help us realize the full potential of the technology (King, 1998).

Recently, the increasing popularity of the Internet and the incorporation of conventional CMC and the World Wide Web (WWW) have begun the ongoing renaissance to enhance human to human interaction in the field of distance education. Due to the development of hypertext, the WWW has become the most popular and user-friendly way to distribute multimedia contents. Considering accessibility of diverse resources from the Web with asynchronicity and cost-efficiency, I have selected the Web-based bulletin boards (WBBs) as an instructional tool to improve interaction and distance learners' academic performance. In addition, based on the suggestions of many researchers and educators, such as Klemm (1998) and Jonassen (1996), who have experienced using WBBs to facilitate their instruction, a set of guidelines and instructional strategies to help instructors stimulate more interactive discussions, cope with the unsolved challenges using WBBs, such as information overload and lack of social presence, as well as enhance overall learning performance in WBB environments for distance education will be synthesized and developed. Based on the theory of constructivism, the proposed instructional strategies will include:

a) How to prepare students with an asynchronous discussion tool they will be using. For example, the instructor can provide students with thorough handouts and training on the use of the discussion tool, clarify student roles in class discussion, and remind students to focus on ideas, not on personal attacks as well as to show tolerance for divergent points of view.
b) How to break the ice, set a tone and create a relationship with students as a class.
c) How to encourage students' participation in discussion. For example, strategies to encourage student involvement may include:

- Motivating students that thinking hard is a meaningful goal not only for this course but for their future life and work as well. Their productions will be taken seriously by the instructor, and their efforts be rewarded by the educational system and society in general (Jonassen, 1996).
- Emphasizing the importance of online discussions by appropriately weighting their value (e.g., the percentage of the overall grade that the discussion is worth.).
- Holding high but realistic expectations for students.
- Posting or disseminating important information, such as quiz results, homework solutions, or exam preparation hints, only on the WBB. This may increase the frequency for students to visit the WBB and, thus, may increase the chances for students to look at, contribute to or respond to the online discussion more frequently.
- Making the instructional activity relevant and interesting.
- Avoiding leading questions or yes/no questions. The instructor should ask more "why" or "how" questions, leading students to try to figure out things for themselves.
- Providing immediate feedback.
- Listening attentively and acknowledging student contributions. Give students some indication of how well they have contributed to the class discussion and how to improve (via private e-mail). Rewards can be as simple as saying a student's response was good, with an indication of why it was good, or mentioning the names of contributors: "Cherry's point about pollution really synthesized the ideas we had been discussing" (Davis, 1993; Willis, 1993).
- Providing a variety of learning activities since variety reawakens students' involvement in the course and their motivation.

d) Modeling critical thinking skills by asking students Socratic questions.

e) What available teaching activities are that can catch students' attention or reawaken students' involvement in the course and their motivation to actively participate the online discussion. For instance, role playing, case studies, debates and study questions that explore the main topics of the course content are all instructional activities that can be incorporated into almost any distance learning course to encourage intellectual discussion and provide opportunities to apply what students have learned.

f) What instructor's role is as a facilitator in online discussion.

The above proposed instructional strategies will be explored in greater depth in the presentation and an open discussion will be facilitated.

The actual impact and the gain of student learning performance by using the proposed instructional strategies have not been realized yet. Thus, the above proposed instructional strategies will form a framework from which to build an analysis of the actual use to facilitate interaction for distance learning courses at Veterinary Technology Distance Learning Program at Purdue University. After this pilot study, appropriate modification will be made and then the use of WBBs with the modified instructional strategies will be experimentally tested to investigate the impact and the actual gain of student learning performance as well as the overall reactions and perspectives of the instructor and students toward the effect and function of using WBBs in the context of distance learning courses.

References

Davis, B. G. (1993). *Tools for teaching*. San Francisco: Jossey-Bass Publishers.

Jonassen, D. H. (1996). *Computers in the classroom: Mindtools for critical thinking*. Englewood Cliffs, NJ: Merrill/Prentice Hall.

King, K. S. (1998). Designing 21st-century educational networlds: Structuring electronic social spaces. In C. J. Bonk & K. S. King (Eds.), *Electronic collaborators: learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 365-383). New Jersey: Lawrence Erlbaum Associates.

Klemm, W. R. (1998). Eight ways to get students more engaged in online conferences. *T.H.E. Journal, 26*(1). Retrieved March 15, 2001, from http://www.thejournal.com/magazine/vault/A1997.cfm

Romiszowski, A. (1988). *The selection and use of instructional media*. London: Kogan Page.

Schaffer, L., & Hannafin, D. (1993). The effects of progressive interactivity on learning from interactive video. *Educational Communication and Technology Journal, 34* (2), 89-96.

Willis, B. (1993). *Distance Education: A Practical Guide*. New Jersey: Englewood Gliffs.

A Case Study for Promoting Collaboration on Online Project-Based Learning

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Abstract: The interactive mechanism of the internet allows learners to interact with teachers, other learners, and contents while it facilitates teachers to interact not only with learners but also with other teachers who teach the similar or related courses and conduct online teaching. The study attempts to analyze teaching strategies for planning collaborative learning and teaching through a case of online project-based learning in inter-universities. The study also attempts to observe the degree of students' learning experience, collaboration and participation with their expectancy and satisfactions on the collaborative online project - based learning .

1. Introduction

In last several years, online education has become an accepted means of teaching and learning in higher educational institutions, and more and more universities use computers to improve learning and instruction by connecting to the resources and by communicating with others. The interactive mechanism of the internet and the Web allows teachers and students to share ideas and to access information and resources with a much broader community than would otherwise be possible. Through the Web learners can interact with teachers, other learners, and contents more actively and effectively. As the same manner, this interactive mechanism encourages teachers to interact not only with learners but also with other teachers who teach the similar or related courses and conduct online teaching. This collaborative interactivity of teachers with the internet can be taken place between or among universities in the mode of intra or inter-universities by sharing ideas in preparing courses, developing course materials, and operating, managing, and evaluating courses.

This collaborative way of teaching would improve the quality of teaching and learning and consequently expand new opportunities of education. When the Web extends learning beyond classroom walls to learning communities, the students can work in inter-group as well as intra-group, and the roles and concepts of teaching and learning are restructured. According to Pea (1994), there are two alternatives to the transmission model of communication. Teachers and students alike are transformed as learners by the process of communication. Through such collaborative discourse within the learning community, active leaning occurs more and knowledge is constructed through more interactions.

The interactions can be actively employed especially in the project-based learning activities by formulating an efficient communication system for group interaction, since project-based learning requires interaction among other students in order to accomplish the group project. In the project-based learning, learners generally involve in identifying the problem and information they need, locating corresponding information needs, and extracting and organizing relevant information from a variety of sources into productive uses through group communications and activities. On the same time, teachers engage in planning a collaborative course by setting the topic of the project, designing the materials and learners' activity, and managing and evaluating learners' progress.

Based upon this assumption, this study attempts to analyze teaching strategies for designing and operating courses, methods for successful collaborative teaching in the Web environment, and suggest new potentials on the view of collaborative teaching, especially for project-based learning with the internet. Also, this study explores the issues in students' learning experience, collaboration and participation along with their expectancy and satisfactions on the collaborative online project through observing an electronic survey.

2. Background of the Study

Structure of Interaction in Collaborative Learning and Teaching

In online learning environments there are usually three kinds of interactions that take place: learner-content interaction, learner-instructor interaction, and learner-learner interaction (Moore & Kearsely, 1996). Learner-content interaction is the interaction between the learner and the information presented that should lead to knowledge acquisition. This interaction relies on the knowledge base that the learner has built from prior learning experiences and on the ability of the learner to interact with the content presented. Learner-instructor interaction is a vertical interaction dependent upon the ability of the learner and the instructor to communicate. At this type of interaction, the instructors provide support, and encourage the learners. Learner-learner interaction is the horizontal interaction between learners. Students learn in a self-directed way, but at the same time they interact with other students by communicating information and ideas so as to increase their participation and enhance their motivation and learning.

These types of interactions in online learning environment are taken place by the instructors focusing on learners. However, for the sake of instructors the interactions can be made with other teachers or outside experts as well as with learners or a group of learners (Yang, 1999). Therefore, the forth type of interaction occurred in collaborative learning is the interaction between instructors. This allows learners to have interaction with not only learners in his/her schools but also learners in other schools or communities. The instructors are connected through shared teaching objectives or contents whereas the groups of learners are connected through the shared problem of the project.

When the collaborative teaching is conducted between instructors, more interactive collaboration has made in the whole teaching and managing process including planning, implementing, and evaluating. The collaborative teaching covered all types of interactions among students and instructors, instructor and instructor, and students and students. Teachers can share their syllabus, lectures, students' task, activity and practices, and students' progress on discussion.

Such a collaborative teaching is not happened before in traditional classrooms. General availability of multimedia and communication tools, such as e-mail, bulletin boards, conferencing systems, whiteboards, chat rooms, and videoconferencing make a great impact to educational curricula, learning materials and instructional practices and are adapted for collaborative learning and teaching. In addition, the learners in online learning environment have become more heterogeneous, and learners' social or cultural background and own interest are divergent so that they tend to receive information actively with more interaction and feedback.

Elements of Collaboration in Learning and Teaching on Project-Based Learning

Collaborative learning emphasizes the mutual engagement of learners in the learning process rather than on the sole efforts of individual to reach a common group goal. Therefore, on project-based learning the final products are evaluated based on collaboration and represent a synthesis of the whole. Some of the main advantages of collaborative learning are that it encourages active and constructive learning and encourages deep processing of information, as well as evoking critical thinking, reasoning and goal-based learning (Bernard et al., 2000). Collaborative learning requires less teacher-imposed goal structuring and includes the process of sharing the learning task, combining expertise, knowledge and skills to improve the quality of the learning process, building or consolidating a learning community (Slavin, 1995).

In a collaborative learning setting, the emphasis is placed on the interactions as common understandings are negotiated and developed across differences of knowledge, skills and attitudes. Motivation to participate and confidence, together play an equally important role if benefits are to merge from the experience. Moreover, participants need to assume a variety of functional roles as interchanges progress and involve question answering and explanations that are open to challenge and justification (Bernard et al., 2000). To conduct collaborative online learning successfully, it is crucial that the learner feels part of a learning community where learner's contributions add to a common knowledge pool and where a community spirit is fostered through social interactions.

Problem Description

The objectives of the study are to identify instructional strategies and support system for project-based learning using the Web and to examine factors for collaborative teaching process. The study examines and exemplary case of more effective and efficient collaborative instructional methods in inter-universities. The process of online project includes not only the identification of the problem, the time of accessing information needed for the project problem, but also collaborative learning and teaching strategies such as preparing courses, creating social climate and sense of community, encouraging students collaboration, and using support mechanism. Accordingly, questions are asked in terms of how much the students learn from online experience, how well they collaborate and participate in the project, how much they are expected and satisfied at collaborative online project-based learning activities.

Learning Community and Environment

Students were junior majoring educational technology or curriculum education, and taking a distance education system and new media course. Students of two universities worked in small groups, and two universities located in 4 hours driving distance were involved in online project, sharing their knowledge and collaborating to perform context-dependent tasks.

The task was developing a model for distance learning, and it is loosely structured in individual activity. The instructors provided the topic upon which each group develop own specific model for distance education, monitored the pace of group task, provided the steps for successful completion, guided the enabling objectives for completing their final group report. Meanwhile, instructors did not interrupt discussion itself while providing supports and facilitating guide.

Students Survey and Analysis

The survey was held at the end of course and the survey was consisted of items including the followings:

- Did the collaborative online project experience enhance understanding of distance education?
- Were your communication skills improved by the collaborative online project learning?
- Were your problem-soling skills improved by the collaborative online project learning?
- Were collaboration well taken place through learning in your group?
- What was the most significant factor to interfere your collaboration?
- When collaboration was not occurred, how did you handle it?
- Did you participate actively in collaborative online project?
- Were you satisfied at participation of other members of your group?
- What did you expect of collaborative online project before it started?
- Do you want to take another online project course if you could?
- What mechanism did you use most for collaboration (e.g., bulletin board, chatting room, etc)?

Additionally, messages were analyzed based on the electronic bulletin board discussion in order to observe which students play leadership most and facilitate team project, monitor other students' thoughts and opinions, put together the process and results of collaboration work.

3. Teaching Strategies for Online Project-Based Learning

Some of strategies for online learning in general are reviewed with collaborative learning and teaching, especially in project-based learning settings. The process of project-based learning with the internet is generally composed of online questions and answers, online report, online discussion by using the bulletin board, e-mail, and newsgroup etc. In the project-based learning, the students learn by problem solving process based on the given problem of the project. For example, teaching strategies such as reflection and summary of what students earn from project, and small group activity in the class which are often used in the traditional class can be more effectively occurred in online learning space when collaborative interaction mechanism are applied. Recently, educational environment and learning process are moved toward the performance centered evaluation, portfolio, cooperative learning task. Teaching methods and strategies for collaborative teaching between or among teachers in project-based learning through the Web were examined by some exemplary case studies. The based framework of teaching process is based upon previous research including Bernard et al. (2000).

Preparing courses

In online learning, students' data as like as traditional classroom settings can be collected by questionnaires, pre-tests through e-mail or electronic questionnaire. In collaborative teaching, it is crucial to plan collaboratively including class scheduling, students grouping, project topic, select of technologies for communication, and organization of the group and leaders. In online project-based learning, it is especially important to select project problem that reflects social issues or debates so that learners can start from the issues the discussion for identifying the problem, specifying the problem and find the solutions, and synthesizing the results of discussion and represent them effectively. Also, it is important for improving the collaboration between instructors to put agreed efforts on the whole process from planning instruction to evaluation. To receive and minimize differences between sites, the value or culture on each other's site should be considered in advance.

The methods of preparing the online courses are as follows: conducting a learning needs assessment, establishing learner profiles, organizing informal face-to-face or online "getting acquainted" activities, teaching and modeling collaborative behavior and skills that are expected of students, providing tutors and students with all technology training required, and scheduling the process and completion of project.

Creating a good social climate and sense of community

Developing and maintaining a positive social environment and creating a community of learners are considered to be essential. Learning collaboratively is basically a social process that must be encouraged and nurtured.

The methods of achieving the community are the follows: providing a social space in the conferencing system that allows for easy and free access to other students and the instructor, assigning students to collaborate, posting introductions, information folders, and other self revealing items like photos of participants, making the environment as democratic as possible to encourage the involvement of everyone, providing a restricted space that is unavailable to the instructor for students to converse among themselves, providing adequate levels of tutor support, initially, that gradually gives way to increased responsibility on the part of students, and arranging for at least one live meeting such as face-to-face group encounter for participants to get acquainted.

The advantage with using a face-to-face audience first is that the additional direct contact makes it easier to modify procedures and instructions than when it is done solely online for the first time. When the online students are taught through face-to-face at the same course, this can be more easily met. The effects of face-to-face group encounters are examined in inter-university project-based learning.

According to Harris (2001), virtual communities are no longer a place-based concept, but formed around issues of identity and shared values. Electronic personalities require internal dialogue, semblance of privacy, deal with emotions using text, and create mental pictures of others, and in online learning we need to personalize communications to create a sense of presence. Harris suggested the community-building steps as follows: define group's purpose, create distinctive gathering place, promote leadership, allow for range of member roles, create and facilitate subgroups, and allow members to resolve their own disputes

Encouraging collaboration

True collaboration can best be realized only when instructors view themselves as facilitators and guides rather than lectures or experts. The degree of instructor involvement is also an issue. As Brown and

Palinscar (1989) suggested "scaffolding", the tutor began by providing high levels of support to all groups and students, but as students started to demonstrate independence and cohesiveness, the tutor support was faded gradually.

The methods of encouraging collaboration are as follows: using small groups, using nickname for each group made by group members, selecting group leader and rotate leadership in turn, assuming instructor's role as a facilitator, modeling desired collaborative behavior, using facilitating techniques, substituting visual social cues with verbal cues, and promoting positive interdependence

In online collaborative learning, instructors use facilitating techniques such as 'weaving' to steer discussions and 'go around the circle' to ensure maximize student participation. Promoting positive interdependence among online team members reinforces collaborative online learning by introducing a legitimate need to collaborate. To give collective rewards and distributing needed resources across group members is fostering a healthy interdependence.

It is important for students to need to be prepared for a collaborative online experience because it is not assumed all learners possess the prerequisites for skilful collaboration. When messages are analyzed based on the electronic bulletin board discussion, some contend strong leadership, and facilitate the team project, monitor other students thoughts and opinions, put together the process and results of students.

Using support mechanism effectively

Land & Green (2000) pointed out the need for external support mechanisms that help learners develop strategies for effectively learning with project-based environments. Encouraging goal setting and reflection during the learning process is important. Supports of extensive teacher-student conversation in complex learning situations facilitate gradual changes in understanding.

The methods of using the support mechanism are as follows: matching medium to instructional objectives, using technology that is accessible to all participants, making use of internet features, e. g. discussion forums, chat rooms, etc, and using a metaphor that relates to learners' experience

The teachers provide the topic upon which each group develop own specific group task, monitor the pace of group task, provide the steps for successful completion, guide the enabling objectives for completing their final paper. Meantime, teachers do not interrupt discussion itself while providing supports and facilitating guide. Minimum support can be given as necessary in mechanically, individually by personal using e-mail to the learners those who do not participate well.

4. Results of Case Study and Conclusion

The students survey showed that their experience on collaborative online project would enhance understanding of distance education overall and provide adjustment skills in other collaborative works. The students responded that their communication skills and problem-solving skills were improved by the collaborative online project learning. More than 70% of students were satisfied at their active participation and other members' participation in groups. In open questions in the survey, students pointed out the factors that interfere their collaboration and the way they cope with them. In addition, the types of mechanism used most in online community were discussed.

Collaborative teaching with the internet, with its expanded interactions, has a great potential in designing and managing courses more effectively and efficiently than ever. The interactive mechanism of the internet and the Web allows teachers and students to share ideas and access information and resources with a much broader community. The interaction between instructors occurred in collaborative learning was emphasized in which instructors can have interactions with other teachers or outside experts as well as with learners or a group of learners while learners have interaction with not only learners in his/her schools but also learners in other schools or communities.

Strategies for online learning in general were analyzed with collaborative learning and teaching, specially applied to project-based learning settings including preparing courses, creating a good social climate and sense of community, encouraging collaboration, using of support mechanism. Furthermore, to identify the students' learning experience, their involvement in the process of collaboration and participation as well as students' expectations and satisfaction level, a survey was conducted at the end of the course and analyzed. The findings and results of study would provide implications for other settings and suggest for further studies.

As a conclusion, it is still difficult for teachers to construct a collaborative learning activity in online teaching because the web features was not developed collaborative teaching and the web itself do not support collaborative learning and teaching. Therefore, we need to refine collaborative teaching strategies for various situations, and by using technology support the process of collaborative learning and teaching.

References

Austin, A.E., & Baldwim, R. (1991). Collaboration in teaching. In *Faculty collaboration: Enhancing the quality of scholarship and teaching*, pp.35-45. ASHE-ERIC Higher Education Report No. 7.

Bernard, M.R., & et al. (2000). Collaborative online distance learning: Issues for future practice and research. *Distance Education, 21*(2), 260-277.

Bordia, P.(1997). Face-to-face versus computer-mediated communication: A synthesis of the experimental literature. *The Journal of Business, 34*(1), 99-120.

Brown, A.L. & Palincsar, A.S. (1989). Guided, cooperative learning and individual knoweldge acquisition. In L.B. Resnick (ed), Knowing, learning, and instruction: Essays in honor of Robert Glaser. Hillsdale, NJ: Erlbaum.

Chang, C. (2001). Refining collaborative learning strategies for reducing the technical requirements of web-based classroom management. *Innovations in Education and Teaching International, 38*(2), 133-143.

Chen, G., Liu, C., Ou, K., and Lin, M. (2000). Web learning portfolios: A tool for supporting performance awareness. *Innovations in Education and Teaching International, 38*(1), 19-30.

Collis, B. (1996). Supporting project-based collaborative learning via a World Wide Web environment. In Khan, B.H. (Ed.), *Web-based instruction*, pp.213-219. Englewood Cliffs, NJ: Educational Technology Publications.

Harasim, L., Hilts, S.R, Teles, L. & Turoff, M. (1995). *Learning networks: A field guide to teaching and learning online*. Cambridge, MA: MIT Press.

Harasim, L, & et al. (1996). Virtual U: A web based system to support collaborative learning. In B.H. Khan (Ed.), *Web-based instruction*. Englewood Cliffs, NJ: Educational Technology Publications.

Harris, J.B. (1995). *Organizing and facilitating tele-collaborative projects.* http://www. gsn.org/ weblib/ harris.

Harris, J.B. (2001). *Community-buiding to successful online courses*. A special lecture at Sejong University.

Laffey, J., Tupper, T., Musser, D., & Wedman, J. (1998). A computer-mediated support system for project-based learning. *Educational Technology Research and Development, 46(*1), 73-86.

Mark. M. (1990). The differentiation of instructional structures and effectiveness in distance education programs. In M.G. Moore (Ed.), *Contemporary issues in American distance education*. London: Pergamon.

Moore, M.G., & Kearsley, G. (1996). *Distance education: A systems view* Belmont, CA: Wadsworth Publishing Company.

Newell, W.H. (1994). Designing interdisciplinary courses. In J.T. Klein & W.G. Doty.(Eds.) *New directions for teaching and learning*, *No.5*, 35-51. San Francisco: Jossey-Bass Publishers.

Penuel. W.R. (1999). *Observing classroom processes in project-based learning using multimedia: A tool for evaluators.* The Secretary's Conference on Educational Technology-1999, Washington, D.C.

Russell, J.D., Reiser, R.A., Hruskocy, C., & Ruckdeschel, C. (1999). Strategies for teaching project-based courses. *Educational Technology, 39(*2), 56-60.

Slavin, R.E. (1995). Cooperative learning. 2nd Ed Allyn & Bacon. Boston, MA.

Taplin, M.(2000). Problem-based learning in distance education: Practitioners beliefs about an action learning project. *Distance Education, 21*(2), 278-299.

Yang, Y. (1999). A study of collaborative teaching strategy and support method for project-based cyber instruction, *Journal of Educational Broadcasting, 5*(2), 111-130.

Yang, Y. (2001). *Collaborative teaching strategies for online project-based learning.* International Conference on Computers in Education/Schoolnet, Seoul, 3-12.

Extending Educational Access Through Hand-held Devices

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ABSTRACT

The University of Hong Kong has been critically aware of the need for students to gain "access" to their instructors at various times and from various locations. In a sense, education may be enhanced and communication accomplished while the student is "roaming". Through University sponsorship, a project to utilize PDA Hand-held devices for accessing a Web-server is under implementation. Questions are asked and answered; course materials are downloaded to the PDA. Educational "access" is thereby extended.

I. Introduction

The Hand-held Devices for IT Education (HHIT) project was initiated at the University of Hong Kong in late 2001. The goal of the HHIT project is to promote students' learning outside their classroom, anytime and anywhere. Through this project, learning materials, lecture notes and tutorial exercises are made easily accessible to students by means of their hand-held devices. Students can review course material anytime and anywhere, freed from the physical boundaries of the classroom.

II. HHIT Design

2.1 Palm Platform

Students prepare and compose their FAQs on the Palm and forward them for eventual communication with Web servers via communications interface conduits. These requests are maintained and managed in their hand-held devices. The Palm platform is comprised of two software elements: Creating a new FAQ and Reading the FAQ. This includes the database management software to permit the 2-way interchange with the Web server. The Palm-FAQ interface, showing the software components and the necessary conduits to interface with the Web server, is shown in Figure 1.

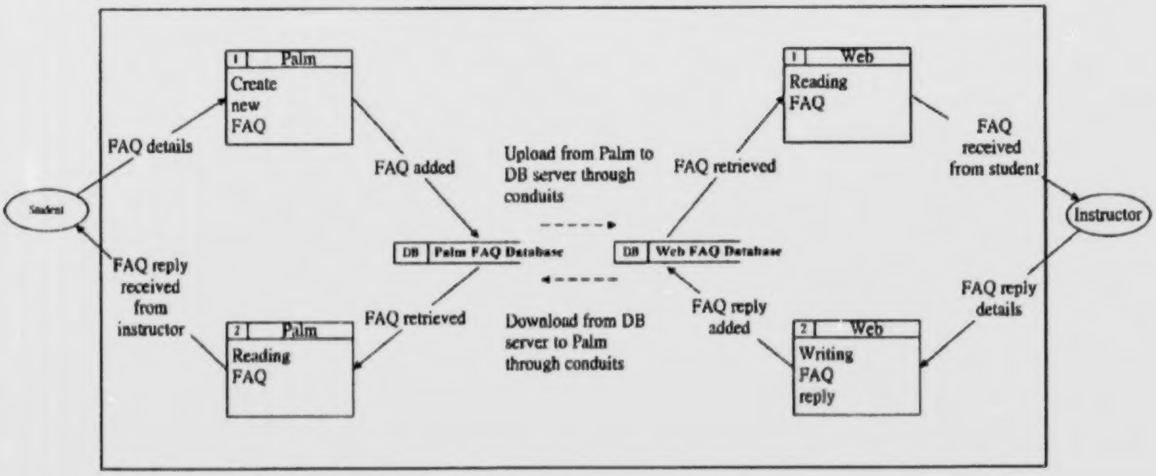
1 Palm
Create new FAQ
FAQ details
Student
FAQ added
Upload from Palm to DB server through conduits
FAQ retrieved
1 Web
Reading FAQ
FAQ received from student
Instructor
DB Palm FAQ Database
DB Web FAQ Database
FAQ reply received from instructor
2 Palm
Reading FAQ
FAQ retrieved
Download from DB server to Palm through conduits
FAQ reply added
2 Web
Writing FAQ reply
FAQ reply details

Figure 1. Palm-FAQ Web-FAQ System Data Flow Diagram

2.2 Web Platform

The Web platform is the primary interface on the receive-and-response side to the students FAQs. Instructors receive and inspect messages composed by the students. They, in turn, compose messages including clarification requests and responses to the FAQs. These are forwarded via software operating on the Web platform to complete this two-way interchange.
The Web platform consists of FAQ Reader and FAQ Writer components. It provides for the receipt and presentation of

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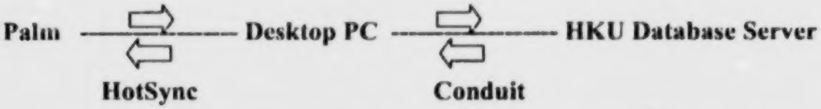
FAQs to the instructor as well as the composition and re-transmission of replies to the originating student. The identity and directivity of the FAQ to the originating student is preserved and the instructor has an on-going dialogue with him.
The overall flow of Web FAQ interfaces with the Palm database is shown in Figure 1.

III. HHIT Implementation

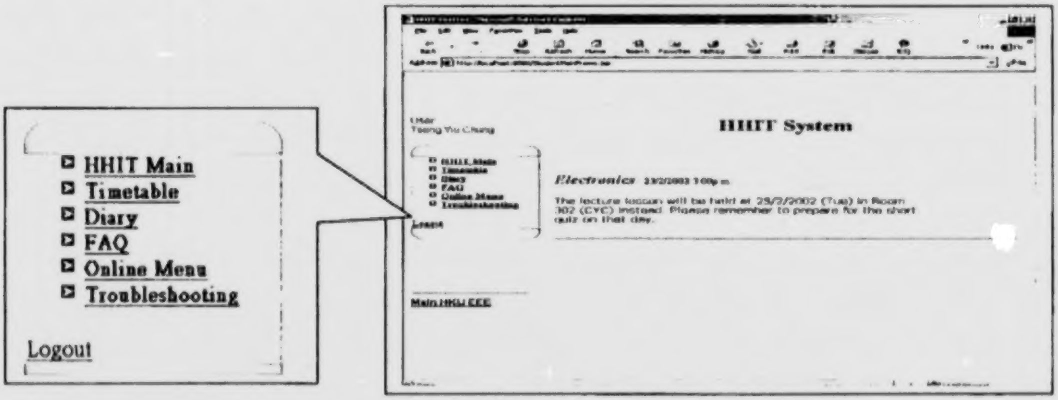
3.1 Palm Platform

Our Palm FAQ system is divided into 3 sub-systems:

- Palm Application Subsystem: the Create Question and View Question functions in our FAQ system on the Palm.
- Conduit Subsystem uploads the question created by student to the instructor via the PC Desktop and the Web and downloads the corresponding instructor response.
- Server Database Subsystem stores the record of the FAQ and does further processing



Students create a new FAQ according to their subject studied and their area of concern. The title and content of the new FAQ is inserted via Palm entry keys. The system prompts the student to supply all missing fields until the entry is complete. Students can temporarily save the question, or complete the writing and formulation of the FAQ on their handheld devices at their own convenience. The completed FAQ can then be directed to the corresponding instructor and is stored in the FAQ database. The student performs the HotSync on his/her desktop PC which forwards the FAQ to the ultimate HKU Database Server via the conduit interface. This generates an e-mail to the instructor. The HHIT system prompts the student through a series of screens to insert FAQ requests for instructor responses (Figure 2).



User
Tsang Yiu Chung

Electronics 23/2/2002 1:00p.m.

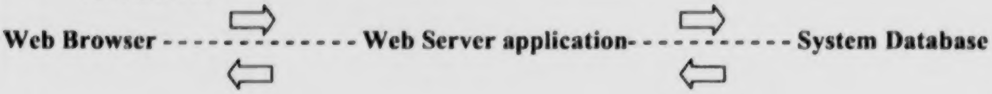
The lecture lesson will be held at 25/2/2002 (Tue) in Room 302 (CYC) instead. Please remember to prepare for the short quiz on that day.

Figure 2. HHIT System Main Screen

3.2 Web Platform

The Web Platform of our FAQ system is divided into 3 sub-systems:

- Web Server applications consist of the software which provides user requests and then sends them to the server for querying the database or processing data.
- Web Browser applications are those programs with JavaScript, which are downloaded to the client computers to provide different services, e.g. navigation menus.
- System Database stores the record of the FAQ and does further processing. The database should be common to both Palm and Web.



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3.3 Database

The databases interact with the programs through a Java Database Connectivity (JDBC) - Open Database Connectivity (ODBC) bridge as Java Server Pages (JSP) is used to write server related programs. It requires the bridge to connect the Java DB engine to Microsoft DB engine due to the development of Java programs on a Windows environment.
Figure 3 shows the relationship between Web platform subsystems.

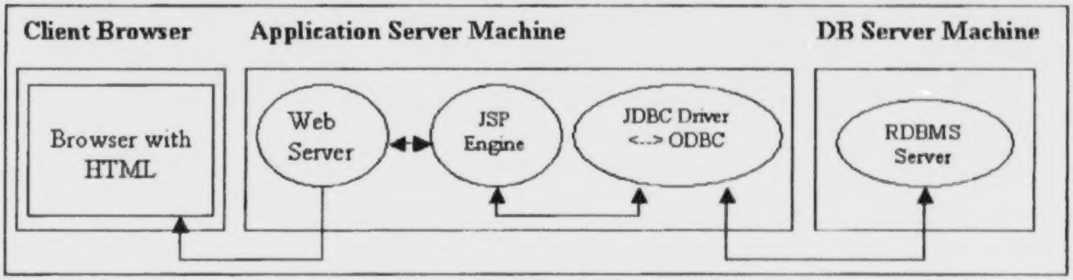

Figure 3. Relationship between the Web Platform Subsystems

When a user makes a client request on the browser, the request is sent to the Web server for processing. All data processing and request handling is done on the Application Server Machine. The JSP engine will change all the custom tag extensions and custom Java classes or JavaBeans to JDBC driver and other data access technologies to their control codes. Database queries can then be made to the database server by using the "open" schemes of JDBC to make a bridge with Win32 ODBC.

There is no applet or JDBC driver to download to the client. The browser using the Web application is not required to support Java at all. The JSP has full control over how many JDBC connections are made to the server; the client never makes direct JDBC connection to the server. This solution can work readily through a firewall; only standard HTTP is used between the Web server and the client.

IV. Future Plans and Improvements

PDA Hand-held devices offer a new hardware platform with numerous opportunities for developing future applications. New, important and useful, functions such as multicasting to allow all students in the class to read someone's questions, and Chat-room via the Palm for each class, are planned for implementation. The use of wireless technology to set up Webcast in the classroom to enhance teaching, and Search Engine on the Palm to enhance learning, is projected. Scheduling and eForm, will reduce the paperwork associated with our educative practices. We have identified the following capabilities for our future implementation:

1. **Multicasting, and Chat-room**: Students designate questions as unicasting or multicasting. A Chatroom is established.
2. **Webcast**: Students download Palm version notes for the lesson; instructors send a quiz or other learning materials.
3. **Search engine on Palm**: Students and instructors input a keyword to search any topics of interest, or learning materials.
4. **Scratch graphics for Questions, and eBook**: The scratch graphics function converts graphs into Palm displayable format. The eBook function allows users to download useful materials in Palm version.
5. **Two-way scheduling**: Students and instructors download their timetables/events or schedule the many facilities.
6. **eForm**: eForm permits students to download required forms from desktop and then beam it back.
7. **Short message services (SMS)**: SMS (short-message service) via PDA to send messages about the seminar, course or other announcements. We set up a BEAM point for those with PDAs to get the messages/announcements beamed.

Many other extensions for our HHIT project exist subject to limitations on the amount of available resources and the current advances in networking and wireless communication technology.

V. Summary

The HHIT initial capability and its inherent growth offer a new dimension to the instructor-student relationship. The University of Hong Kong is seeking to incrementally empower the education-teaching process. By facilitating student access to their instructor on an "anytime-anywhere" basis, the education process becomes a more natural part of the student's everyday life and activities. Finally, the textual and graphic nature of their interface encompasses the sum total of their requisite interaction. The University of Hong Kong will seek to disseminate and technically transfer this capability.

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WebQuests for Reflection and Conceptual Change: Variations on a Popular Model for Guided Inquiry

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Abstract WebQuests have become a popular form of guided inquiry using Web resources. The goal of WebQuests is to help students think and reason at higher levels, and use information to solve problems. In this paper we present modifications to the WebQuest model drawing on primarily on schema theory. We believe these changes will further enhance student reflection and deeper conceptual change through the use of WebQuest activities in the classroom. The revised model is illustrated in a makeover of a sample WebQuest.

WebQuests have become a popular form of guided inquiry using Web resources. The goal of WebQuests is to help students think and reason at higher levels, and use information to solve problems. Thousands of teacher-authored WebQuests are currently available on the Web for use in different subject areas and at all educational levels. Teachers may thus choose to incorporate WebQuests developed by others, or they may develop their own WebQuest as a way to get their students reasoning at higher levels.

Dr. Bernie Dodge of San Diego State University first created the WebQuest model in 1995 (Dodge, 1995). Though he and Tom March articulated a fairly specific model and created many example WebQuests, there is now an even wider range of activities that fall under the WebQuest umbrella. Of course, the WebQuest model is a subset of the larger class of guided inquiry activities in use today. Other guided inquiry activities contain instructional strategies that are not a part of the WebQuest model, e.g., stronger reliance on a case as a resource; higher levels of guidance toward reflection. In this paper we propose modifications to the WebQuest model drawing on primarily on schema theory. We believe these changes will further enhance student learning through the use of WebQuest activities in the classroom. We also discuss ways to help teachers integrate WebQuests successfully into the overall curriculum.

The WebQuest Model: Evolving Over Time

There is no strict format for WebQuest design, and this flexible structure is one of its most appealing attributes (Dodge, 1995). Most WebQuests have the following elements:

1. An *introduction* that sets the stage and provides some background information. The introduction can be likened to an instructional set that stimulates prior knowledge and prepares students for new learning.
2. A *task* or problem to be addressed. This problem-solving task is at the heart of the WebQuest. The task is like the problem in a problem-based learning unit--It is the challenge or conflict to be addressed in the WebQuest activities. Dodge has provided additional assistance to educators attempting to create the WebQuest task through his online training materials. His "Taskonomy" helps educators envision a wide array of possible WebQuest tasks (Dodge, 1999).

3. A clear description of the *process* learners should go through in accomplishing the task. It is here that collaborative teams are formed and roles for each member of the team identified. Specific guided activities are often included in the process.
4. A set of *information sources* needed to complete the task. Since the WebQuest itself is delivered as a webpage, these resources are most typically Web-based, though widely available print or video resources can be identified for student use as well. Some WebQuests provide a common list of resources used by all members of the team; others identify information sources based on team member role.
5. An open-ended *evaluation* system for products created by students as a result of their problem solving. It is recommended that rubrics be used for the purposes of evaluation (Pickett & Dodge, 2001).
6. A *conclusion* that brings closure to the quest, reminds the learners about what they've learned, and perhaps encourages them to extend the experience into other domains.

A number of sites serve as portals or clearinghouses for WebQuests, allowing teachers to search for resources in their areas, including:
Blue Web'n (http://www.kn.pacbell.com/wired/bluewebn/),
The Matrix of Examples (http://edweb.sdsu.edu/webquest/matrix.html), and
The WebQuest Collections (http://edweb.sdsu.edu/webquest/webquest_collections.htm).

Many of the more innovative WebQuests will include unique design elements. Some developers have offered formal variations on the WebQuest model. March (2000), for example, has made modifications to the original WebQuest structure. Spartenburg (2001) presents a model for CyberInquiry projects that, at once, are more open and more linear in progression than WebQuests. Rather than seek out information from prespecified locations, CyberInquiry students conduct more open searches as part of a clear line of inquiry.

Schema Theory and Guided Inquiry

WebQuests can be seen as part of a broader movement within education that was heavily influenced by the paradigm shift away from behaviorism and toward cognitive psychology in the 1970s and 80s (Mayer, 1992). Schema theorists of that era advocated an approach to education that valued deep conceptual change over simple behaviors (Norman, 1976). Following this schema-based approach, students use their existing knowledge to make predictions and address problems (Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1985). By engaging in a number of inquiry and problem-solving activities, students undergo a conceptual shift that leads to new schemas and ways of seeing the world--as well as specific procedural skills for dealing with that world. At beginning, middle, and end of problem-solving activities, students reflect on their changing schemas and their growing understanding. Math and science have been particularly fertile areas for schema-based curricula because new schemas can provide the hooks for making the computational details meaningful and stable in memory (Perkins & Simmons, 1988).

STAR.Legacy is a promising instructional model developed by Vanderbilt's Cognition and Technology Group that is based on conceptual-change principles (Schwartz, Lin, Brophy, & Bransford, 1999). The basic framework is an inquiry cycle with repeated opportunities for reflection and prediction. STAR is an acronym for Software Technology for Action and Reflection. The authoring tool, currently in prototype form, is intended to support the development of multimedia units for encountering and solving authentic inquiry challenges through small-team collaboration and research activities.

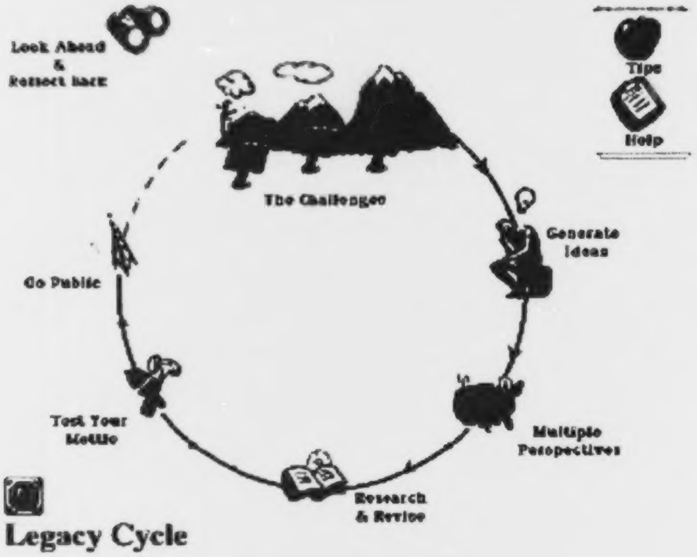

Figure 1: problem-solving cycle embodied within the STAR.Legacy instructional model. From http://peabody.vanderbilt.edu/ctrs/ltc/brophys/legacy1.html.

In a website overview, Sean Brophy provides a succinct description of the STAR.Legacy approach (see http://peabody.vanderbilt.edu/ctrs/ltc/brophys/legacy1.html):

> The learning cycle begins with the presentation of a challenge in either audio or text format. Then students are asked to reflect on the challenge and to "Generate Ideas." Once they've articulated their thoughts, then they listen to "Multiple Perspectives" from various experts. These experts provide hints about things to think about when solving the problem. However, these hints do not provide a specific solution to the problem. This allows users to compare their naive first impressions with the experts to help them notice their lack of differentiated knowledge.

This initial sequence is similar to a WebQuest, but takes things a little slower. Students are asked to use their existing knowledge to think about the problem and generate some initial ideas. They are then exposed to other points of view about the problem. All of this precedes formal inquiry using outside sources.

> Now they are prepared to engage in a process of "Research and Revise." This stage of the learning cycle organizes resources into meaningful learning activities designed to help them focus on issues related to the initial challenge.

This is like a WebQuest's process activities, with students using various Web resources to learn more about the subject.

> Once they feel they've learned enough they can go to "Test your mettle." Here they engage in a set of activities that helps them explore the depth of their knowledge. The goal is to create assessment situations that help them evaluate what they do not know so they can return to the "Research and Revise" section to learn more.

This cycle of "testing mettle" and returning to resources is more elaborate than the WebQuest model and requires a more fully developed instructional unit.

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> Students progress to the "Go Public" stage after proving to themselves that they understand the content well enough to express a solution to the challenge.

Students "go public" with their solution, but they also "look ahead and think back." The reflection involved in the process--from beginning stages using limited knowledge, to final stages at the conclusion of inquiry--creates greater opportunities for students to undergo conceptual change rather than simple incremental addition of new facts. As Brophy explains:

> This cyclical process of active research and reflection on the process provides an excellent opportunity for students to generate their own understanding of the content knowledge.

A Variation on the WebQuest model

STAR.Legacy units require more comprehensive resources and design than most teachers are able to include in a WebQuest. Even so, WebQuests can do more to encourage reflection and active use of knowledge. Our project incorporates elements of the STAR.Legacy model to create a more schema-based approach to WebQuest design (see Fig. 2 below).

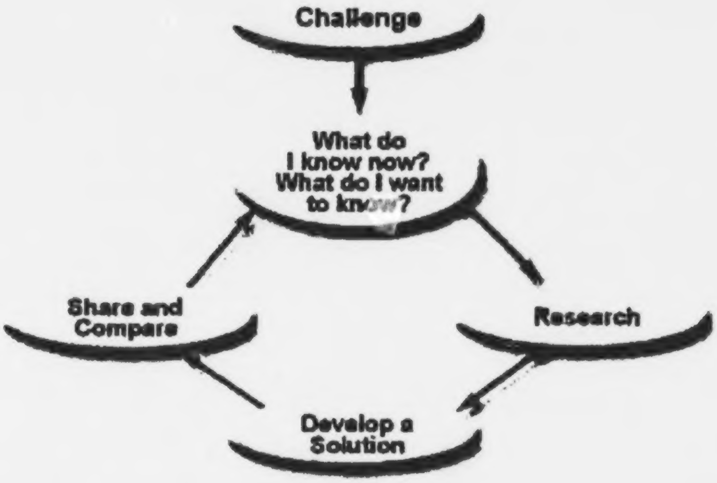

Figure 1: A four-stage reflection process can be triggered by an outside assignment or by continuing work of an individual of team.

This cycle of reflection can be prompted by an external challenge, as in WebQuests, or by the natural and continuing interests of team members. We see this reflection cycle as a variation on the Star.Legacy and K-W-L models of inquiry learning (Ogle, 1986).

Specifically, the WebQuest model is revised at two main points:

1. What Do You Think? following the task. Students need opportunities to test and use their initial understandings before engaging in specific search activity. We suggest that once students have been introduced to the Task in step 2 of the WebQuest, they be given a chance to propose possible solutions to the problem based on their current knowledge and understandings. What Do You Think? requires team members to pool their initial knowledge concerning the topic of research, and to present that knowledge as a basis for inquiry.

   There are specific advantages to adding this step. First, by allowing students to articulate possible solutions to the task or problem, both students and teacher can identify students' existing knowledge.

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Second, this first pass at a solution provides a benchmark against which students can compare their conceptual growth over the course of the WebQuest. Third, the collaborative discussion that occurs as students share their ideas allows them to understand the thinking of the other members of their team (van Zee & Minstrell, 1997). And finally, it may become apparent to the teacher, based on the solutions generated at this stage that one or more steps of the WebQuest activity need to be revised. For example, it may be discovered that the information sources identified in step 4 of the WebQuest are inadequate. Or, a teacher may uncover that the task itself needs to expanded or narrowed to make the job of problem solving more meaningful to students.

2. Share and Compare. Students also need time to debrief and reflect with others as they complete WebQuest activities. The Conclusion step of most WebQuests often seems to be an afterthought rather than an essential component. We believe that this step should allow students to take an active role in assessing their conceptual growth throughout the course of the WebQuest experience. This could be easily done by comparing and contrasting the final team solution to the problem or task with their initial attempts at problem solving articulated in the new "What do you think?" step that we have added earlier. Share and Compare provides a structure for the public sharing of research findings, then feeding those findings into further inquiry questions.

   Public sharing of findings allows all students in the class to experience the solutions offered by each of the teams. This opens up opportunities for large-group analysis of the solutions and further opportunities for conceptual development. Active sharing will also allow the teacher to help link the understandings and knowledge that students gain from the WebQuest experience to the rest of the curriculum for the course. This linkage back to the curriculum is an oft-neglected aspect of WebQuest use.

A Modified WebQuest

To illustrate how a typical WebQuest can be modified for increased reflection, we have conducted a makeover of a WebQuest preparing 5th grade students for a field trip to Southern Colorado (see http://ouray.cudenver.edu/~dl0young/adam/html_files/ for the revised site). In this WebQuest, students study a site they will visit and prepare inquiry questions relating to that site.

Three pages are added to the site to increase support for reflection and conceptual change: Teacher Page, What Do You Think? and Share and Compare. The Teacher Page presents the learning objectives for the site and suggestions for appropriate use. The Teacher Page also presents the four-stage model (see Fig. 2 above). As part of the What Do You Know? activity, students brainstorm together to pool their initial knowledge about their site. In the Share and Compare page, students submit their research questions and are prompted to review and compare questions from other teams. Once the teams have contributed questions, the whole class, working under the teacher's direction, can decide how to use the questions as they physically visit the geographic sites. Alternatively, the visits can be conducted virtually, with similar kinds of sharing and reflection activities.

Contextual Use of WebQuests

It is important to remember that WebQuests are not isolated instructional activities. Instead, they are intended for use within the larger context of course objectives and curriculum. Encouraging greater reflection by active students will increase the likelihood that they will successfully link the activity back to the principles and ideas of the curriculum. Achieving this connection between specific activities and general principles is a challenge for education. We see WebQuests as powerful tools to help meet that challenge.

In some instances, a WebQuest may be used as the instructional set for a larger unit of work. In other instances, it may be a culminating activity. Because the ability of students to think and reason at higher levels varies widely, a teacher may elect to implement a particular WebQuest in different ways from class to class. In fact, a teacher's first administration of WebQuest will most likely vary significantly from their later use of the strategy. In general, we need to examine closely how teachers choose to incorporate WebQuests into their everyday activities.

The Need for Continuing Research

The rapid rise of the WebQuest as an educational practice has outstripped the research community's ability to provide a solid theoretical foundation for its use. This is no different than other technologies that rise rapidly into use. The many approaches to WebQuest design further complicate efforts to study the impact of these interventions. We see this dynamic and diverse state of affairs as a healthy condition that now provides a fertile opportunity for research of various forms.

We have proposed modifications to the original WebQuest model. The key issue for research, however, may not be finding the perfect model but, rather, finding ways to help teachers make best use of these models in their teaching practices. We intend to continue studying how teachers make use of models and frameworks, and how they adapt these frameworks to their own purposes and conditions. Over time, we hope to better understand conditions and strategies that will help students develop higher-order reasoning skills.

References

Dodge, B. (1995). Some thoughts about WebQuests. Online:
http://edweb.sdsu.edu/courses/edtec596/about_webquests.html

Dodge, B. (1999). WebQuest Taskonomy: A Taxonomy of Tasks. Online:
http://edweb.sdsu.edu/webquest/taskonomy.html

March, T. (2000). WebQuests 101: Tips on choosing and assessing WebQuests. In Multimedia Schools Magazine, October 2000. Online: http://www.infotoday.com/MMSchools/oct00/march.htm

Norman, D., Gentner, D., & Stevens, A. (1976). Comments on learning schemata and memory representation. In D. Klahr (Ed.), Cognition and instruction. Hillsdale, NJ: Erlbaum.

Ogle, D. M. (1986). K-W-L: A teaching model that develops active reading of expository text. The Reading Teacher, 39 (6), 564-570.

Perkins, D. N., & Simmons, R. (1988). Patterns of misunderstanding: An integrative model of misconceptions in science, mathematics, and programming. Review of Educational Research, 58(3), 303-326.

Pickett, N., & Dodge, B. (2001). Rubrics for Web Lessons. Online:
http://edweb.sdsu.edu/webquest/rubrics/weblessons.htm

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. Science Education, 66(2), 211-227.

Schwartz, D. L., Lin, X., Brophy, S., & Bransford, J. D. (1999). Toward the development of flexibly adaptive instructional designs. In C. M. Reigeluth (Ed.), Instructional-design theories and models, Volume 2: New paradigm of instructional theory (pp. 183-214). Mahwah NJ: Erlbaum. Also online:
http://peabody.vanderbilt.edu/ctrs/ltc/schwartzD/STAR.Legacy.html

Spartenburg County Schools District 3 (2001). CyberInquiry. Online: http://www.spa3.k12.sc.us/cyberinquiry.htm

Strike, K., & Posner, G. (1985). A conceptual change view of learning and understanding. In L. H. T. West & A. L. Pines (Eds.), Cognitive structure and conceptual change. New York: Academic Press.

van Zee, & Minstrell, J. (1997). Using questioning to guide student thinking. The Journal of the Learning Sciences, 6 (2), 227-269.

Integrating the Internet in ESL Education in a Senior High School

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Abstract: This qualitative study explores the potential impacts of one application of the Internet--on high school-level English, including 29 students and an instructor. Based on the findings, the researcher concluded that the Internet could motivate student learning and provide students with a less stressful environment to write down their opinions and thoughts freely on the Internet, but the Internet alone could not improve student English writing in terms of grammatical proficiency. Recommendations were made for maximizing the educational benefits, and minimizing the limitations, of using the Internet in the Internet English classroom to develop the confidence and writing ability of students.

Introduction

With the rise in the popularity of information communication technology among the younger generation, there is a pressing need for the integration of technology in education and for further study ondomain-specific effects. Obviously nowadays English is the mostly used language in cyberspace. This need is particularly acute for the domain of teaching/learning English as a second language because of the features of the Internet and the abundance of English learning resources freely available on the Internet. Currently, for example, more and more websites intended to be free English virtual learning and teaching environments for listening, speaking, reading and writing have been sprouting up on the Internet over the past few years.

The emerging applications of the Internet in educational settings have energized learning (Ian, 1999; Lee, 2000; Krajka, 2000; Gerald, 1998). The Internet has the potential to provide a new learning environment that has rich digital textual, graphic, audio, video and other interactive features for the language learning approach as well as for culture (Muehleisen, 1997). The Internet is considered a key-factor in enhancing the learner's motivation for both language learning and linguistic proficiency (Lee, 2000). In recent years, language teachers are exploring ways in which information communication technology can be employed to make language learning more effective and motivating for students (Kern, 1995; Vallance, 1998; Bricknall, 1999; Donaldson& Kotter, 1999; Wible, et al., 2000). According to Muehleisen (1997), reasons for using the Internet in the English classroom are as follows:

- Learning to use computers provides a strong intrinsic motivation for learning English;

- The Internet places English in an international contexts;
- Internet projects are interactive;
- Facilities for using the Internet are often readily available.

On the Internet, students have the chance to communicate and collaborate with other remotely distributed classmates, peers, or teachers by using e-mail. Communication over the Internet can help learners create, analyze, and produce information and ideas more easily and efficiently. Research shows that by using network computers, students can be empowered by the capacities of the technology and become better problem solvers and better communicators (Frizler, 1995; Belisle, 1996; Al-Kahtani, 1999). The communicative potential of Internet-supported classes has recently become the focus of much attention in the fields of education and research (Kern, 1995; Warschauer, 1997). With the integration of information communication technology in language learning, new kinds of activities, such as electronic communication via e-mail or chatrooms, have also been developed to help students (Liao, 1999; Kokkas, 1999). Different modes include synchronous and asynchronous interactive e-mail, Webchat, MOOs, IRC-multimedia activities, Web-based reading, and task-oriented activities. Each mode fosters a different kind of linguistic competence, and calls for various skills (Negretti, 1999; Liou, 2000; Oliver, 1996). Meanwhile, teachers also face many challenges (Singhal, 1997). Such contexts have been shown to facilitate students' willingness to participate in discussion, as evidenced in the increased volume of language output.

This Study

The study employed both qualitative and quantitative methods. The researcher used a multi-method approach to document and evaluate the process of integration of the Internet in the English leaning settings, including the collection of their electronic data from chats, discussions, dialogues and email exchanges on the Internet, observations of their online classroom activities, formal and informal interviews with the instructor, and a post-class questionnaire.

Specific questions explored in the study include the following:

1. Can students learn the functions of the Internet via the English language and significantly improve their English e-talk on the Internet?
2. What are the benefits or difficulties with the use of Information Technology in the teaching of English as a Second Language?
3. What are the issues and challenges that arise in the integration of the Internet in English learning contexts?

The research project was conducted at a vocational high school in the northern part of Hsin-chu city. The course was geared to intensive study and was named Internet English; it was offered by a young male English teacher. The goal of this course was to use various methods to facilitate students' Internet usage by way of English writing. A two-hour on-line lecture plus a computer session was held on Tuesdays in a computer lab where thirty Personal Computers were set-up and networked. In the lab the teacher lectured on some introductory aspects of the Internet and its functions andat the same time demonstrated its uses and gave students opportunities for practice using English and exploring the Internet. In addition to the weekly lecture and computer session, the after-class activities and assigned tasks were required of each student. The online lecture was divided into four sections, with each section focused on one of the following topics: the World Wide Web, Newsgroups, Email and MOOs. To carry out the after-class projects and assignments, the students, therefore, needed to connect to the Internet and search for the required materials in response to the teacher's weekly questions and, meanwhile, they were required to use English to communicate with the teachers as well as with the other classmates. Moreover, all of the students needed to write "letters" to email pen pals in other countries such as Japan, U.S.A., and Korea and address several topics posted by the teacher.

The participants in this study were 29 third-year high school students: 22 females and 7 male students plus the young male teacher. The course was conducted in two semesters: autumn/fall semester, from September 2000 to January 2001 and spring semester from February 2001 to June 2001. The results reported here are mainly based on the data for the first academic semester of the project, fromautumn 2000 through spring of 2001.

Findings

Overall results of the use of information technology in the class

The teacher used an open-ended question to solicit student overall response to the use of the information technology in the class. This question was, "Do you think Internet English can really improve your English? Tell me why." Most students thought the Internet was an interesting and useful tool in their Internet English class. Statistical data indicate that nineteen out of the twenty-three students (19 out of 23, 82.16%) held positive attitudes toward this class, while three out of the twenty-three (3 out of 23, 13%) had negative attitudes and one gave an irrelevant answer (1 out of 23, 4.4%). The benefits they gave varied and included the following: 1. Being able to practicing typing (5 students); 2. Learning more English (4); 3. Being more motivated in learning new vocabulary (4); 4. Being able to learn more about the computers (4); 5. Communicating with others using Emails and making friends from other countries (4); 6. Looking for information on the Internet and enhancing reading comprehension by reading materials on the Internet (3); 7. Meeting people (2); 8. Talking on line (1); 9. Being able to correct mistakes instantly (1). Negative reasons included 1. Not liking the Internet (1); 2. Too much vocabulary resulting in learning pressure (1); The fast-paced schedule of the class (1).

Students' English learning/improvement in terms of the use of the advanced technology

After Reviewing thoroughly the in-depth qualitative data from student discourse and based on the interview data with the teacher, the researcher concluded that the Internet could motivate student learning and provide students with a less stressful environment to write down their opinions and thoughts freely on the Internet, but the Internet alone could not improve student English writing in terms of grammatical proficiency. The most common mistakes students made in their e-writing could be categorized into the following six groups: 1.) Spelling mistakes; 2.) Not capitalizing a proper noun; 3.) Incorrect word combination; 4.) Single and plural disagreement; 5.) Incorrect phrases; and 6.) Grammar errors.

Throughout this study, the qualitative data from sentence analysis indicated that students did not really improve much in their grammar usages in making sentences, but the students could express themselves freely on the Internet. Each correct sentence was almost of the same length, since longer sentences were more likely to contain more grammar mistakes. Results from this study suggest that most students welcome computers as a powerful tool to be integrated into English learning. The use of computers and computer networks does not seem to pose concerns for most of the high-school students. Student could benefit a lot from the use of the Internet for many different reasons, including greater volume of English utterances rather than the grammatical proficiency. This study indicated that integration of information technology in the Internet English facilitates the creation of a virtual environment that thus transforms learning from a traditional passive experience to one of discovery, exploration, and excitement in a less stressful setting.

However, data collected from formal and informal interviews with the teacher and observations indicated that the teacher, although he was very familiar with the computer functions and was active and enthusiastic in the integration of information technology in the English class to maximize the learning effect, seemed to feel more concerned about classroom management in the virtual classroom setting. He was further occupied with technical assistance in handling computers, troubleshooting problems, and seeking logistical support from staff to help organize digital data generated in the pedagogical settings. In general preparing a network session plus taking care of the after-class online activities demanded up to *three to four times* the class time that a traditional session required. The author hopes that the paper provides some insights toward a better understanding of high school student use of the Internet in English classes in Taiwan. More studies on how to improve student grammar through English writing practice on the Internet should be strongly encouraged.

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References

AlKahtani, S., (1999). Teaching ESL Reading Using Computers, *The Internet TESL Journal*, 5, 11.

Belisle, Ron. (1996). E-mail Activities in the ESL Writing Class. *The Internet TESL Journal, 2*(12).

Bricknall, J. (1999). Promoting writing and computer literacy skills through student-authored web Pages. *TESOL Journal,* 8, 1, 20-26.

Donaldson, R. P., & Kotter, M. (1999). Language Learning in Cyberspace: Teleporting the Classroom into the Target Culture. *CALICO, 16*, 4, 531-543.

Frizler, K. (1995). *The Internet as an Educational Tool in ESOL Writing Instruction.* Master's thesis, San Francisco State University [WWW document].

Kern, R. (1995). Restructuring classroom interaction with network computers: Effects on quality and characteristics of language production. *Modern Language Journal, 79*, 4, 457-476.

Krajka, J. (2000). Using the Internet in ESL Writing Instruction. *The Internet TESL Journal*, 6, 11.

Lee, K.W., (2000). Energizing the ESL/EFL Classroom through Internet Activities. *The Internet TESL Journal*, 6, 4.

Liao, C.C., (1999). E-mailing to Improve EFL Learners' Reading and Writing Abilities: Taiwan Experience, *The Internet TESL Journal*, 5, 3.

Liou, H.C., (2000a). Conceptualization and implementation of an English learning Web site which bridges TEFL theories and practices. *Proceedings of the 4th International conference on multimedia language education*, 2000.10

Liou, H.C., (2000b). Development of the ELT in Taiwan Web site for English Learning and Teaching.

Muehleisen, V., (1997). Projects Using the Internet In College English Classes. *The Internet TESL Journal, Vol.*3, No. 6.

Negretti, R. (1999). Web-based activities and SLA: A conversation and analysis research approach. *Language Learning & Technology, 3*(1), 75-87.

Oliver, D., (1996). Dave's ESL Café on the Web. *The Internet TESL Journal*, 2, 12.

Singhal M., (1997), The Internet and Foreign Language Education: Benefits and Challenges. *The Internet TESL Journal*, 3, 6.

Vallance, M. (1998). The design and use of an Internet resource for business English learners. *ELT Journal, 52*, 1, 38-42.

Wible, D., Kuo, C. H., Liu, A., & Tsao, N. L., (2000). A Web-based EFL writing environment: Integrating information for learners, teachers, and researchers. *Proceedings of ICCE/ICCAI 2000--Learning Societies in the New Millennium: Creativity, Caring & Commitments*, 529-534, Taipei, Taiwan, R.O.C., 01.21-24, 2000.

Group Dynamics in a Synchronized Computerized Competitive Learning Environment: the Effects of Anonymity and Proximity Factors

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Abstract: The present study set out to investigate whether the negative effects associated with face-to-face team competition can be mitigated with the support of networking technologies where opponents' identity or proximity can be manipulated. Results indicated that subjects in the face-to-face team competition condition rated statistically significantly less favorably on inner-group processing than those in the decreased proximity and anonymity conditions. Data analysis on student perception toward classroom climate revealed that subjects in the anonymity condition rated statistically significantly more favorably on classroom climate than those in the other two conditions. The results of this study tend to lean toward the position that to promote effective interactions within learning groups and to cultivate more regulated classroom climate, networked team competition where opponents are not identified may be the preferred instructional strategy to adopt.

Introduction

Competition has been suggested as a means of enhancing the motivational appeal of educational activities, and as a way to foster learner involvement and excitement in the activity (Butler & Kedar, 1990; Clinkenbeard, 1989; Malone & Lepper, 1987). Adding an element of competition between individuals or groups is widely believed to be a motivational-enrichment strategy in play, work, and education (Deci Betley, Kahle, Abrams & Porac, 1981). Despite the fact that competition is encouraged as an appropriate goal structure in the form of various academic contests to motivate people to perform to the best of their ability, the negative side effects of competitiveness on learning has provoked discussion and suspicion. While empirical bases claim that competition has negative effects on learning, past studies were primarily conducted in traditional classrooms involving face-to-face situations. For example, Festinger (1950) found that defensive reactions are more commonly aroused in face-to-face competing groups. Results from Hammond and Goldman (1961) yielded that small face-to-face competing groups was less favorable for group process. High school students in Garibaldi's study (1976) perceived less effective communication within their dyads in face-to-face team competition situations.

Gleaned from the literature on media effects and human factors in telecommunications, face-to-face and mediated interaction differ in many psychological significant ways; nevertheless, evident for such differences on group dynamics have only been examined in decision making situations for small group interaction (Er & Ng, 1995; Jessup, Connolly & Galegher, 1990; Jessup & Tansik, 1991; Valacich, Dennis & Nunamaker, 1992). The effects of face-to-face versus networked team competition where opponents are identified or not on group dynamics in academic learning environments have yet to be explored. Within the limitations imposed by the laboratory conduct of experiments it is rarely possible to examine the issue up till the advent of networking technologies. Thus, the present study set out to examine the effects of anonymity and proximity feature of computer telecommunications on group dynamics within competing groups

A number of questions could be examined within this context. For example, would face-to-face and networked team competition generate different atmosphere of competition, which, in turn, construes different group dynamics within the learning groups and the overall classroom climate? More specifically, would close proximity in face-to-face team competition situations be less favorable for group process? In other words, would face-to-face competing groups suppress inner-group information exchange and sharing due to the fact that competitors sitting next to them might overhear their answers to the posted questions and that what their competitors exhibited during the game will distract them from concentrating on the task at hand? Might opponent proximity, physical separation and/or loss of identification provoke different defensive reactions and behaviors among competitors, which, as a consequence, engender different classroom climate? The data yielded from this research can provide informative and practical suggestions regarding the suitability of embedding elements of anonymity and/or physical separation among competing groups for real-time game-based competitive learning environments.

Methods

Participants

Three classes from the fourth-grade level of one primary school in the southern part of Taiwan were selected. In total, 103 fourth-graders (ages 10-11) participated in the actual study for three instructional sessions in three consecutive weeks. All students in the participating classes had been taking computer literacy classes for two years, and possessed a fundamental knowledge of computer hardware operations.

Learning systems

A synchronous computerized competitive learning system, called Joyce, was devised for the study. Joyce with its origin dated back from 1972, in essence, adopts a board game format that allows learners practice answering multiple-choice questions with competing opponents simultaneously face-to-face or via network (Chang, Yang, Wang, Yu & Chan, 2001). Various functions and rules including shortcuts, funny questions, random number, bump, spaces move control, and icon selection were built into the system to increase its intrinsic motivational values to the user (Yu, Chang, Wang, Han, Chan & Liu, 2001).

The main interface of the Joyce system (see Figure 1) is divided into six parts. Part 1 Question Area presents the item stem and four alternatives through a pop-up window. Part 2 Feedback Area provides information on players' responding status, for instance, who has not keyed in their answers to the question yet, and the correct answer for the question, etc. Part 3 Dice Rolling and Combination Choice Area. After answering each question correctly, a simulated dice will give a random number from one to six. After two questions answered correctly, students can determine the number of steps that the icon can move on the board via three different combinations of the two numbers. Part 4 Route Map. There are 31 stops in each round. In addition to general questions, which are related to a specific subject matter and instructional topic, five funny questions and four shortcuts are included in the route map. Part 5 Icon Window allows the player to choose and change the icon to represent him/her to move around the board game. Part 6 Win/Loose Status Window shows the number of games won by both sides of the competing parties. When the player wins a game, he/she will be promoted to a higher step up the ladder.

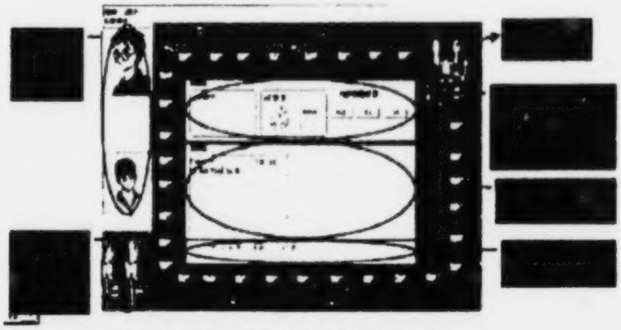

Figure 1: Joyce Learning Environment

Multiple-choice questions corresponding to large class instruction on social studies and natural science in the

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participating school were built in the system for the purpose of this study. Specifically, "Folk custom and life of Taiwan" was taught in social studies. "Omnipresent water," "Underwater creatures" and "Photosynthesis" was taught in natural science. All test items built in Joyce were drawn directly from textbook publisher's test banks and student study guides. Sample items included, *"Which ethnic group in Taiwan like to express their feelings using lyrics and songs during leisure times (Hakka, Fukien, Ya-Mei, A-Mei)? Which one of the following does fish use for breathing under water (skin, gills, lung, scale)? What color will the water with a weak base indicator change if you blow CO2 into it (from blue to transparent, from blue to yellow, from transparent to yellow, from transparent to blue)?"*

Treatment Conditions and Experimental Procedures

To examine anonymity and proximity factors in synchronized computerized team competition environments, three different team competition modes were derived in the study. Considering normal arrangements for computer literacy instruction for fourth graders at the participating school, which is two students per computer, in all treatment conditions students were randomly re-assigned to groups of two to compete with their randomly assigned opponents for the duration of the study.

In Treatment A (the face-to-face team competition condition), pairs of students were competing with their randomly assigned opponents sitting next to them. In Treatment B (the decreased proximity condition), names of the competing teams were announced before the activity but competing teams were intentionally displaced away from each other while interacting in the game via networking technologies. To examine the effect of proximity, competing teams in Treatment B were sitting at least 15 feet away from each other in the computer lab. In Treatment C (the anonymity condition), competing teams were not identified throughout the experiment. Pseudonyms were randomly selected from a list prepared for the study for each dyad and used to log in the system. Pairs of students were competing with unidentified opponents via networking technologies.

To avoid teacher's effect, one elementary school teacher was trained to implement the study. An instructor's manual delineating all the procedures and directions to participants was developed to standardize the experimental procedures. To further secure that experimental procedures were accurately carried out during the study, a training program was provided to the implementer prior to the actual study. Each classroom was observed by the investigator to verify that all experimental conditions were implemented appropriately to ensure experimental fidelity throughout the whole study. In addition, two pilot studies were conducted to ensure that the learning system was operating accordingly and the experimental procedures for each of the treatment conditions was adequately and appropriately implemented prior to commencement of the study.

In the present study, students participated in three instructional sessions in three consecutive weeks. The study was conducted during computer literacy classes in the school's computer laboratory. In the first session, ground rules for participating in the activity, including ?Being on time?, ?Staying in your seats?, ?Raising your hands before posting questions?, and the purpose of the learning activity (i.e., to have student practice answering questions to the instructional content just covered in whole class instruction) were announced and explained via classroom broadcasting system. Various features and the operating procedures of the learning environment were introduced and demonstrated before having students compete answering social science questions with their randomly assigned opponents.

At the beginning of the second session, the ground rules and procedures for running Joyce were reviewed before having students compete answering natural science questions on the system with their randomly re-assigned opponents on computers for the next 35 minutes.

At the beginning the third session, before having pairs of students compete with their randomly re-assigned opponents for the next 15 minutes on social science and natural science questions, the teacher quickly reviewed the basic procedures involved in operating Joyce. Subjects were given a questionnaire to be completed individually afterwards.

Measurement Instruments

A post-experiment self-report questionnaire was disseminated to students to be completed individually. The questionnaire consisted of "Student Perceptual Impressions of In-group Processing," and "Student Perceptual Impressions of Classroom Climate."

A number of scales from previous research were adapted to make the items better fit the experimental task and target population used. Specifically, Yu's (2001) "Perceptions of the Communication Process Within One's Own Dyad" was adopted for "Perceptions of In-Group Processing." Xiang's (1979) "Classroom Environment Scale" and Li's (1980) "Learning environment Scale" was adopted and adapted for "Perceptions of Classroom Climate." Semi-structured interviews with six students purposefully selected from the target audience and expert reviews were undertaken during scale development to ensure validity of the measurement instruments.

The questionnaire consisted a total of 24 Likert-scale items to collect data regarding whether anonymity and proximity influenced in-group processing and classroom climate. Nine items was included to test the hypothesis relevant to in-group processing. Sample statements included, "My teammate and I discussed our answers to the posted question in order to reach consensus; when my teammate had trouble understanding the rules of the game or the question posted, I assisted him/her during the activity." 15 statements were included to test student perceptual impressions of classroom climate. Sample items included, "During the activity, almost all students can keep silent; during the activity, class order is usually out of control; Most of the participants are focused during the activity."

Each statement was rated on a five-part discrete scale, with corresponding verbal descriptions ranging from "strongly disagree" through "disagree," "no-opinion," "agree," to "strongly agree." To counteract possible response-set tendencies, both positive and negative statements were included in the instrument. The questionnaire was scored according to the number of "strongly disagree," "disagree," "no opinion," "agree" "strongly agree" responses a student selected. Each response received a weight of 1, 2, 3, 4, or 5 respectively. Scoring on the negative statements was reversed so that negative and positive responses could be summed and averaged with higher scores reflecting more positive attitudes. The internal consistency reliability (coefficient alpha) for each of the scales on the post-experimental questionnaire calculated after the actual study was .8681 and .7438, for in-group processing and student perceptual impressions of classroom climate, respectively.

Results and Discussion

The means and standard deviation (SD) values for student perceptual impression of inner-group processing and classroom climate for different team competition modes were listed in Table 1. Collected data were analyzed using the analysis of variance technique on each of the two dependent variables followed by Scheffé multiple comparison tests when a significant main effect is found.

	Treatment A, N=34		Treatment B, N=35		Treatment C, N=34	
	M	(SD)	M	(SD)	M	(SD)
Perceptions of inner-group processing	32.2647	(7.4684)	37.5143	(6.2420)	36.2353	(7.0970)
Perception of classroom climate	48.3824	(7.4955)	47.4571	(7.4057)	56.6176	(7.8971)

Table 1: Descriptive Statistics of Different Team Competition Modes on Student Perceptions of Inner-Group Processing and Classroom Climate

According to the data analysis conducted on student perceptions of in-group processing the study found a statistically significant effect for different team competition modes, F (2,100)=5.326, p<.01. Scheffé multiple comparison tests revealed that subjects in Treatment A (the face-to-face team competition) (M=32.2647) rated significantly less favorably on inner-group processing than those in Treatment B (the decreased proximity condition) (M=37.5143) and Treatment C (the anonymity condition) (M=36.2353) at .009 level, and .067 level, respectively.

Data analysis on subject perception toward classroom climate yielded a statistically significant effect for different team competition modes, F (2, 100)=15.065, p<.001. Scheffé multiple comparison tests further revealed that subjects in Treatment C (the anonymity condition) (M=56.6176) rated significantly more favorably on classroom climatethan those in Treatment A (face-to-face team competition) (48.3824) and Treatment B (the decreased proximity condition) (M=47.4571) both at .000 level.

The present study compared the effects of three different team competition modes, i.e., face-to-face, decreased proximity and anonymity team competition, upon inner-group processing and classroom climate. Data from the present study support our proposition that anonymity and proximity are more favorable for group process.

Distinguishing aspects of telecommunications media, that is, anonymity and proximity, did have an influential mediating effect on human behavior in present study. Students participating in the physical separation and anonymity competitive conditions perceived themselves to be focusing more on information sharing and exchanging as compared to the face-to-face team competition condition.

It is suggested by social psychologists that nonverbal information transmitted in a face-to-face situation may involve visual cues that distract the participants from formulation of their own arguments (Short, Williams & Christie, 1976). With competing teams unidentified and dispersed, cooperating pairs tended to encourage attention to the content of a message and task at hand rather than to the nominal characteristics of the face-to-face interacting parties, which may distract from that (Maxx, 1999). In other words, anonymity and reduced proximity minimize the in-group process losses associated with face-to-face team competition situations and induce more task-related interaction and effective communication within groups

The present study also found that networked competition where competitors were anonymous rated significantly more favorably on classroom climate than those in other two treatment conditions. That is, pairs competing with unidentified competitors tended to rate lower toward statements on the subscale like: It was loud and noisy during the activity; The atmosphere during the activity makes it hard for me to concentrate; during the activity, class order is usually out of control, etc," as compared to the face-to-face and physically dispersed team competition modes. That is, with competitors identified, the atmosphere exhibited in the classroom seems to be noisy, out of order, unmanaged, and unregulated no matter variability of competing group proximity.

Conclusions

The capabilities of communication and computer technologies offer interested parties the opportunity not to be identified and be physically separated from each other while interacting with each other within the system. The purpose of this study is to examine the effects of competing group's anonymity and proximity, two important components manipulable with the support of networking technologies, on group process of cooperating dyad. Data from the present study found that anonymity and decreased proximity of competitors is conducive to effective in-group processing and information-sharing behaviors. The results of this study tended to lean toward the position that to promote constructive interactions and to enhance regulated classroom climate, networked team competition where opponents were not identified might be the preferred instructional strategy to adopt, as compared to face-to-face team competition. Gleaned from the results from the present study, it is recommended that designers of competitive game-based learning systems are well advised to include the feature of anonymity in their system to support student learning.

This is the first empirical evidence investigating the potential of network team competition on group dynamics with the support of networking technologies. Future studies with longer duration of experimental time, different age group subjects, content areas, interaction tasks and dependent measures of learning outcomes may be needed to extend the scope and extent of the generalizability of present study. Finally, the present study involved pairs of participants competing with each other in objective-type question-answering practice. As group process are more complex than dyadic ones while engaged in problem-solving questions, further studies involving various group size and different question types might make finer distinction so as to make practical recommendations regarding the particular situations in which anonymity and proximity could be used for the enhancement of learning outcomes.

References

Chang, L. J., Yang, J. C., Wang, C. T., Yu, F. Y. & Chan, T. W. (2001). The Design of Multiple Competitive Activities in a Synchronous Question-Answering Game System with Educational Agents. *Artificial Intelligence in Education, 2001*, San Antonio, Texas, 539-541

Clinkenbeard, P. R. (1989). The motivation to win: negative aspects of success at competition. *Journal for the Education of the Gifted, 12*(4), 293-305.

Deci, E. L., Betley, G., Kahle, J., Abrams, L. & Porac, J. (1981). When trying to win: competition and intrinsic motivation. *Personality and Social Psychology Bulletin, 7*, 79-83.

Er, M.C.,& Ng, A.C. (1995). The anonymity and proximity factors in group decision support systems. *Decision Support Systems, 14*(1), 75-83?

Festinger, L. (1950). Informal social communication. *Psychological Review, 57*, 271-282.

Jessup, L.M., Connolly, T.& Galegher, J. (1990).The effects of anonymity on GDSS group process with an idea-generation task. *MIS Quarterly, 14*(3), 313-321.

Jessup, L.M. & Tansik, D.A.(1991). Decision making in an automated environment: the effects of anonymity and proximity with a group decision support system. *Decision Sciences, 22*(2), 266-279.

Krueger, B. P. (1976). *Teleconferencing in three communication modes as a function of the number of conferees*. Unpublished doctoral dissertation. Johns Hopkins University.

Malone, T. W., and Lepper, M. R. (1987). Making learning fun: a taxonomy of intrinsic motivations for learning. In Snow, R. E. and Farr, M. J. (Eds.), *Aptitude, learning, and instruction*. Hillsdale, NJ: Erlbaum.

Short, J. A., Williams, E., & Christie, B. (1976). *The Social Psychology of Telecommunications*. London: Wiley International, 1976.

Valacich, J. S. , Dennis, A. R. & Nunamaker, J. F. (1992). Group size and anonymity effects on computer-mediated idea generation. *Small Group Research, 23* (1), 49-73.

Xiang, Bi-Di (1979). *The relationship of high school instructional materials, grade level and gender to classroom climate*. Unpublished Master Thesis. Graduate Institute of Education, National Chengchi University, Taiwan.

Yu, F. Y., Chang L. J., Wang C. T., Han, C., Chan T. W. & Liu, Y. H. (2001). Student Preference and Satisfaction Toward Network and Face-to-Face Computerized Competitive Learning Environments. *International Conference on Computers in Education 2001*, Seoul, Korea, 1820-1826.

Yu, F. Y. (2001). Competition within computer-assisted cooperative learning environments: cognitive, affective and social outcomes. *Journal of Educational Computing Research, 24* (2), 99-117.

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WEB-BASED TESTING: DYNAMIC CONSTRUCTION OF ASSESSMENTS OVER THE WEB

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ABSTRACT

The World Wide Web can serve as a complete learning and educational environment and poses new challenges. Testing and assessment are value-added services in a learning process, which aim at evaluating and measuring the outcomes of learning experiences. Developing tests in an instructional efficient and effective manner is a difficult task, especially when this is implemented over the web. In this paper we describe the main features and functionalities of a web-based testing system that deploys state-of-the-art technologies providing the instructors and learners with a powerful web-based testing environment.

1. INTRODUCTION

1.1 Background

An increasing number of researchers and practitioners have been motivated to discuss and develop Computer – based and Web-based testing systems, in recent years. These kinds of systems should provide certain basic instructional functionalities like other web-based learning and education systems (Overbaugh, 1994). On the other hand, instructors must recognize the need to design assessment appropriate to the medium. The component of the assessment in an online learning environment is of great importance. Assessment is an integral, ongoing aspect of learning, which is about gathering, analyzing, quantifying information about learner performance. Comparisons with traditional assessment methods suggest that the use of computer and web-based techniques may improve the overall performance of learners (Bocij and Greasley, 1999). The major benefit of computer-based assessment appears to be the improvement of task-focus. If performance increases and completion time for the test decreases, then computer-based assessment enhance the ability of learners to focus on questions and recall relevant information (Bocij and Greasley, 1999).

2. DEVELOPMENT OF THE SYSTEM

2.1 Goals, motivation and basic concepts

Our work and development effort focuses on answering the following question:

- ➢ How can we provide instructors, teachers, trainers or testing authors the capability to construct tests dynamically over the web in an efficient and effective manner?

The main focus is on the user that has the responsibility to create tests, no matter if he/she is a teacher, instructor (subject matter experts), testing author/designer etc. Additionally two other questions raised our motivation to develop this web-based testing system:

- ➢ How can we provide them (instructors, testing authors etc.) the capability to review the tests' results whenever they want and receive feedback in a manner that will help them to adjust their learning material and courses?
- ➢ How can we motivate the learners (test takers) and provide them with options for receiving more customized feedback?

As far as it concerns the basic concepts, feedback is main concept of our system. Providing feedback is crucial for the orientation and motivation of the learner. In the web-based testing system we developed, a learner is free to choose whether he/she wants to receive feedback while he/she is executing the test. Furthermore a learner is provided with the option to receive his/her own results report either in a text format, or a graphical presentation, pie charts, histograms etc. according to his/her preference and learning style (Honey and Mumford, 1992). Rich feedback is provided to the instructors also through the reporting capability of the system, which keeps tracks of learners' performance and progress. This kind of feedback is of great importance since it helps the instructors to evaluate the success of a learning experience and adjust the learning objectives, courses and learning materials to the level of learners' performance. Additionally, addressing issues like plagiarism and cheating is of high importance in testing environments and these concepts have been taken into account while designing the system. This system has been developed towards summative assessment: Careful design of summative assessment is an approach that can reduce plagiarism. More specifically in *selected response* type of assessments (Rovai, 2000), the construction of a large pool of items can be of great importance in order to produce tests that will be unique for each learner and to reduce cheating or plagiarism (Howard, 1995) (Carnevale, 1999a). Timed tests can also decrease the opportunity to cheat (Rovai, 2000).

2.2 System Architecture

Following the 3-tier Architecture model with a thin client, we use relational database technology for the database layer, Java and Java Server Pages for the application logic, and html and JavaScript technology for the presentation layer. A common browser (Microsoft Internet Explorer 4.0 or Netscape Navigator 4.0 or newer versions) is the minimum requirement for the client.

2.3 Basic System's Modules

The system we developed consists of the following four basic modules:

1) User Management Module: It is the module that enables the administrator of the system to specify the instructors and learners as well as the subjects/topics and groups of learners, respectively. This module also includes i) the management of roles and ii) security issues

2) Authoring Module: It is the module that enables the instructors to construct their own questions and questionnaires (tests), as well as to manage and modify the question pool. This module is about authoring, storing and selecting questions and tests. The main user of this module is the instructor, or testing author. The types of questions supported by the system are the following: 1) True or False, 2) Multiple Choice, 3) Multiple Response, 4) Text Question, 5) Fill in The Blanks, 6) Ordering, 7) Matching and 8) Composite.

3) Testing Delivery Module: It is the module that is responsible for the execution of the tests by the learners.

4) Reporting Module: It is the module that gives both the instructors and the learners the capability to view the results of the tests that are related to them.

3 PILOT TESTING

3.1 Introduction

The evaluation of the system has been carried out in real environment conditions using a selected sample of educators and learners. The objective of this process was to combine the outcomes for the usability and the functional evaluation in order to assess the acceptance of the system by its users, acquire further suggestions concerning its functionality, as well as remove technical obstacles. In order to evaluate every aspect of the system, a distinction between two orthogonal parameters has to be made:

- *User Interface Parameters*, that identifies the level of acceptance of the User Interface (UI) by the users.
- *Functionality Parameters*, measuring the level of compliance of the system with the user requirements, upon which the system development was based.

3.2 Methodology

Usability is considered as a basic parameter of the quality of a system and it was a basic component of the system's evaluation. Particularly in the case of developing software for learning and educational purposes, there is a clear need for the system to become "invisible" allowing the learner to focus at his/her learning tasks. Usability testing has taken place in laboratory settings. The researchers involved in this work conducted experiments with real users. As already mentioned, the testing places were three university laboratories; the testing duration was 2 hours maximum per subject and the experimenters were the system designers. The purpose of this test was to record the reactions and responses of potential users of the system regarding mainly the ease of use, system's potential marketing application and its improvement possibilities. For the testing process a sample test was designed containing 20 various type questions such as open, dichotomously, multiple choice, multiple answers etc. These questions were related to general knowledge questions as well as Marketing and Computer Science specific. These questions were imported into the system comprising the test data for the testing process. The results obtained lead the researchers into formulating specific suggestions for the improvement of the system. It should be clear that before starting the testing session, all users attended a 30-minute introductory presentation of the system functionality and were shown the testing sessions content. The rationale for the latter is that users would become accustomed to the questions mentioned above and as a matter of fact, to be more focused to the measured tasks and user interface elements, during the real testing sessions.

3.3 Preliminary Evaluation Results

As part of the evaluation process, we designed and distributed to the users a questionnaire that has been devised for the evaluation of the system. The questionnaire consists of several sub-sections, each dealing with different aspects of the system: the design of the GUI, the performance of the system, the system's ease of use, the state of the documentation and other issues that a user may be able to identify. For the purpose of the evaluation we have already established 6 evaluation indicators, and we are trying to approach the systems evaluation from these various perspectives. For each indicator we are presenting the results of the system evaluation:

Indicator	Result
General System Issues	Apart from the users' response to question A6, which is related to the ability provided by the system to the user in order for the latter to avoid making mistakes, the judgment of the users regarding the general issues of the system, is positive with a large percentage of the subjects replying very positively or partially positively.
Dialogs, Forms and Menus	The judgment of the users related to dialogs, forms and menus is again positive with a large percentage of the subjects replying very positively or partially positively. In the question "Can the keyboard be used to control the program as extensively as with the mouse?" the response of the subjects was rather negative, whereas regarding the question "When accessing a form, is there a logical grouping of the various choices on the form?" it was probably not clearly understood from the subjects probably due to formulation.
User Interaction and Convenience	The results of the questions related to user interaction and convenience present a great fluctuation. Many negative responses have been recorded regarding the speed of the system, progress notification and short key availability.
Errors and Error Messages	Apart from the users response to question "Are error messages categorized by, for example, a certain subsystem of the program, by an error code or some kind of keyword?", the judgment of the users regarding errors and error messages of the system, is positive with a large percentage of the subjects replying very positively or partially positively.
Help and System Documentation	The results of the questions related to Help and System Documentation present particularity since there is a high percentage of not answered questions. This is possibly due to the fact that users haven't used the help system sufficiently or that this component is not easily accessible or usable. Most received answers were positive apart from the questions related to the provision of examples in the help system and a printable version of it.
Overall Assessment and Evaluation	The overall assessment and evaluation score of the system expresses a generally good opinion of the users. The majority of the answers are above average level, whereas a high percentage is between 7 and 8 out of 10 (Very Good).

Table 1: Evaluation indicators and results

4 FUTURE WORK AND IMPLICATIONS

Next steps in our research include the development of the next version of the system by taking into account users' feedback derived from the pilot testing. Further use of the system and the preparation of a large-scale experiment in educational settings (universities and training organizations) have been planned for usability testing purposes. Future enhancements concerning next versions of the system will include:

a) The addition of question types that require multimedia features and

b) The integration of the testing system with other learning systems such as Learning Management Systems etc.

Finally, another important issue to be taken into account is interoperability and the conformance with standardization efforts such as IMS-QTI (IMS-QTI Specification, 2000), etc.

REFERENCES

Bocij, P., and Greasley A., "Can computer-based testing achieve quality and efficiency in assessment?", International Journal of Educational Technology, Vol. 1, No. 1, 1999 http://www.outreach.uiuc.edu/ijet/v1n1/bocij/ (Last access December 2001)

Carnevale, D. (1999a). *How to proctor from a distance.* The Chronicle of Higher Education, 46, A47-A48

Honey, P. and Mumford, A., "The Manual of Learning Styles", Maidenhead, 1992

Howard, R.M. (1995). Plagiarisms, authorships, and the academic death penalty. *College English*, 57, 788-806

IMS-QTI Specification, 2000 http://www.imsproject.org (Last access December 2001)

Overbaugh, R. C., "Research-Based Guidelines for Computer-Based Instruction Development", Journal of Research on Computing in Education, Vol.27, N. 1, Fall 1994, pp.29-47

Rovai, A. (2000). Online and traditional assessments: what is the difference?, *The Internet and Higher Education.* Vol. 3, 141-151

Case Study: Cognitive Flexibility Theory and the Evaluation of Re-purposable Learning Activities

Purpose: The purpose of this study was to examine the re-purposability and reusability of "learning activities" used in two courses within the domain of cognitive psychology and explored the role of Cognitive Flexibility Theory with respect to instructors' use of learning activities.

Introduction: The main purpose of this study is to investigate the role of Cognitive Flexibility Theory in the development of learning activities for use in online course in the domain of cognitive psychology. Cognitive Flexibility Theory emphasizes the flexible reassembly of preexisting knowledge to fit the needs of new situation. (Spiro et al, 1987) We believe that it is important for instructors of courses to be cognitively flexible when developing and re-purposing learning activities for their courses. In order to attain cognitive flexibility, instructors must have a working mental model of the actual domain, which leads to the re-purposability of the learning activities. Mental models provide "an explanation of why procedures work." (Black, 1992) It is "an image of the different parts and objects of a mechanism together with procedures for transforming these parts and objects to form a mental simulation." The focus of this study is on the cognitive flexibility exhibited by the instructors rather than the students of the courses.

A learning activity can be as simple as a graphic or as complicated as a whole curriculum. The granularity of a learning activities can be broken down into two levels, a Fundamental Information Object (FIO) or a Combined Information Object, (CIO). An FIO is defined as a unit independent of context. For example, a single graphic of a gear would be considered an Fundamental Information Object. An FIO has the highest degree of reusability. (Wiley, 1998) A CIO results from combining several FIOs. This results in added context but lower granularity. For example, several gears put together with a direction arrow and a question asking in which direction will the last gear turn is a CIO.

The goal is to create Generative Instructional Learning Activities that allow for the repurposing of learning activities. A repurposable object is developed when an FIO is taken from a CIO and repurposed for a new CIO. Not all FIOs can combine together to form a meaningful CIO. An analogy of this would be similar to how atoms combine to form molecules. Not all atoms are able to combine together. Furthermore, certain atom combinations lead to changes in the overall structure of the molecule. We believe that FIOs should not be repurposed for all domains. In order to do so, the creators of the learning materials must be able to be cognitive flexible when developing the learning activities.

Case Study: Two graduate courses in the domain of cognitive psychology were used in this study. The study was conducted after the semester ended. The first course, Theories of Human Cognition and Learning focused on theories of Cognitive Psychology and related empirical results. Cognitive Psychology includes such topics as memory, learning, comprehension, problem solving and attention. The second course, Cognition and Computers, focused on applications of theories and results from artificial intelligence and cognitive psychology to try to improve uses of computers and related technologies in education. Separate instructors, with similar backgrounds in the field of cognition and learning, taught the courses.

Both instructors created learning activities specifically for their respective courses. Once the learning activity was created, it was stored in an online distance learning platform to which both instructors had access. As the instructors were creating their modules (CIOs), they could look online at the other instructor's course with the intent of gathering learning activities that could be re-purposed for their own use. The learning activities were created as the semester progressed and either instructor could check to see if new objects had been added. There was no enforced structure of looking, nor did the instructors discuss uses and implications of these objects between themselves.

Discussion: The fundamental question was whether the re-purposing of these objects was feasible and if instructors were able to be cognitively flexible. Although the focus of the courses differed, reciprocal exchange of learning activities was prevalent. For example, one instructor created a CIO learning activity with specific instructional intent, which included images, lecture notes, journal article readings and a learning activity. The other instructor used the images (FIO) to create another CIO with a different learning purpose. Thus, through this re-purposing of the learning activity, the second instructor was displaying cognitive flexibility.

Because there was no active communication between instructors, and the sharing of learning activities occurred naturally, we believe that the instructors demonstrated cognitive flexibility when designing their own learning modules. The instructors indicated in interviews that they were able to be cognitive flexible in their development of the materials because they were both familiar with each other's courses and understood the original purpose of the learning activity. The results point to a need for further evaluation of learning activities a feasible instructional design tool as well as a measure of instructor cognitive flexibility.

Implications: This study is important because it demonstrates a successful case for collaborative instructional design. Both courses were enriched because the instructors were able to draw upon common resources and still develop unique learning activities for each course.

This also allows instructors to become more productive with the development of their course materials and cuts down on redundancy of effort. Another implication of this case study points to a deepening of content knowledge and reasoning of instructors because in order to be cognitively flexible with the learning activities themselves, instructors must know how and when the use the objects appropriately. If the instructors are more knowledgeable about the content and are cognitively flexible, they can pass on this knowledge to their students more readily.

References:

Black, J. (1992). *Types of Knowledge Representation*. CCT Report 92-3.

Gentner, D., & Stevens, A. L. (1983). *Mental Models*. Hillsdale, NJ: L. Erlbaum Associates,1983.

Gibbons, A. S., Nelson, J., & Richards, R. (2000). The nature and origin of instructional objects. In Wiley (Ed.), *The instructional use of learning objects*. Bloomington, IN: Association for Educational Communications and Technology.

Spiro, R. J., Feltovich, P.J., Jacobson, M.J., & Coulson, R.L. (1987). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In Jonassen (Ed.),*Constructivism and the Technology of Instruction: A Conversation.* Englewood Cliffs, NJ: Lawrence Erlbaum Associates

van Merriënboer, J. J. G., (1997). *Training complex cognitive skills: A four-component instructional design model for technical training*. Englewood Cliffs, NJ: Educational Technology Publications.

Wiley, D. (2000). Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In Wiley (Ed.), T*he instructional use of learning objects*. Bloomington, IN: Association for Educational Communications and Technology.

Zielinski, D. (2000). Objects of Desire. *Training*, 37(9), 126-13

The Status of Web Accessibility of Canadian Universities and Colleges

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Abstract: The fundamental ideal that access to education and information as one of our basic human rights must not be neglected in the electronic information age. This ideal however is not being met in the area of postsecondary web accessibility. This study surveyed 350 postsecondary institutions in Canada to see their level of web accessibility using the Centre for Applied Special Technologies accessibility tool, Bobby. It was found that 14.9% of postsecondary institutions surveyed met the priority 1 checks as established by the World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI, 1999), and only 1.7% were free of both priority 1 and priority 2 errors. The specifics of these errors however, reveal that with the recognition of the issues for those with disabilities and the web, they can be easily addressed.

'The power of the Internet is in its universality. Access by everyone regardless of disability is an essential aspect.' - Tim Berners-Lee (WAI, 2001)

The fundamental ideal that access to education and information as one of our basic human rights must not be neglected in the electronic information age. With many facets of our society's information taking a digital form, the Internet has become the primary source of information for many, including those with disabilities. Applications such as the World Wide Web, video conferencing, and email provide disabled people with the potential to participate in, and contribute to, education in a way that would never have been thought possible ten years ago (Booth, et. al, 2000). Many people with disabilities today use a variety of assistive devices to participate in the digital world. Screen readers, Braille embossers, screen magnifiers, and voice recognition technologies give some disabled people the ability to render electronic information accessible. But even with the use of such devices, there is no guarantee that they will be able to access the information. Poorly designed Websites, no matter what assistive device is used, will continue to hinder the user from deciphering and accepting the message and information contained within. Since the end-user cannot count on either standard technology or other enabling devices to ensure access to information on the Web, the onus is on the Web developer to deliver the message in such a way that allows everyone to benefit (Canada, 1998).

Approximately 4.2 million Canadians and approximately 7.4% of the post secondary student population have some type of disability; it is mandatory that information on the Web is accessible to them. University and College Web pages serve as the gateway for many student activities such as checking grades and class schedules, even down to the simplest task of finding phone numbers. It is in the best interest of the institution, students, and prospective students, that all information is made available and accessible. This goal however, must at present be an institutional initiative, as the guidelines and laws in this area are yet to be established in Canada.

Canada currently has no laws governing the accessibility of electronic and information technology. Although Section 5 the Canadian Human Rights Act does protect citizens against any discriminatory practice in the provision of goods, service, facilities, or accommodation customarily available to the general public

(Canada, 1976), there is no federal legislation that governs Web accessibility. There are however guidelines that have been established within two federal government departments: the Public Service Commission of Canada and the Treasury Board of Canada Secretariat.

The Treasury Board Secretariat, a federal government agency whose mission is to help the Government of Canada manage its human, financial, information and technology resources, established *The Common Look and Feel for the Internet* (Canada, 2000), a set of standards and guidelines. These guidelines, based on the World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI, 1999), were approved on May 4, 2000 with the goal of having all government Websites meet both priority 1 and priority 2 checkpoints by December 31, 2002.

The Employment Equity Positive Measures Program Directorate of the Public Service Commission of Canada is an independent agency responsible for safeguarding the values of a professional public service: competence, non-partisanship and representativeness. In conjunction with the Adaptive Technology Resource Centre at the University of Toronto, they have developed the Universal Internet Access Project (Adaptive Technology Resource Centre,_1996), which aims to provide information and research on ways to enhance the provision of accessible information on the Internet. The project has created tools for Web site evaluation and guidelines for Web accessibility.

Although Canadian agencies, both are based on the W3C's Web Accessibility Initiative (WAI, 1999) which aims to provide accessibility of the Web through five primary areas of work: technology, guidelines, tools, education and outreach, and research and development (WAI, 2001). The Web Content Accessibility guidelines as recommended by the W3C in May of 1999, have become the defacto standard for the identification and resolution of Web accessibility issues, and serve as the basis for the development and authoring of accessible Web resources. These guidelines also serve as the basis of post secondary Web accessibility studies and Web accessibility evaluation tools, such as Bobby (Center for Applied Special Technology, 2001).

A number of U.S research studies have been conducted using Bobby as a Web accessibility validation tool. Although these studies range in focus from distance education to library Web information, all found a large gap between the actual and ideal for Web accessibility. The research has shown that the current status of university, library, and distance education Websites are fraught with accessibility obstructions. At the very best, the accessibility figures fall between 30% and 40% (Schmetzke, 1999). In a study that evaluated the accessibility of a random sample of Web pages of 400 prominent colleges and universities in the U.S., Rowland and Smith (2000) found that only 22% had front pages that would receive Bobby approval. In a follow up study by Walden, Rowland and Bohman (2000) the number rose to 24%. In a similar study, Schmetzke (2001) examined the Web pages of 219 post-secondary distance education institutions and found that 15.1% were free of major accessibility errors. The trend continues with 21% accessibility for a study on the accessibility of Web sites of 80 college of communications and schools of journalism (Guthrie 2000), and 27% of 89 special education program homepages (Flowers, Bray and Algozzine, 1999).

These studies show that there is a need for the identification and evaluation of Web accessibility issues at the post secondary level. These types of studies however, are not evident in the evaluation of Canadian post secondary institutions. Therefore, this study evaluates the accessibility of post secondary Canadian institutions top-level or entry level Web pages.

Evaluation tool

Bobby is a free application developed by the Center for Applied Special Technology (CAST) that analyzes Web pages for their accessibility to people with disabilities (CAST, 1998). It analyses Web pages based on the Web Content Accessibility Guidelines 1.0 as proposed by the World Wide Web Consortium's (W3C), Web accessibility initiative (WAI, 1999). Bobby establishes three levels of priority errors based on the checkpoint's impact on accessibility:

- *Priority 1.* Priority 1 errors are those that seriously limit a page's accessibilty. Every effort must be made by the developers to ensure that these errors do not exist. Satisfiing this checkpoint is a basic requirement for some groups to be able to use Web documents.
- *Priority 2.* Priority 2 errors are those that the Web content developer should satisfy. Otherwise, one or more groups will find it difficult to access information in the document. Satisfying this checkpoint will remove significant barriers to accessing Web documents.

- *Priority 3.* Priority 3 errors are those that a Web content developer may need to address. Otherwise, one or more groups will find it somewhat difficult to access information in the document. Satisfying this checkpoint will improve access to Web documents (WAI, 1999).

Bobby checks for all three priority errors in its evaluation. The number of each priority error in each page is displayed in the tool and the specifics of these errors are displayed in a summary report. There are a number of errors however, that cannot be detected in the automated process. For this, a list of user checks is generated that the user must manually go through while evaluating the site. In order to be recognised as a Bobby "approved site," which is equivalent to WAI Conformance Level A designation, the site must have no priority 1 errors. This includes both priority 1 errors detected by Bobby and the manual user checks. It is highly recommended however, that all Priority 2 checkpoints also be satisfied, when evaluating sites, since WAI Conformance Level AA is now frequently required by U.S government agencies and others (CAST, 2001).

For this study the downloadable version of Bobby 3.2 was used to evaluate the pages and generate a summative report. Priority 1 and Priority 2 errors were summarized for this study.

Research Methodology

A list of 357 post-secondary Websites were identified from the Canadian Information Centre for International Credentials (CICIC, 2001). This list, based on information supplied by the ministries and departments responsible for education in Canada, is the only Canada-wide list of all postsecondary institutions recognized by the competent governments in Canada (CICIC, 2001). Seven of these were excluded from the study due to sites under construction, duplicate sites, and those links that were down at the time of the study. Of the remaining 350 sites, 166 are universities and 184 are colleges.

Each URL from the list was viewed and the URL was changed if it did not represent the top-level information page for the institution. For example, if the site provided a splash page with the option for an English version or French version of the page, the English version was chosen to represent the top-level information page.

The list of sites were imported into Bobby for evaluation. Priority errors were evaluated within each site and the summative report was generated. The results from this report were then entered into an Excel speadsheet for analysis.

While Bobby did identify items that require manual user checks before approval can be granted, most studies of a great number of sites (e.g., Rowland & Smith, 2000; Walden, Rowland & Bohman, 2000) do not perform these manual checks due to the time constraints of evaluating the source code of all these sites. These checks however must be done in order to display Bobby approval.

Results

Table 1 summarizes the results of the Bobby examination. Of the 350 post-secondary sites evaluated, Bobby found that only 14.9 % (n=52) of the University and College top-level Web pages were free of priority 1 errors. Within this group only 8.7 % (n=16) of the college Websites and 21.7 % (n=36) of the university Websites were error free.

	Number of Sites (n=350)		
	Colleges (n=184)	University (n=166)	Total (n=350)
Bobby Approved	16 (8.7%)	36 (21.7%)	52 (14.9%)
Free of Priority 1 Errors	16 (8.7%)	36 (21.7%)	52 (14.9%)
Free of Priority 2 Errors	24 (13.0%)	15 (9.0%)	39 (11.1%)
Free of Both Priority 1 and Priority 2 Errors	3 (1.6%)	3 (1.8%)	6 (1.7%)

Table 1: Canadian Post-Secondary Website Evaluations

The most common Priority 1 errors identified in the evaluation were contained within three categories: images without alternative text 69.4 % (n=243) and image map hot spots without alternative text 19.1% (n=67) and not giving each frame a title 16.9 %(n=59). Other priority 1 errors that were found were, not providing alternative text for applet's 2.6% (n=9), not providing alternative text for all image-type buttons in forms 1.4% (n=5), and not having each frame referencing an HTML file 0.9% (n=3).

It is also worth noting that only 1.7 % (n=6) out of the 350 sites passed both Priority 1 and Priority 2 errors, which is required to meet the *Common Look and Feel for the Internet* guidelines (Canada, 2000).

Discussion

The finding that 14.9% of Canadian University and College initial Web pages would be classified as a Bobby approved site, which is equivalent to WAI Conformance Level A standards, is significantly lower than similar to findings for prominent US university and college initial Web pages (Rowland & Smith, 2000; Walden, Rowland & Bohman, 2000). This means that over 75% of college and university sites in North America contain errors that seriously limit their accessibility to the disabled. Universities and colleges recognize that the Web is one of their most important methods of communicating with their potential clientele. One can imagine that a university or college president would be terribly embarrassed it if the front page of their site displayed a "broken graphic" image, or contained a broken link. There would undoubtedly be a very sharp message to the University Webmaster that this should be fixed immediately and that it shouldn't happen again. This is exactly what the disabled person encounters when they encounter a page with a Priority 1 error.

It is unlikely that any organization would intentionally alienate 7% of its clientele. It is more likely that post-secondary administrators and Webmasters are unaware that their Web sites are being read (or not) by the disabled, and what they must do to make them accessible. We charge that a post-secondary initiative be established to raise the awareness and educate administrators and the public about equal access to information. Guidelines for post-secondary institutions should reflect this goal.

Conclusion

Bobby 3.2 was used to examine the accessibility by the disabled of the front pages of the universities and colleges in Canada. Approximately 85% of these pages were found to contain Priority 1 errors and more than 95% contain either Priority 1 or 2 errors. This is totally unacceptable. The Government of Canada has set December 31, 2002 as a goal for having government Websites free of Priority 1 and 2 errors. While it is not mandated, it would appropriate for post-secondary institutions to set a similar goal. While it is likely through ignorance, there is a long way to go before we meet these standards. We need to take action to bring this issue to the attention of senior administrators in University and colleges to raise the awareness and prompt immediate action.

References

Accessibility & Technology. Learning Technology & Distance Education. Division of Information Technology (Do-IT). University of Wisconsin-Madison. (2000). Summary results of the accessibility analysis of UW-Madison department Websites. Retrieved October 21, 2001, from http://wiscinfo.doit.wisc.edu/ltde/access/dept-summary.htm.

Adaptive Technology Resource Centre and Diversity Management Directorate. Universal Internet Access Project (1996). Retrieved October 28, 2001 from http://www.utoronto.ca/atrc/rd/uiap/

Bergob, M. (1995). *A portrait of persons with disabilities*, Retrieved October 21, 2001 from http://www.statcan.ca/english/IPS/Data/89-542-XPE.htm

Booth, P, Gregor, P, Rowan, M, and Sloan, D. (2000). Ensuring the provision of accessible digital resources. *Journal of Educational Media, 25*(3), 203-216.

Canada. (July 1998). *Internet Guide* (3rd ed.). Retrieved October 28, 2001, from http://www.canada.gc.ca/programs/guide/3_1_4e.html

Canada (2000). Common Look and Feel for the Internet. Retrieved October 28, 2001, from http://www.cio-dpi.gc.ca/clf-upe/index_e.asp

Canada, Department of Justice. (April 1976). Canadian human rights act. Retrieved October 28, 2001, from http://lois.justice.gc.ca/en/H-6/26172.html#rid-26186

Canadian Information Centre for International Credentials (2001). Full List of Recognized Postsecondary Institutions in Canada. Retrieved December 15, 2001 from http://www.cicic.ca/postsec/volume2/db/listfull_en.asp

Center for Applied Special Technology. (August 2001). *Bobby 3.2*. Retrieved October 28, 2001, from http://www.cast.org

Center for Applied Special Technology. (2001) *Bobby 3.2 Manual*. Retrieved October 21, 2001, from http://www.cast.org/Bobby/ManualforDownloadable622.cfm

Intergovernmental On-line information kiosk. (2001). Retrieved August 23, 2001, from http://www.intergov.gc.ca/edu/index.html

Rowland, C. (2000). Accessibility of the Internet in postsecondary education: Meeting the challenge. Paper presented at the Universal Web Accessibility Symposium 2000. Web Net World Conference on the WWW and Internet, San Antonio TX. Retrieved October 31, 2001 from http://www.Webaim.org/articles/whitepaper.

Rowland, C., & Smith, T. (1999). Web Site Accessibility. The Power of Independence (Summer Edition), 1-2. Outreach Division, Center for Persons with Disabilities: Utah State University.

Walden, B., Rowland, C., & Bohman, P. (2000). Year One Report, Learning Anytime Anywhere for Anyone. Unpublished report to the U.S. Department of Education, FIPSE/LAAP.

Schmetzke, A. (1999). Online distance education - "Anytime, anywhere" But not for everyone. *Information Technology and Disabilities, 6*(2). Retrieved October 28, 2001 from http://www.rit.edu/~easi/itd/itdv07n2/axel.htm

Stewart, R. (1999). *Distance education and individuals with disabilities*. Paper presented at the 1999 CSUN conference. Retrieved October 21,2001, from http://www.dinf.org/csun_99/session0179.html. Reprinted in *Information Technology and Disabilities*. (1999). 6(1). Available: http://www.rit.edu/~easi/itd/itdv06n1/article3.html.

Web Accessibility Initiative (WAI). Retrieved October 20, 2001, from http://www.w3.org/WAI/

Young, J. R. (1998). For students with disabilities, the Web can be like a classroom without a ramp. Chronicle of Higher Education, 44(27), 5. Retrieved October 28, 2001 from http://chronicle.merit.edu/data/articles.dir/art-44.dir/issue

A RDF Implementation Model for Personalized E-Services Composition in Adaptive E-Learning Systems

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Abstract: In this paper, an instruction sequence constrained learning objects composition approach is described and its RDF (Resource Description Framework) implementation model is introduced. Semantically sequential composition of learning objects in the recursive mode is featured at metadata level to allow agent access learning objects automatically in the assigned instruction sequence. The model supplies RDF based dynamic linker to combine learning objects within personalized deployment. Our current implementation is based on Jena API.

Introduction

Term "learning objects" is used by the Learning Technology Standards Committee to define small instructional components, i.e. learning object, as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning (LOM, 2000). LOM also tries to enable computer agents to automatically and dynamically compose personalized lessons for an individual learner. How to combine instruction sequence design with learning object composition is still an important issue especially when e-learning services are going to be dynamically composed or accessed for agents.

Gagné etc. (1985) refer to the learning conditions as building blocks for instruction since they influence the learning outcomes. In his theory, objects of learning consist of five categories of learning outcomes. With these various types of learning outcome and conditions of learning, there are nine general instructional events to facilitate maximum learning and to support the internal process of learning. Based on Gagné's theory and point view of software architecture, we proposed a semantically sequential composition model for learning objects to support the capability for dynamically composing learning services. To present multiple granularities of learning objects and instruction processes, the model is recursive as shown in Figure 1 and 2 in which nine steps processes are presented as problem description (PD), objective description (OD), stimulate recall (SR), learning object presentation (LOP), learning guide (LG), doing practice (DP), sending feedback (SF), testing & assessing (TA), and enhance retention and transfer (SRT). There is iterative interaction between LOP and LG to get assigned learning object in the LOP. LOP can be further presented as learning processes (LP) flow in which each LP has similar multiple steps process but at finer granularity level. We believe this kind of recursive pattern presents a generic principle existing in the must of learning process of engineering technology area.

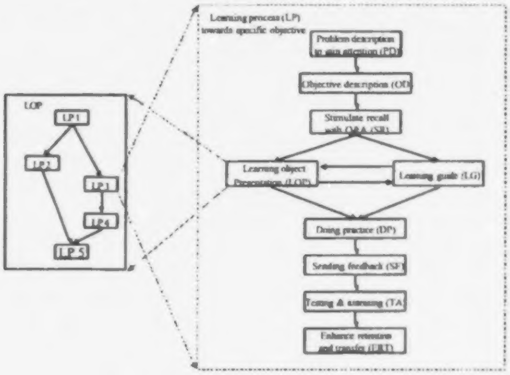
LOP
LP 1
LP 2
LP 3
LP 4
LP 5
Learning process (LP) towards specific objective
Problem description to gain attention (PD)
Objective description (OD)
Stimulate recall with Q&A (SR)
Learning object Presentation (LOP)
Learning guide (LG)
Doing practice (DP)
Sending feedback (SF)
Testing & assessing (TA)
Enhance retention and transfer (ERT)

Figure 1 A recursive multi-step model of learning processes

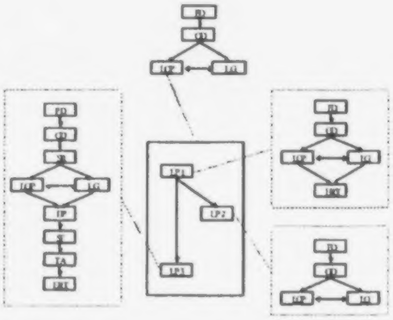
PD
OD
LOP
LG
TA
LP 1
LP 2
LP 3

Figure 2 Composition of learning processes

Implementation model in RDF

RDF provides a standard data model for representing machine-readable semantics of information. We use RDF to model instruction sequence logic for the suggested learning process (LP), as shown in Figure 3. In the model, URIs (uniform resources identifiers) of sequential instruction steps such as PD, OD, ERT, and LOP etc are kept in <rdf:Seq> container. The iteration between LOP and LG is further modeled in <rdf:Bag> container with certain retrieve method to present LG constrained LOP, and this <rdf:Bag> container is presented as a resource SOP/LG in the ordered list of resources in <rdf:Seq> container. The URIs of learning object such as text, presentation, questions, exam, etc. are kept in <rdf:Bag> and <rdf:Seq> containers respectively. The learner feature is also attached within <rdf:Bag> container to present learner model.

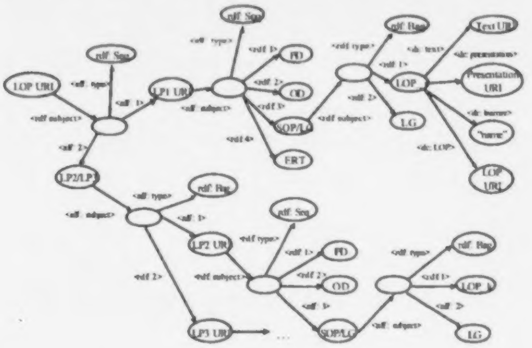
rdf:Seq
rdf:Seq
LOP URI
<rdf:type>
<rdf:1>
LP1 URI
<rdf:subject>
<rdf:subject>
<rdf:type>
<rdf:1>
PD
<rdf:2>
OD
<rdf:3>
SOP/LG
<rdf:4>
ERT
<rdf:2>
LP2/LP3
rdf:Bag
<rdf:type>
<rdf:1>
LOP
<rdf:2>
LG
<rdf:subject>
Text URI
<dc:text>
Presentation URI
"name"
<dc:LOP>
LOP URI
rdf:Bag
<rdf:type>
<rdf:subject>
<rdf:1>
LP2 URI
<rdf:2>
LP3 URI
...
rdf:Seq
<rdf:type>
<rdf:subject>
<rdf:1>
PD
<rdf:2>
OD
<rdf:3>
SOP/LG
<rdf:subject>
rdf:Bag
<rdf:type>
<rdf:1>
LOP
<rdf:2>
LG

Figure 3 RDF model for the learning processes

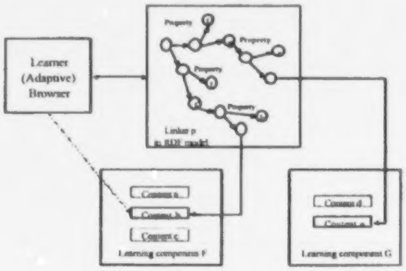
Learner
(Adaptive)
Browser
Property
Property
Property
Property
Linker p
in RDF model
Content a
Content b
Content c
Learning component F
Content d
Content e
Learning component G

Figure 4 RDF model as contents linker

The described RDF model of learning process can be used in the several different ways to support adaptive e-learning systems. Our current project intends to use this RDF model for:

- Dynamic virtual linker between learner and learning objects, as shown in Figure 4, or linker between distributed learning objects.
  The language-oriented RDF query/inferences engine provide basis for semantically driven hyperlink services, and support run-time computation of links and anchors in addition to statically defined links and anchors that defined at authoring time of learning objects. Upon learner profile, dynamic linker may be able to maintain personalized linking configuration to fit individual learner.
- Learning process annotation.
  Annotation is ability to annotate learning objects and learning process without the need to modify the resource itself. The designed learning process RDF model can be used to allow embedded or external annotation of linker.
- Tracking learning process for learner own using
  Track is a way to help learner especially part-time learner's study to keep thinking stream, memory, and reminder, etc. during discrete learning process. Add track sub-model and associated triples based on learning process RDF model can maintain dynamic track record.
- Making learning plan
  By retrieve RDF based instruction sequence logic, agent can help to make learning plan or schedule upon available time constraints, workload standard, and assigned due time parameters.

References

[1]. Gagné, R.M. (1985). The conditions of learning (4th ed.). New York: Holt, Rinehart & Winston, Inc.

[2]. Danny Ayers, etc., Professional XML Meta Data, Wrox Press, 2001

[3]. David A. Wiley, II, Learning object design and sequencing theory, Ph.D. dissertation, Brigham Young University, 2000

[4]. LOM (2000). *LOM working draft v4.1* [On-line]. Available: http://ltsc.ieee.org/doc/#LOM Draft

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Peer Modeling Method in Web-Based Intelligent Collaborative Learning System

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Abstract: Collaborative learning approach is one of the most considerable methods which can be used in computer-mediated learning environment, and an important element in this approach is peer modeling, which aims to resolve how to simulate collaborative learning process and to get high performance for students. Some factors should be utilized to build peer model, e.g., knowledge structure, cognitive and behavioral styles, and physiological elements, etc. Among these factors, according to our experiences, knowledge structure is a significant factor due to it represents the learning and instructional objective. In this paper, an effective method about how to build peer model based on the knowledge structure of Chinese Reading in web-based intelligent collaborative learning environment was mainly introduced.

Introduction

Peer model is a core element of the small learning group to construct the web-based collaborative learning environment, which can be considered as a virtual real learner. The different purpose of peer model can be found in intelligent tutoring system (ITS) environment is to facilitate individual learning performance and in web-based collaborative learning environment is to promote individual and collectivity development and to enhance peers' interaction..The term peer model comes from student model, and they are the similar concept. When students are organized into different learning teams to work together and to pursue a common goal, the individual can be called peer.

Some examples about various practical and efficient methods and approaches to build peer model in web-based environment can easily be found, e.g. Kumar and et al. (1995) observes artificial intelligent technology in CALL and discusses some techniques about diagnosis. Eliot (1997) constructs a web-based intelligent tutor which requires information about what student has and has not learnt. M. K. Stern (1997) states that the difficulties in web-based tutoring and some possible solutions. According to his opinion, a tutoring system must have function about recording student actions and make decisions based on these actions. There are some elements should be involved in peer model, e.g. knowledge structure, cognitive styles, behavioral factors, and physiological elements. One of the most important elements is expert's knowledge structure, which can be considered as knowledge point. Our past works focus on how to build and realize knowledge-based student model, which already get a significant achievement and can be considered as a general approach to build peer model (Zhao, J. H., 1997).

When artificial intelligent technology was integrated into collaborative learning electronic system, its efficiency and flexibility must be enhanced. Some emerging issues in this area already have been explored, e.g. intelligent pedagogical agent, student models, tutor models, diagnosis strategies, and knowledge intelligent representation. CITS (Collaborative Intelligent Tutoring System) provides an environment in which the student can interact with one or more, simulated collaborative partners and/or fellow students, to progress towards a common goal of learning (Kumar, V. S., 1992). GSS (Group Support Systems) is a set of techniques, software and technology designed to focus and enhance the communication, deliberations, and decision making of groups. In GSS, software intelligent agent which can facilitate and streamline group problem solving in organizations is applied (Jay F. Nunamaker Jr, 1997; Sen, S. and et al., 1997). Brna, P. & Burton, M. (1997) describes modeling students collaborating while learning about energy, which has the potential for providing better computer-based support in the future – both in respect of providing improved quality dialogues and in terms of comprehending the student's activities. K. Miyahara and T. Okamoto (1998) studies how to develop information filtering system, which gathers, classifies, stores various kinds of information found on the Internet. According to our experiences, intelligent technology can be used to enhance the quality of web-based collaborative learning, e.g. flexible, efficient, and suitable and to facilitate students learning. Peer model is a core component for this purpose to utilize intelligent technology into instructional and learning system. In web-based intelligent collaborative learning system (WebICL), peer model can be used to decision-making, search, find, and utilize the precise instructional strategies in terms of different learner's learning status and to evaluate peer's performance.

Knowledge-Based Peer Modeling

Knowledge-based peer model means how to integrate learning knowledge into intelligent tutoring system to build peer model. In intelligent tutoring system, peer's behavior includes a lot of knowledge processing variables, which can be used to express student's learning status. The process of building knowledge-based peer model includes four stages.

Stage One: Core Factors of Web-Based Collaborative Learning

Some methods can be utilized to find the factor variables which related to simulate peer model, e.g. literature research, documentaries research, questionnaire, and case study. According to our experience, all of them can be used to collect research data very well.

According to our questionnaire research result, core factors of web-based collaborative learning system can be clarified into four levels, which the first level is learning approach level and involves group composition, task features, communication media, conflict identification, conflict resolution, role playing, and collaborative communication skills (Foote, E., 1996); the second level is personal information level, which involves gender, age, region, grade, ethnic, and year-in-school; the third level is peer's cognitive structure level, which involves cognitive styles, behavior styles, previous academic performance, and IQ; the fourth level is curriculum knowledge level, which involves knowledge structure, knowledge points, hierarchy of knowledge points, and knowledge categories. All of these factors in different levels can be used to build peer model. As states above, learning knowledge is an important element to build peer, so it can be considered as the umbrella (Zhao, J. H., 1997).

Stage Two: Discipline Knowledge Elements for Language Learning

A peer modeling approach was developed to simulate knowledge-based peer model, which the core factors of course content can be got from questionnaire and factor-analysis. The different weights should be assigned to each factor in terms of the result of data analysis. This modeling method can be considered as a common approach to build peer model based on different learning materials (J. H. Zhao, 1997). Dr. Mo Lei describes his research result about Chinese reading for grade six in table 1 (Mo Lei, 1989).

Table 1: Chinese Reading Ability for Primary Students in Grade Six

Factor of ability	Language Comprehension Ability	Organizing Coherence Ability	Pattern Recognition Ability	Filtration and Store Ability	Language Sensation Ability	Transferred Ability
Weights	.375	.249	.128	.119	.069	.060

Students in different grade will learn different knowledge, our research addressed in grade three, so we should amend the data described in table 1 to match grade three. The questionnaire is also used to do this work and the amended result can be described in table 2. Comparing the weights in table 1 and table 2, the different weights and the significance for each factor can be clearly clarified.

Stage Three: Basic Static Knowledge Peer Modeling

Based on the factors' weight in table 2, the basic static knowledge peer modelcan be formulated as

$$G = (0.421 \quad 0.256 \quad 0.064 \quad 0.13 \quad 0.061 \quad 0.066)$$

Where G is the objective weight matrix.

When peer register to the WebICL system, he/she will be provided a pretest opportunity. The points of each learning objective will be calculated and the pretest evaluation matrix will be expressed as

$$P = (s_1 \quad s_2 \quad s_3 \quad s_4 \quad s_5 \quad s_6)$$

Where P is the score matrix for peer and s is score that he/she got from each question; s_i is the score for each learning objective; $i = 1,2,3,\ldots 6$.

P's Regression result can be expressed as

$$P = (s_1/t_1 \quad s_2/t_2 \quad s_3/t_3 \quad s_4/t_4 \quad s_5/t_5 \quad s_6/t_6)$$

Where t is the mark of each question; $t = 1,2,3,\ldots 6$.

Table 2: Chinese Reading Ability Structure for Primary Students in Grade three

Ability Structure	Language Decoding Ability	Organizing Coherence Ability	Pattern Recognition Ability	Filtration and Store Ability	Language Sensation Ability	Transferred Ability
Weights	.421	.256	.064	.130	.061	.066

The evaluation result for each peer can be got fromfuzzy evaluation method and can be expressed as

$$\tilde{A} = G \bullet P \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where A represents that each student's synthetical fuzzy evaluation result.

Stage Four: Dynamic Knowledge Peer Modeling

Dynamic knowledge peer model can be simulated based on the basic static knowledge peer model in WebICL system. Tutor and system will monitor peer's behaviors when peer mates start to discuss or negotiate each other in learning group. The system can record and save the group and peer's learning history record. When they finish one topic, tutor will assign the average score to each peer in the same learning group based on the result of intergroup evaluation or other similar approaches. In order to getting the peer's score and the peer performance points, peer should attend the individual formative examination. When the peers are taking a formative examination, two elements will be concerned, which are peer's performance score and the time of peer resolving question which will influence peer's performance score. To get this score about student resolving question, the following strategies will be used (Zhao J. Hua, 1997).

$$Score\_i = \begin{cases} score/times & times <= n \\ 0 & times > n \end{cases}$$

Where *times* is peer to try times to resolve the question; *score* is each question's marks; *Score_i* is the student's factual score of each question.

The time which peer resolving each question spends also influences the peer-performance's score. The following strategies can be adopted (Zhao J. Hua, 1997).

$$Score\_i = \begin{cases} [1 + (spend - spent)/spend] * score/times & times <= n \\ 0 & times > n \quad or \quad spend > 2spend \end{cases}$$

Where *spend* is the average response time (time limitation for problem-solving); *spent* is the factual time which peer spends to resolve question; *times=1,2,3... n*.

The data of static knowledge peer model will be modified when peer finishes the formative examination, and then the dynamic knowledge peer model can be formulated based on the result of fuzzy evaluation. Each item in different test will be organized based on the learning objective by tutor. Peer can get the different evaluation score when he/she answers the different questions and one score matrix will be built. The matrix B can be described as follows.

$$B = \begin{bmatrix} s_{11} & s_{12} & s_{13} & s_{14} & s_{15} & s_{16} \\ s_{21} & s_{22} & s_{23} & s_{24} & s_{25} & s_{26} \\ s_{31} & s_{32} & s_{33} & s_{34} & s_{35} & s_{36} \\ s_{41} & s_{42} & s_{43} & s_{44} & s_{45} & s_{46} \\ s_{51} & s_{52} & s_{53} & s_{54} & s_{55} & s_{56} \\ s_{61} & s_{62} & s_{63} & s_{64} & s_{65} & s_{66} \end{bmatrix}$$

Where B is score matrix of peer; s_{ij} is each score for different objective; $i = 0,2,3,...6$; $j = 1,2,3,..6$.

Peer knowledge dynamic model can be formulated as follows, which it indicates the status of peer's knowledge which already learnt based on different learning objective.

$$\tilde{A} = G \bullet B$$

$$= \begin{pmatrix} 0.421 & 0.256 & 0.064 & 0.13 & 0.061 & 0.066 \end{pmatrix} \bullet \begin{bmatrix} s_{11} & s_{12} & s_{13} & s_{14} & s_{15} & s_{16} \\ s_{21} & s_{22} & s_{23} & s_{24} & s_{25} & s_{26} \\ s_{31} & s_{32} & s_{33} & s_{34} & s_{35} & s_{36} \\ s_{41} & s_{42} & s_{43} & s_{44} & s_{45} & s_{46} \\ s_{51} & s_{52} & s_{53} & s_{54} & s_{55} & s_{56} \\ s_{61} & s_{62} & s_{63} & s_{64} & s_{65} & s_{66} \end{bmatrix} \text{.......(2)}$$

Where A is the result of fuzzy evaluation which represents the dynamic knowledge peer model.

The main feature of dynamic knowledge peer model is that its data will be modified and updated in terms of the learning objective. The score which assigned to dynamic peer model can be considered as one of the components of peer's learning performance which is the average score of group's learning performance.

Peer Modeling in WebICL

Peer model in WebICL involves two kinds which is general peer model and virtual peer model which can be considered as peer agent.

General Peer Model

General peer model in WebICL represents the status of student who registered (logged) in the system. Five basic elements are involved in the general peer model, which they are gender, former learning performance, IQ, and cognitive style. The general peer model can be simulated in terms of these five elements, which it can be described as one-dimension matrix.

$$GPM = \begin{pmatrix} iG & A & iQ & iCS \end{pmatrix}$$

Where GPM means general peer model, iG means gender, A means student learning performance which was introduced above formula (1) and (2), iQ means student's IQ, and iCS means cognitive style. The value of IQ and cognitive style can be got before collaborative learning in web-based environment through psychological survey. A is the result of fuzzy evaluation to student. Three elements are the permanent variables, which they are iG, iQ, and ICS. The result of iG can be got in term of peer's personal registered form; iQ and iCS can be got through psychological survey. The result of iCS mainly used field-dependent and field-independent style field survey and it can be got before peers start collaborative learning process.

Virtual Peer Model (Peer Agent)

Virtual peer model (VPM) can be organized into the same group with general peer model if the number of peer cannot reach the group size. VPM includes three components, which they are knowledge database, strategies database, and deducing mechanism. The virtual peer model can be described as figure 1.

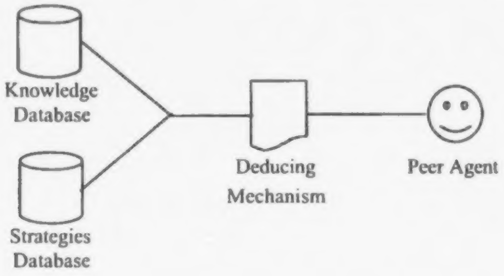

Figure 1: Virtual Peer Model

Knowledge Database

Knowledge database provides knowledge support for virtual peer agent, which it is similar with knowledge database in WebICL. Especially, it is more related to learning task. The structure of knowledge database for peer agent includes five elements, which they are knowledge number, knowledge types, knowledge content, question and answer, and grade level, which knowledge number means knowledge record number in knowledge database, knowledge types means the types of discipline and task, knowledge content is used to record learning content, question and answer represents learning question and its normal answer, and grade level represents which grade level of learning task.

$$KD = (Kn \quad Kt \quad Kc \quad Qa \quad Gl)$$

Which Kn represents knowledge number, Kt means knowledge types, Kc is knowledge content, Qa means question and answer, and Gl is grade level.

$$Kt = (a \quad b \quad c)$$

Where $a = 1, \ 2, \ \ldots, \ n$ means discipline, $b = 1, \ 2, \ \ldots, \ n$ means task, and $c = 1, \ 2, \ \ldots, \ n$ means difficult level.

$$Kc = (d \quad e \quad f)$$

Where $d = 1, \ 2, \ \ldots, \ n$ means content number, $e = 1, \ 2, \ \ldots, \ n$ means content index number, and $f = 1, \ 2, \ \ldots, \ n$ means learning content showed times.

$$Qa = (g \quad h \quad i \quad j \quad k)$$

Where $g = 1, \ 2, \ \ldots, \ n$ means the number of question, $h = 1, \ 2, \ \ldots, \ n$ means the number of answer, $i = 1, \ 2, \ \ldots, \ n$ means the difficult level of question, $j = 1, \ 2, \ \ldots, \ n$ means the question showed times, and $k = 1, \ 2, \ \ldots, \ n$ means the index number of question.

$$Gl = (m \quad q)$$

Where $m = 1, \ 2, \ \ldots, \ n$ means educational level (primary school, junior school, senior school, etc), and $q = 1, \ 2, \ .. \ n$ means grade level.

Strategies Database

Some strategies about how to build the virtual peer model based on the on-line peer's situation in the WebICL system and organize them into different learning group. There are five elements are included in the strategies, which they are strategy index number, performance level, role-playing, peer number, and role gender.

$$SD = (Si \quad Pl \quad Rp \quad Pn \quad Rg)$$

Where Si means strategy index number, Pl represents performance level, Rp is role-playing, Pn means peer number, and Rg means the status of role gender.

$$Si = 1, \ 2, \ \ldots, \ n$$

$$Pi = (Hi \quad Mi \quad Lo)$$

Where Hi means high level, Mi means middle level, and Lo means lower level.

$$Rp = 1, \ 2, \ \ldots, \ 18$$

The value of Rp represents different role in learning group, which it can be described as table 3 (Donelson R. Forsyth).

Table 3: Role-playing in learning groups

Index Number	Role-playing	Index Number	Role-playing
1	Initiator/Contributor	10	Energizer
2	Information Seeker	11	Encourager
3	Opinion Seeker	12	Compromiser
4	Information Giver	13	Gatekeeper and Expediter
5	Opinion Giver	14	Standard Setter
6	Elaborator	15	Group Observer and Commentator
7	Coordinator	16	Follower
8	Orienter	17	Recorder
9	Evaluator/Critic	18	Procedural Technician

$$Pn = 1,\quad 2,\quad 3,\quad 4$$

The value of Pn means the peer number in learning group.

$$Rg = 1,\quad 2$$

Where $Rg = 1$ means peer is male and $Rg = 2$ means peer is female.

Reasoning Mechanism

Reasoning mechanism is the representative of expression and discriminant. The virtual peer model will be formed based on its reasoning result. The condition-decision is the formal approach to realize the reasoning mechanism. The basic decision norm is rules that it defines an applied framework. There are various rules can be used to make reasoning decision. One of the examples is as follows.

```
If <group_number less than three> Then
    Case 1 if group_number=2 then <compare the differentiation of real peer and determine the VPM >
    Case 2 if group_number=1 then < determine other two VPM based on the peer's situation>
```

Conclusions

According to our study, peer model can be used to design and build web-based collaborative learning system and enhance its flexibility and adaptability. Peer modeling should be built in terms of the peer's personal characteristic and learning content of curriculum knowledge. When the number of peer's login is less than the necessary number of one group, WebICL system should simulate virtual peer according to the actual on-line peer. Peer model is an important approach to utilize intelligent technology into web-based collaborative learning system.

References

Brna, P. & Burton, M. (1997). Modelling Students Collaborating While Learning About Energy. *Journal of Computer Assisted Learning*. Vol. 13, pp. 194-205.

Edelson, D. C., O'Neill, D., Gomez, L. M., and D'Amico, L. (1995). *A Design for Effective Support of Inquiry and Collaboration*. School of Education and Social Policy, Northwestern University.

Eliot, C. (1997). *Implementing Web-Based Intelligent Tutors*. Center for Knowledge Communication, Department of computer Science, University of Massachusetts.

Foote, E. (1996). *Collaborative Learning in Community Colleges*. ERIC Clearinghouse for Community Colleges.

Forsyth, D. R. (1990). *Group Dynamics* (2nd Ed). CA: Brooks/Cole Publishing Company.

Jay F. Nunamaker Jr. (1997). Future Research in Group Support Systems: Needs, Some Questions and Possible Directions. *International Journal of Human Computer Studies*. Vol. 47, pp. 357-385.

Kumar, V. S. (1992). *Collaborative Intelligent tutoring System: A Learning Environment*. National Center for Software Technology, Bombay, India.

Kumar, V. S., Srinivas, P., and Anjaneyulu, KSR. (1995). *Artificial Intelligence Techniques in CALL: a Review*. Knowledge based Computer Systems Project, National Center for Software Technology. Department of computational Science University of Saskatchewan.

Miyahara, K. & Okamoto, T. (1998). Collaborative Information Filetering in Cooperative Communities. *Journal of Computer Assisted Learning*. Vol. 14, pp. 100-109.

Mo, L. (1989). *Chinese Reading Research for Student in Elementary School*. Guangdong: Guangzhou.

Sen, S., Haynes, T., and Arora, N. (1997). Satisfying User Preferences while Negotiating Meetings. *International Journal of Human Computer studies*. Vol. 47, pp. 407-427.

Stern, M. K. (1997). The Difficulties in Web-Based Tutoring, and Some Possible Solutions. *Proceedings of the workshop "Intelligent Educational systems on the World Wide Web"*, 8th World Conference of the AIED Society, Kobe, Japan, 18-22 August 1997.

Zhao J. H. (1997). *Student-Model-based Chinese Reading Instruction System for Primary School: Design and Implementation*. Master Thesis Paper: South China Normal University.

Understanding the social context for online learning

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The world of online learning is fascinating and so different from face to face. What are its characteristics? What kind of learning works best in these environments? And how do you take advantage of these characteristics when you are designing your online curriculum?

An online learning environment works most effectively to facilitate the examination of issues from multiple perspectives. People can take time to read, reflect, and respond. This gives a participant a sense of security to say what she really means. The combination of a certain anonymity coupled with a sense of connectedness allows people to open up and take risks to express their thoughts even in areas they are just learning. The environment motivates people to think rather than to take a fixed position- divergence rather than convergence (Zuboff, 1984).

Mathemagica, a five-year mathematics initiative funded by the Department of Education Star Schools initiative, is developing an innovative model for online professional development for K-8 math teachers. Our online professional development philosophy is captured in a statement from the NCTM discourse standards , "When teachers make public conjectures and reason with others about mathematics, ideas and knowledge are developed collaboratively, revealing mathematics as constructed by human beings within an intellectual community.". One component of the professional development is rich multimedia math applets that empower both teachers and students to investigate mathematical topics. For example, one series will allow students to experiment with (and even invent) computational algorithms using base ten blocks, arrays, and number lines. Another component is a sequence of mathematical investigations using the applets combined with readings and reflective tasks that teachers work on collaboratively in teams of 8 facilitated by a moderator. The applets and professional development are being piloted with50 teachers who have a wide range of skill in technology and inquiry math practice.

This paper and presentation will describe the design of an online learning environment used with teachers in a math professional development project. The model builds upon key understandings about the social dynamics of online learning. The session will include key characteristics and strategies as well as several vignettes that demonstrate the model's effectiveness.

Mathemagica's Web site
http://www.mathemagica.org

MoBy: Modular Multiple Media Course Content for On-Line Courses

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Abstract

The MoBy interactive content delivery system addresses the problem of providing complex, well-integrated, multiple media course materials on-line, in a form that is maintainable by content experts, and with a process that is scalable.

The system is delivering content, testing, and tracking in courses as diverse as Chemistry pre- and post-laboratory materials, Arts of Asia, Anthropology, Winemaking, and others. The Andrew W. Mellon Foundation has funded detailed evaluation of the cost-effectiveness of the system that is also being used for research on student profiling and learning styles.

Introduction

MoBy is a development of a system prototyped with a biochemistry course in 1997 and 1998 (...) and demonstrated at an Internet2 conference and the showcase of an EduCause annual meeting (...). MoBy differs from commercially available learning management systems in the full integration of varied multiple media as the natural presentation and interactive modes of learning on-line thereby enriching the learning process.

Design principles

The fundamental design principle is modularity and flexibility within a common framework. This is achieved by combining both the content and its method of display within a single object, the content module or learning object.

The second design goal is control by the content expert. The modularity of the learning objects allows the content expert to rearrange and re-use modules without any restrictions or code changes.

The third design goal is to integrate MoBy with the campus portal that handles course management chores including student registration and grade calculations and reporting.

Implementation

Implementation is based on the three design principles: learning objects; editing by content experts; and integration with course management.

Learning objects, organization and structure

A content module, also called a learning object, is a record in the database table called Module. The Module Table is part of a hierarchy of relational tables. The tables above the Module Table in the hierarchy contain information that is used to organize the modules into lectures and courses. The tables below the Module Table in the hierarchy contain information about the data and files that comprise the content of the module

Editing by content experts

The content may be in any form that can be displayed by a Web browser. Two strategies are used to broaden the range of tasks accessible to a technically unsophisticated content provider. The first strategy involves building the Flash animations using templates that draw their content from database tables. The second strategy is intrinsic to the object-based approach. Content modules can be rearranged, added, deleted, and re-used by making changes to the database contents, which again is achieved through the use of HTML forms that a content provider can easily use.

Integration with course management

MoBy needs to be aware of which students are registered in each course, for tracking purposes and for password-protection of course materials that are governed by copyright fair use or intellectual property restrictions. Registration information resides in a central student information system (SCT BANNER) and is accessed by faculty members and students through a custom portal known as MyUCDavis. Access to this information requires authentication and authorization. Authentication is handled by a separate enterprise-level Kerberos system and authorization is controlled by MyUCDavis using information in the student information system.

Examples of Use

MoBy is used in several undergraduate courses at both lower and upper division level and in a professional school course. These courses include Chemistry pre- and post-laboratory materials, Arts of Asia, Anthropology, Winemaking, Introduction to Biology, Food Science & Technology, Molecular & Cell Biology, and additional courses planned for Winter 2002.

The primary driving force for the use of MoBy at UC Davis is the urgent need to accommodate rising student enrollments, together with a determination that the quality of student education should not suffer in spite of enrollments rising faster than physical facilities can accommodate. The costs and educational effectiveness is being studied with the help of a grant from the Andrew W. Mellon Foundation.

Conclusions

The use of learning objects allows seamless integration of multiple media into course delivery. This allows authors to concentrate on using the best media for each concept or example without the need to embed it in an HTML page and with complete transparency to the user. The learning objects can be easily rearranged and re-used because they contain both the data and the method of display. Eventually, it will be possible to exchange learning objects between systems, allowing the construction of courses using the best available objects from disparate authors.

The Virtual Platform SENEKA - A knowledge management network tool

Dr. Phil. Regina Oertel, Georg Schoeler

Abstract

The Virtual Platform SENEKA - information, communication and knowledge management system of the SENEKA project - is in every-day use since July 2000. Here about 30 partners of the research project get the latest news about meetings, project data, conferences or information with relevance to the research community. The business processes hold up on the Virtual Platform SENEKA via email, document sharing or discussions. Thus, in using the Virtual Platform SENEKA the project participants are able to enlarge their knowledge and learn to integrate information and communication technologies in their daily work. By these means the Virtual Platform SENEKA supports the idea of "live-long learning".

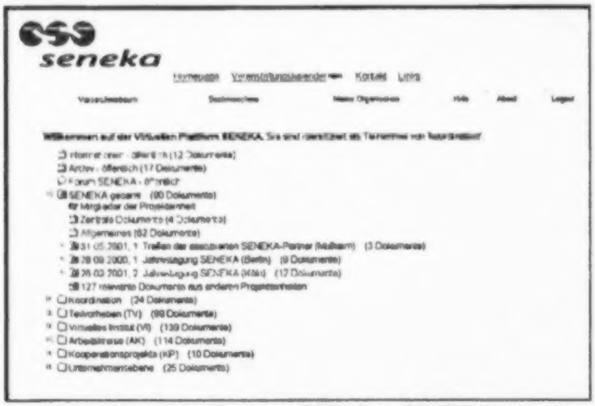

Figure 1: The Virtual Platform SENEKA

Introduction to SENEKA

SENEKA is a large scale entrepreneurial and research project supported by the German Federal Ministry of Research and Education focussing on knowledge management, learning and networking. The project's aim is to enhance the management of information and knowledge as well as to reinforce its usability in innovation processes within small and medium-sized enterprises. To achieve this aim 26 – small and medium-sized as well as multi-national – enterprises in co-operation with 6 research institutions work together in a vivid network. The project started in 1999 and will last until 2004; the total financial volume adds up to about 20 million Euro.

The Virtual Platform SENEKA

The Virtual Platform SENEKA is the web based information, communication and knowledge management system of the SENEKA project. It was designed during the first half of the year 2000 and is in full operation since July 2000. By now the platform is widely utilized by the project participants. It supports the project internal information and communication with the concept of shared working spaces for the different project units. The project partners are able to upload and categorize documents of general interest, inform co-workers automatically or manually via email, start discussions on the new content, manage project meetings with special appointment folders and, of course, search and download documents of their special concern. This features list shows that the platform works an integration of different IT support systems. There are aspects of content manangement system and data management systems as well as project management systems. Moreover, as in the internet, communit ies can be established on certain topic fields.

The basis for the technical implementation of the Virtual Platform SENEKA builds the open-source application server ZOPE, which is an integration of an object-orientated database, a web-publishing system and a web-based programming and administation interface.

The necessity of a Virtual Platform

As mentioned above, SENEKA is a large industry and research project with a very heterogeneous national and multinational partner structure. Already at the start of the project in the year 1999 following reasons showed the necessity to develop a web-based IT-system. Because of the organizational conditions in the co-operation of such different partners, which work on different topics and in different parts of the country. The partner structure represents a

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cross section of completely different habits in the use of IT tools . This lead to the idea to take the project network as experimentation and evaluation field for such a knowledge management tool. The focus of the project belongs to knowledge management, networking and competency development as central topics in SENEKA. On this background it is neccesary to develop best practice solutions which represent an optimal interlink of real and virtual knowledge transfer processes.

Thus the Virtual Platfom SENEKA has a double function in the SENEKA project: It is at the same time tool for the project and also product of the project. It directs to support and organize the knowledge-oriented working processes between heterogeneous senders and recipients by accentuated IT application. Virtuality – as the idea to work and learn independently of time and space – here offers the possibility of dealing with the increasing complexity of information and communication.

Authors & contact

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Weaving the Web for all: Creating institutional policy to support Web access for those with disabilities

Cyndi Rowland, Ph.D.

Overview

Postsecondary institutions must insure that their Web sites can be accessed by those who have disabilities (i.e., faculty, staff, and students). Creating institutional policy and a climate for coordination and reform can be a difficult task. This presentation will begin where reform efforts must begin, with an understanding of the problem. Several multimedia simulations will be presented to enable participants to understand what happens when designers do not keep web accessibility in mind as they build out a site. Following this, participants will hear about an 8-point model for institutional coordination of Web accessibility. This presentation is important because many participants of Ed Media have long been the technologic elite on their own campuses. When these participants return from this conference session they will have practical knowledge regarding Web accessibility. They can then share what they know with administrators and colleagues and thus help their institution begin the work of Web accessibility coordination and reform.

An UnderstandingOf The Problem?

The latest census figures indicate that approximately 59 million Americans have disabilities. Clearly all of those individuals do not use the Web nor are they all blocked from the Web because of their disability status. Reports do indicate that at least 4 million individuals with disabilities ages 16 and older report that they use the Web. However, it may be impossible to determine how many do not use the Web because they cannot gain consistent access, or how many use the Web inconsistently because of accessibility problems. No matter the exact number, we know that there are millions of individuals in the U.S. alone that cannot freely use the Internet because of inaccessible designs.

Empirical investigations on the accessibility of the Internet are relatively new, and current studies are complicated by the use of dependent measures that produce both false positives and false negatives. With this said, there exists a surprising constancy of summary data. As a general statement, less than 25% of Internet pages sampled in the literature are accessible to those with disabilities.

This is a horrendous statement considering the fact that few individuals go to a specific page. If you were to search the Web and could not fully access 3 of every 4 pages, how successful would you be?

Who are these individuals that are affected by inaccessible designs? The range of disability types is wide and represent persons with challenges in vision and/or hearing, motor skills, cognitive skills, and seizure disorders, as well as age-related processes. It is important to remember all of these distinct groups. Often Web developers address the accessibility needs of only one or two groups. The group most typically discussed is the blind. It helps to understand the experiences of all groups of individuals with disabilities. The following provides a peek into their use of assistive technologies, the problems they can experience using the Web, and thoughts for designers who wish to consider the needs of these individuals.

? Vision impairments—Web design can affect three categories of individuals with visual problems. Those include individuals who are blind, have low vision, or experience color blindness.

? Those who are totally blind typically surf the Web through the use of a screen reader (packages include *JAWS*, *Window Eyes*, and *HomePage Reader*). The reader provides voice output that essentially "reads" what is on the screen, although it is really reading the code behind what is seen. When images or elements appear that do not have alternative text placed in the code, the reader defaults to reading anything it can find, such terms as *image* or *graphic* or a file name or even a number or coordinate grabbed remotely from the server. Sometimes the reader skips elements of a page entirely, since it cannot detect that anything is there. The presence of alternative text (ALT tags in HTML code) is particularly important if the images happen to be navigation buttons. Imagine the frustration of an individual who's encountered a page for the University of the Anartic that the screen reader reads as *Welcome, choose what information is important to you today, image1.gif, image2.gif, image3.gif, image4.gif, image5.gif.* Look at the code and see what the screen reader must try to interpret:

```
<html>
<title> University of the Anarctic</title>
<map name= "Welcome, choose what information is important to you today>
<area shape="rect" coords="509,43,565,62" href="image1.gif">
<area shape="rect" coords="428,45,505,62" href="image2.gif">
```

```
<area shape="rect" coords="336,43,422,60" href="image3.gif">
<area shape="rect" coords="266,41,330,60" href="image4.gif">
<area shape="rect" coords="173,44,259,61" href="image5.gif">?
```

? In addition, screen readers rely on the keyboard for navigation, since blind consumers are unable to use a mouse. An alarming percentage of sites aren't keyboard accessible. Certain applications and technologies (including *Flash* and *JavaScript*) can trap a user in a spot where they cannot move forward or backward.

? Experience it yourself: To simulate being blind and using a screen reader, go to

? Those with low vision typically use a screen enlarger such as *ZoomText* to enlarge entire sites up to 400% of typical size (beyond this degree of magnification, the use of a screen reader is typically encouraged). If a designer does not consider this group of consumers, they may use absolute sizing rather than proportional sizing of information on their site. When this happens, the consumer must scroll endlessly side to side as well as up and down to read content or find an important link.? Screen enlarger users can be frustrated when designers use graphic text in their images rather than real text. When images are significantly enlarged, they become so pixilated that they're uninterpretable.

? Experience it yourself: To simulate having low vision and using a screen enlarger, go to

? The largest numbers of individuals with vision impairments are those who are color blind. Since they cannot differentiate between some colors (most often red and green), the use of color alone to convey content poses a problem.? Imagine looking at a Web page showing a subway map with routes that have been color coded (blue line, red line, and green line), then imagine that you can't distinguish between the three colors. The use of the words on that section of the map (*red line*) or the use of symbols (a line of asterisks to denote the green line route, a series of plus signs to denote the red line route, a solid line to denote the blue line route) would provide an easy fix.

? Experience it yourself: To simulate having color blindness, download the free *Opera* browser from . Then turn off all colors (a preference item on the top left bar in *Opera*) and visit See if you can determine when your holidays would be if you were a faculty member.

? Hearing impairments—People are often surprised that the Web can block out individuals with hearing impairments, but that's what's happening because embedding multimedia elements within Web pages is becoming more common. Today, users can log onto CNN or even their local news station to hear current news. They can listen to a history lecture given by a university professor. They can even watch multimedia tutorials on health issues, such as how the cardiovascular system works.? Imagine turning on a TV and keeping the sound off. This is the same experience for those who are deaf trying to make sense of audio content on the Web. Even when a speaker can be seen, lip reading may be impossible because of the size of the speaker on the screen and the inconsistent nature of bandwidth delivery.? The obvious fix is to provide simultaneous captioning for multimedia and transcripts for audio-only elements. Because multimedia development is often time consuming and costly, this aspect must be considered at the beginning of any development effort.

? Experience it yourself: Go to and select any of the eight chapters to view (via either the **QuickTime** or **RealPlayer** browser plugins). Make sure your sound is off and the captions are off. Watch for a while, then turn the captions on. What different does this make for you

? Dual sensory impairments—Individuals who experience both severe vision and hearing impairments are considered to be *deaf/blind*. To use computers, these individuals most often rely on Braille output devices, placing their hands on a tactile display in which tiny pins move up to create Braille symbols which can be read with the fingertips. Because the Braille displays "read" text in the same way that screen readers do, many of the design features that are used to make Web pages accessible to totally blind users also apply to deaf/blind users. Deaf/blind users also need to provide input via keyboard rather than mouse, so pages must be keyboard accessible. Finally, audio must be rendered in a text form so it can be extracted and read via the Braille display.

? Motor Skill Impairments—The range of individuals considered to have motor impairments is great. Individuals with quadriplegia will require an alternative way to get commands into the computer (including devices such as voice recognition and/or switch access) since they are unable to use the keyboard. Those with cerebral palsy may have problems with accuracy of mouse or keyboard access. Some individuals with neurologic conditions can experience extreme fatigue or tremors, affecting mouse or keyboard use. For any of these conditions the designer must understand issues of accuracy (for instance, how small to make the hit box around a navigation link), and fatigue (if an individual can only move from one link to the next by pressing the *Tab* key, how many times must it be hit to get through the site). Understanding how these individuals experience the Web will go a long way toward fixing potential problems that can keep individuals with motor impairments out of your site.

? Experience it yourself: Go to . Using only the keyboard (no mousing allowed!), get to the link on the 5-day forecast for 10,000 cities. Type in your city to see your forecast. As a hint, the tab key will move you from one link to the next. Count the number of times you had to hit this key to move to where you wanted to go. Also, be aware of the tabbing order. If you wanted today's top news, how long would it take you to get to this information?

? Cognitive Impairments and Learning Disabilities—There are many individuals who are cognitively impaired

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(developmentally delayed or have a traumatic brain injury) who would like to use the Web. Moreover, there are millions of individuals with learning disabilities (which are not cognitive impairments) who experience difficulties with Web sites. The most salient problems experienced by both groups of users are their inability to synthesize complex information quickly and their inability to adapt to inconsistent interfaces. It is very likely that a designer who works hard to attend to usability in design will also accommodate this group of users.

? Experience it yourself: Although this is not really a simulation of having a cognitive impairment, go to . This simulates having multiple task demands simultaneously. The "hard" version simulates what it is like to have an inconsistent interface. Often, those with cognitive disabilities express that the Web is too much to process at one time. See how you do in a task overload situation.

? Seizure Disorders-—Some individuals have a particular type of epilepsy called *photoepilepsy*. Seizures can be induced if these persons encounter information that is blinking at a rate from greater than 2 cycles per second to 55 cycles per second. Blinking content is discouraged for this reason. If the designer insists on using it, setting the blink or flash rate to under 2 cycles or greater than 55 cycles can avoid triggering seizures. It also helps to reduce the size of any necessary blinking material.

? Experience it yourself: Go to any irritating blinking ad to see this (e.g., http://webaim.org/training2002/week1/seizuregraphic) Please do not view these if you have photoepilepsy

? Age Related Processes—The largest growing segment of our population is the elderly. As we age, we will likely continue to enjoy the use of the Web. The aging process includes many of the disability types described above. For many of us, we will progressively lose vision, hearing, or motor skills. To the extent that we work to fix the problem of Web inaccessibility, we will work to continue our own Internet enjoyment for years to come.

An 8-Point Process for Coordination and Reform

The Use of the Web in Postsecondary Education

The winds of change have blown over postsecondary education. As Internet technologies transform our educational experiences, so these technologies create a wide chasm. There is a very real divide between students who do and do not have access to the Internet in education today. As our nation grapples with issues of physical access to hardware, software, the Web, and a National Information Infrastructure, decision-makers must be mindful of those with different issues of access. These individuals are those with disabilities and their issues of access are related to the environment of the Internet today.

Postsecondary entities, like the rest of our society, use the Internet more and more for the things that they do everyday. The rapid rise in the use of the Internet as well as the functions of pages within sites grow each day. Today if you were to go to almost any institutional site, you would find that students could at least do the following:

? get information about required courses,
? register for courses,
? look up transcripts,
? order books,
? pay for educational expenses with a credit card,
? take online courses,
? gain access to Web-enhanced courses,
? complete Web-based assignments,
? meet others in virtual student lounges,
? conduct research from library holdings or the Internet,
? take tests online (e.g., MAT), and
? get information from Web-based kiosks about social and community events and issues.

Each day students can find new ways to interact with their education provider as new functions are added to sites. It is clear that the Web is seen as a central element in postsecondary education. So much so that many institutions are dedicating enormous resources to keep up with the advantages that technology holds for students. This access is viewed as desirable, if not necessary, for students to succeed in their educational endeavors and participate in the digital community that has emerged. However, population of students with disabilities are being increasingly shut out of these opportunities.

When institutional sites are not accessible we harm students with disabilities in at least 2 ways. First, they may not have an educational experience that is equivalent to their non-disabled peers. Second, they loose out on opportunities to learn how to efficiently gather Web-based information. It becomes a tail-chasing phenomenon where lack of access reduces skill acumen and fledgling skills further reduce access. In our grandmother's words; "practice makes perfect". Students without opportunities to practice cannot be as prepared to meet their future, one that will include the Internet. The potential failure of postsecondary education would be that systems are not created or sustained to help students with disabilities participate in the Web-based society that is growing with each day.

So what can be done about this important issue? The only way to really get the job done is for institutions of higher education to engage in a system-change effort where they are dedicated to coordination and reform of their Web site.

Institutional Reform Efforts and the Future of Accessibility

On the topic of producing a campus-wide plan of institutional reform, Cynthia Waddell stated, "Just as a removal of architectural barriers requires a plan for implementation, the removal of technological or digital barriers in programs and services requires a comprehensive institutional plan impacting every campus office." (The Growing Digital Divide in Access for People with Disabilities, 2000)

There are many elements to the future success of postsecondary access. The most salient would be (a) commitment, (b) action, and (c) an eye toward new technology solutions. Postsecondary entities must begin to grapple with current inequities and federal mandates. Institutional commitment and coordination will go a long way toward reforming the present crisis. The institutional "actions" that are taken will show the commitment that is present. These actions must include all stakeholder groups: students, faculty, Web designers, departmental units, administrators. Action plans should be created with input from all and should articulate change in small, measurable steps that are place along a reasonable timeline. Systems that include multiple points for input in the process will be more likely to succeed over time.

Principles of Institutional Reform

Institutional reform is not a simple process, but a very complex one whose scope and importance are increasing with the growth of the Internet's use. Before moving on to explaining the specific steps of the process of institutional reform, it is valuable to keep in mind a few key principles.

Principle 1. Understanding the Problem

Always in take into account the size of the problem by taking into account the size of your institution. It is certainly easier to coordinate the actions of 10 individuals than 1,000. Moreover, it is easier to insure coordination across 15 units than 150. Size does matter in coordination and reform efforts in postsecondary education. This is not unlike any corporate environment that struggles to support, monitor, and ultimately comply with internal policies or federal regulations. As you progress through each step of the process, remember that the size of your university may affect decision-making and action.

Principle 2. Understanding the Process

Due to the complexity of the issue of Web accessibility, it requires a solid commitment to the process in terms of people, time, money and facilities. Resources committed by a postsecondary entity also factor into the complexity of the problem. Entities that can appoint someone to chair an accessibility committee as part of their role assignment (e.g., half time for the first year) will do better with Web accessibility than those that cannot.

Also, postsecondary entities that use their resources to create a stable environment for Web development staff will have a better chance delivering accessible sites across the institution. Training and support in accessible design for Web developers are two important elements of this. Salary and career incentives for technical development personnel to stay in postsecondary education are others. Over 1,400 Web masters in postsecondary education were electronically surveyed by WebAIM staff in 2000. Of the 536 response (representing a 38% response rate), most had been in their current position for only 2 years. Just over half of the sample (54%) indicated Web design as their full-time responsibility. Sixty-two percent (n=334) reported that they had learned about at least some aspect of accessibility; most (n=300) reported that they did so on their own and not during any pre-service or inservice training. It is likely that frequent changes in Web personnel would have a negative affect on the accessibility of sites within a postsecondary institution. Postsecondary entities that commit more resources to this issue will also be able to better monitor the accessible design of their Web development staff.

Besides personnel, another resource that must be considered is money. This allows for the allocation of personnel time (as part of role assignments) and for training efforts that will ensue. It is possible to secure outside sources of support. However, you should not count on obtaining these types of support (e.g., grants, donations). Moreover, you should not wait to secure outside sources of support prior to initiating policy efforts. The most reasonable source of funding will come from line items within the institutional budget. It is much like the physical facility changes that were required when the Americans with Disabilities Act was implemented on campus. It is not wise to wait for money from outside sources to begin the process of institutional reform. Your institution could put itself in a vulnerable legal position.

The 8-Step Model of Institutional Reform

There is a model of institutional reform that may be helpful in planning change at your institution. This model is comprised of an 8-step process. Each step is like the spoke of a wheel, and each is essential to the overall function of the wheel. If you miss even one spoke, or if a spoke is weak, you compromise the integrity of the wheel. So, as you begin your journey of institutional reform, we'd like to give you some information to plan for a safe journey.

Step 1. Gaining Administrative Support

Setting out on your journey of accessibility must begin with gaining administrative support at your institution. This backing is important for three primary reasons. The first is that it helps to validate the cause of Web accessibility at your university. This gives it more visibility and verifies a commitment that other members of the institution can then look to in their own dedication. Even in institutions where change can occur from a grass-roots level, it will be important to secure support from those who are charged to make institutional decisions and those who control budgetary items.

Another reason the sponsorship of your administration is beneficial is the value this status sheds on accessibility. Those both outside and inside the institution may see this as more important if the administration is committed to making positive changes. Over time it will help you set policy, create training and support mechanisms, as well as monitor the success of your institution's work.

Step 2. Organizing an Institutional Web Accessibility Committee

Once the administration at your institution supports the importance of Web accessibility, a group should be formed to draft accessibility policies and to see the process through its implementation. It is vital that this group be comprised of other key individuals at your institution. Those chosen should be respected in their individual fields and have the ability to influence change with their colleagues. They must also be able to commit the time necessary to see the process through. In some instances this could be substantial 2-year commitment.

So, who should be part of this process? It is important to remember that every institution will need to approach this process in a slightly different way, thus membership of this committee should reflect these differences. There are typically at least 5 groups of stakeholders who should take part in this process. These groups include: the administration, the faculty, the Section 504 and ADA coordinators, Web designers, and students with disabilities. At least one member from each of these groups should participate in a Web accessibility committee, although it may make sense to have more than one representative for certain groups.

It is important that this committee be constructed in such a way that all members will work constructively toward the goal of helping to create a fully accessible Web for their institution. Please remember that these individuals will report back to the larger groups from which they came. As such, it would be helpful to the process if they were respected within their own groups. Representation and support by all parties is essential if implementation is to be widely accepted. The implementation of Web accessibility at your institution will be much easier and when all of these pieces fit together.

Step 3. Web Policy: Defining a Standard

Defining Web Accessibility

After you gain administrative support and organize an effective Accessibility Committee, the next step is to develop the institution's Web policy. There are 2 important components to the overall Web accessibility policy. The first is the standard, or institutional definition, of Web accessibility. Second is the implementation plan. Taken together, they form the complete policy. What follows is a description of the accessibility standard. Descriptions of the implementation plan will be discussed in Step 4.

One of the first responsibilities of the Web Accessibility Committee will be to draft a document that will be used to define what is meant by the phrase "Web accessibility". Different individuals might define this in different ways. The importance of a clearly defined Web accessibility policy cannot be overstated. This standard will enable everyone to understand the level of accessibility your institution will employ. It will also act as a planning guide for developers; they will know precisely what practices they must include in their design to fit the institutional standard. Furthermore, this standard will serve as the template in any future monitoring effort. This process is not unlike the process of designing the specifications for the production of a car. What laws are in place describing weight and size of specific features or the minimum requirements of certain functionalities? Beyond the basic elements required by law, what special components do you want to add to your product? Will you have air bags or anti-lock brakes? Determine then that the first task of this group is to develop the "specifications" of a Web accessibility definition for the institution.

Composing a Detailed Accessibility Standard

To define a Web accessibility policy for your institution, it is critical to remember 3 things. First, it is important to make sure you compose a detailed accessibility standard. It does little good to announce that your institution will be "ADA compliant" or that "We will insure all our pages are accessible to students with disabilities". Ask yourself, what does this mean? Would others in the institution interpret this statement in the same way? If you were a Web developer would you know if you had created a document that followed institutional policy? If you were monitoring the accessibility progress of this institution, would you know how they are doing? In order to help those that will work with the policy you must first define the standard by which all will comply. Provided below are resources you can consult in forming your own standard. These are 3 sources that will provide you with detailed descriptions of Web accessibility standards and guidelines. Remember that these guidelines are provided as models and references for you. There are no hard and fast rules to setting a standard and there is no right answer. But you must make sure that standard that you choose or create suits your institution.

1. The Web Accessibility Initiative (W.A.I.) of the World Web Consortium (W3C) has studied this topic in depth and has published a set of guidelines which define accessibility. These guidelines have been organized into three priority levels. Priority 1 guidelines are those which must be met for a page to be accessible. Priority 2 guidelines should be met. Priority 3 guidelines may be met (it would be nice if they were, but perhaps not necessary).? ? Because of the credibility and international scope of the W.A.I.- and because of their affiliation with the W3C - the W.A.I. guidelines have served as a basis for organizations setting standards for Web accessibility. Nevertheless, the W.A.I. guidelines as they are currently written may not necessarily fulfill the policy-setting needs of all organizations. It may be beneficial for some organizations to include in their standard other principles of Web accessibility which the W.A.I. has not enumerated. For example, the W.A.I. does not mention the timeliness of accessible content as one of their guidelines. In the case of online courses, it is important the online syllabi be made accessible to students with disabilities at the same time that they are made available to other students, to avoid putting the disabled students behind. Organizations may find other considerations which the W.A.I. guidelines do not address, which are important to the organization.? ? To more specifically study the WAI Guidelines, visit to ?
2. Section 508 of the Rehabilitation Act has a detailed set of 16 items, written in standards language, that define what Web accessibility will mean for Federal agencies. To view the government Web 508 site, visit to http://www.section508.gov/index.cfm?FuseAction=Content&ID=12 ? ? To view a streamlined checklist of the above items, visit the WebAIM site at http://www.webaim.org/standards/508/checklist?
3. Many institutions have created hybrid standards that blend elements of both the WAI and Section 508. Some have even created some of their own standards. These are found in the **Online Institutional Examples** section below.

Review and Revision of Your Accessibility Standard

Once you have a draft of an institutional standard for Web accessibility, it is important that the initial draft of the accessibility standard be sent out for review by others at your institution. Including others in open dialogue will improve the likelihood of adoption and successful implementation of the standard. Institutional ownership that results from this feedback step is often a key to standard success. We would recommend the draft be seen by the groups who have representation on the committee as well as those who will responsible for implementing it (i.e. designers and faculty). Finally, t would be good for the Committee to assume that the draft will be reworked after it has gone out for review, rather than assume that it will receive widespread approval. Most importantly, the members of the Accessibility Committee should insure that all feedback is strongly considered in any reworking of the draft for production of a final policy.

Step 4. Web Policy: Creating an Implementation Plan

In postsecondary education, a priori systems must be created to optimize the participation of all students and staff. It is imperative that we create goals aimed at establishing coordinated systems that enable full access for all. The sooner we create and implement sustainable solutions, the sooner ALL students can participate in their right to experience the power of the Internet for lifelong learning. The community of postsecondary education is a resourceful group of individuals, so the composition of an implementation plan can be accomplished in these environments.

An essential part of creating an implementation plan is to thoroughly document the actions taken by the committee and institution at every step. The Web policy you construct is not only a great way to lay the foundation for your accessibility travel and destination, but it also documents your good faith efforts for others to see. At every step, the policy should leave a detailed and well-documented proceeding for others who may use it as a reference.
When you are constructing your institutional Web implementation plan, there are four areas to consider. They are establishing timelines, setting priorities in terms of what standards to achieve and on what timeline, delegating responsibilities and monitoring the progress. These tasks often do not occur in order, but should be addressed when needed.

Establishing Timelines

The first task in formation of your plan is establishing a time frame for implementation. Depending on the size and scope of need for change at your institution this time frame may extend from weeks to years. It is important to recognize that this is a complex process. Establishing a timeline allows you to sequentially follow the tasks and duties you lay out for all of those participating in Web accessibility at your institution. It also stimulates action and accountability in all involved by creating deadlines by which work must be completed. However, keep in mind that, although initial timelines are an aid in your travel, Web accessibility compliance is an ongoing process and must be established permanently as well as in the short-term beginning phases. Plans should be made for both initial changes and long-term establishment of Web accessibility as a priority at your institution.

Setting Priorities in Terms of Standard Achievement

Due to the complexity of the institutional reform process, setting priorities at the onset along with deadlines for observance is essential. These priorities outline which pages will be required to be compliant in what order as well as the minimum requirements for established deadlines. This process may also take part in phases. For example, one university required that the pages with the top 20% of hits on the institutional Web site were the first priority. These pages, as well as training fell into the first phase, while matters such as gathering further funding fell into a third phase.

Delegating Responsibilities

Once standards and a timeline have been determined, the next step is to delegate responsibility for each of the tasks. This portion of the policy should include a breakdown of each work group's purpose and tasks. As tasks are delegated to specific members of the main accessibility committee, subgroups will form. Who will be included in these groups? When will they meet? A list of campus entities and what their responsibilities are to enforce the university policy should be delineated clearly.

Monitoring Progress

The best implementation plan does no good if there is no accountability. Laying a foundation for monitoring progress and following through is the best assurance that institutional reform will be successful and complete. It is very important that you develop a system by which to identify and maintain contact with individuals who have been assigned specific responsibilities within your plan. The administration can provide this leadership in monitoring and compliance, as well as delegating specific tasks and follow-up to others.

For example, the administration in some higher education entities require that Web masters attend training on institutional policies, sign agreements to follow them and are monitored over time for compliance. Of course such an endeavor would assume that the administration has a way to identify and track ALL individuals who place web content on an institutional sever and monitor accessibility as one feature of broader institutional policies. The framework for these abilities must be laid early on.

There are many different methods emerging throughout the nation on how progress is being monitored. Let us present a few for your consideration. The first is random checks. This is fairly self-explanatory, involving persons being hired to randomly test Web pages for compliance to institutional standards. Another method is a yearly purge, in which all pages not declared compliant by campus designers are swept off the system. This may help to clean rogue content off the system, however, it still does not have a system for verifying whether the sites are actually compliant or not.

Another method is the honor system, where it is assumed that those responsible for development will keep their sites fully accessible. However, this brings up the dilemma of 'Why have a policy if we don't even know whether or not anyone is following it?' A final method is the peer system. In this system, a network of designers is set up to provide mutual feedback, support and idea-sharing opportunities. This association has established policies and meetings. In addition, sites are sent to one another in this peer group for review. This is typically done on a regular basis (e.g., 2 pages, twice a month). The sites are checked against the established policies of the group and feedback is returned to the university Web master as well as the designer of the given page. In this system it is imperative that feedback be supportive, as well as constructive.

Step 5. Gathering Baseline Information

Conducting a baseline is an essential part of institutional reform. Once you have created your institutional policy (the standard and implementation plan), it is time to discover where you lie according to the standards you have set for yourself. This will help you know where to concentrate your efforts and where you need to continue to work.

When conducting a baseline, it is valuable to test approximately 8-10% of all pages on your institutional Web site. It also makes sense that as you randomly sample these pages you insure that you have included pages across all levels and departments. In order to gather this information, you could create a checklist of your institutional standard for Web accessibility. If your institution chose Priority I and II of the WAI or Section 508, you may be able to use some of the features of accessibility validators that are available today. An example of a checklist that was developed based on the Section 508 standard (http://www.webaim.org/standards/508/checklist) might provide some insight into how you could blend automatic features of validators with manual checks to gather baseline data.

Techniques for Establishing a Baseline Measure of Accessibility

Technique 1: Evaluate the Site Using an Automated Accessibility Validator

Products such as Bobby WorldWide (commercial version), AccessEnable, AccVerify Server, PageScreamer Spider, and InFocus can scan through entire Web sites and generate reports based on the errors which they find. Most of these programs allow you to choose which criteria to designate as "errors" for the purpose of the report. It is a good idea to decide ahead of time which of the criteria will cause a page to fail. This will eliminate the extraneous information that these programs can produce that, while sometimes useful to developers, can sometimes confuse the issue by labeling too many things as errors, some of which do not apply to the site at hand. These programs can flag such errors as missing alt text and missing frame titles, but they will not be able to determine whether or not the alt text or frame title is the most appropriate for the context. That is why Step 2 is so important.

Technique 2: Evaluate the Site Using a Checklist

Using a checklist, evaluate the subjective elements of all or randomly-selected pages. The WebAIM Section 508 checklist is an example of a pass-fail checklist that could be used for this purpose. Before embarking on this step, though, it is important to ensure high inter-rater reliability. The people using the checklist should be familiar with Web accessibility concepts. They should independently rate a test group of pages, then compare notes and opinions. Step 2 will be effective only if it is clear that these people will rate pages similarly.

Technique 3: Interpret the results

It will probably be helpful to generate a few different types of reports. For example, it can be helpful to compare the pass/fail ration of pages evaluated with the automated software to the pass/fail ratio of pages evaluated by human evaluators. You could also separate out the errors by type, WAI priority or other criteria.

Step 6. Training and Technical Support

The Importance of Training and Technical Support

Once you have institutional support, policies and plans in place, as well as a baseline of your current situation, the next step is to provide training and technical assistance for those who place content on the Web. Training is a critical element in the implementation and success of your institutional reform. Web accessibility may be a brand new issue for many who will be responsible for its implementation. The training and support you provide will be absolutely necessary to help them fulfill the institutional policies that have been established.

Identify Your Audience

It is important to identify those who place content on your institution's Web site. As you design your training and support mechanisms, please be aware of the skills of these individuals. Situations can arise where anyone with Web development skills or the desire to learn the skills are given responsibilities to create and post Web content on an institutional Web site. Some of these individuals may be professional Web developers, such as in-house Web design staff or outside design contractors. Some of these individuals may be faculty or other support staff that wish to explore Web design and, in return, provide a "free" service to their workgroup or department. Some may be students hired for a single term or for one year. Other individuals may be nephews and neighbors, friends and children. Anyone with skills to write in a markup language (e.g., HTML, or hypertext markup language, the language of the Internet), or understand authoring tools, or course management systems (e.g., Blackboard, WebCT, E-college) can be given the task to design and develop elements of a postsecondary education Web site. Few campuses actually know *all* of the individuals that develop and place Web content onto the institutional server system. If the institution cannot identify all of these individuals it is unlikely that they can provide the necessary direction, support, training, and monitoring for accessibility.

In addition, although accessibility fixes may not be a difficult task for those who are technically skilled, new techniques and content can provide some initial confusion. You will want to create a structure in your institution that is supportive of implementing these changes and not merely request change in the absence of support. The training and resources you provide must be as clear as the standards you wish your developers to follow. Web accessibility can be a complex process but is simplified with good training and ongoing support.

Areas of Training

You could focus training in at least three primary areas; the areas of Web accessibility, your institutions' accessibility standards, and strategies and techniques for accessible coding (e.g., HTML, CSS, XML) and multimedia (Flash, Video, PDF, Power Point).

Web Accessibility Issues (coding and multimedia)

It would be reasonable to create a workshop that would focus merely on accessible HTML (or other code techniques) and multimedia. These are the techniques needed by designers to create accessible content. However, in order to help designers and faculty understand why they need to design and develop accessibly, it is valuable to help them first understand the broad issues of accessibility itself.

1. Understanding the perspectives of the student with a disability is critical (http://webaim.org/training2002/week1/). Often, if Web designers really understand what student with disabilities face, the designers will embrace this perspective and be able to internalize many of the changes at an intuitive level. Introducing staff to the personal stories of students and faculty at your institution can be a powerful experience for Web developers as well. Simulations and videos, in combination with live interviews or panels can be another powerful aspect of your training. Help those involved answer questions such as; "What population is benefited by an accessible Internet? What problems do they face without it? How can these problems be overcome?" Having an experience with those who struggle with the Internet helps promote a greater desire to change professional practices.

2. Understanding the incentives for implementing Web accessibility, the reasons of ethics, business and law (http://webaim.org/training2002/week2/), can also motivate them to initial acceptance and help them effect change.

Institutional Standards

Secondly, in development of training it is also essential that all parties involved understand, not only the reasons for accessibility in general, but your institution's choice of standard. When designers and faculty clearly understand the exact regulations of compliance chosen for your university, they are more likely to effectively fulfill their commitments to Web accessibility. Consider training in the following ways:

? Include specific wording of the Web accessibility policy of your own institution
? Provide contact information for people so they can ask questions of those in charge
? Make specific dates and schedules for training available on the current institutional policy or plan

Techniques and Strategies

As far as an overall plan for institutional training and technical support, many factors must be taken into consideration. Will you create the actual training in -house or will you outsource? Will you need separate training for designers than for faculty? In what areas will you specifically need to train? It is important that you consider the unique needs of each group at your institution. Even within groups, there will be different levels of need. Designers are more likely to need training in both multimedia and coding techniques, whereas most faculty will benefit more from knowing how to optimize the tools they use, such as PDF files, PowerPoint, or how to make accessibility workarounds for a course management system (e.g., WebCT, Blackboard).

One good place to start making plans for training is to conduct a survey of the accessibility knowledge skills among those who will be involved. Questions could address what they know about the issues, as well as specific coding techniques. These skills and knowledge might also be discovered as the baseline study is performed for your institution. Understanding the needs of your designers and faculty is valuable to create or tailor training.

Other decisions to make in regards to training involve resources and method of delivery, timing and accountability. Will the training be conducted face to face or online? Will online resources be provided that link to valuable, informational Web sites? Will all faculty and designers have a point-of-contact for answers that cannot be found in manuals or on the Internet?

Step 7. Monitoring Your Institutional Policy

At this stage of the journey you are well on your way toward accessibility. The key now is persistence. Now is the time to execute the strategies you outlined for monitoring progress in your implementation plan. This is the time to make sure that all goals for implementation are being fulfilled. Find out where the problems lie and offer support and training to alleviate them. Take any steps to insure established accessibility and make sure Web accessibility becomes a permanent process at your university.

Questions to Ask Yourself

At this point it is a good idea to reevaluate the commitments to Web accessibility made by those at your institution. Consider some of the following questions:

? How are your Web designers performing?
? Have they all completed training?
? Are the pages up to standards?
? Are certain designers or faculty members having difficulty in maintaining the standards? How might they be encouraged or helped?
? Are there new designers, faculty or administrators who need accessibility training?
? Are there changes that need to be made to the training?

Planning Guide

This is a good time to pull out your implementation plan and evaluate your progress in terms of the timelines and guidelines established. Go through the plan section by section and be certain everything is moving along according to plan.

Step 8. The Importance of Flexibility in Change

Perhaps the most important concept to remember as you travel the road of institutional reform is that change is a dynamic and flexible process. There will be changes in staff, standards and technologies. Your institution must have in place a system to with these changes and a mechanism to update standards as new technologies emerge. You should also remember that there will be turnover of designers and new hires all the time. In that case, new training will be required, as well as retraining when standards change or work becomes sloppy. Your institution must always be at the ready for revamping and retooling as necessary. In fact, there should be allowances and provisions made for this in all policy plans.

Learning Anew: An Exploratory Study about New Online Learners' Perceptions of People Interaction and Learning to Learn in an Online Course

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Abstract: This study looked at how new online learners in the first course in a graduate level online instructional technology certificate program experienced interacting with others in an asynchronous online discussion and learning to learn online. The study followed twelve new online learners throughout the class using email questionnaires and email follow-up questions. Significant themes included difficulties and fears, time factors, and desire for more feedback and smaller groups. Over time, most participants adapted and found benefits in addition to challenges, One-fourth of the participants did not adapt and left the program at the end of the course. Postings gradually became more social and fewer were directed primarily to the instructor. Correlational and predictive analyses provided insights into the importance of computer skills, initial experiences in the course, and quantity of discussion postings.

The entire paper (with full literature review and additional tables and participant data) is available at: http://www.learningpeaks.com/discussion_study.

Introduction

Student discussion in a college classroom conveys numerous instructional benefits and is considered to be critical to learning (Gunawardena and Zittle, 1997; Nunn, 1996; Ormrod, 2000). If interaction with people is important and discussion is the primary venue for this interaction, we must understand why learners chose to (and not to) participate, in order to optimize decisions about design and facilitation in online learning environments. The goal of this study was to take a close look at the thoughts and feelings of adults who are new to online learning as they take their first online course. The primary research questions at the outset were:

- How do new online learners view online discussions?
- What factors influence participation in online discussion? What makes participation more likely? Less likely?
- Do learners' views and participation change over time, as the course progresses?

What I found in these new online learners' responses went beyond the original scope of these questions. I came to understand how they perceived some of the challenges and opportunities of asynchronous online learning, in general, as well. All of the participants struggled with using a new medium for learning. Most overcame the challenges and found the process to be satisfactory or better. The challenges were insurmountable for a few participants and they chose to not remain in the certificate program after the end of the course.

Participant Solicitation

This study involved twelve out of the thirty students in two online sections of a graduate level, asynchronous, large public university instructional technology course called "Developing Educational Websites." This course is the first in a four course online certification program called "Designing and Developing Web-based Learning Environments." I decided to study only new online learners because returning online learners had already self-selected this method of learning as acceptable to them.

Data Collection

Participation consisted of responding privately to me, via email, to three email questionnaires (I used the term "email journals" with participants in order to encourage in-depth answers) at the beginning, middle, and end of the study. The course was 10 weeks long and the questionnaires were sent to participants by email in weeks 2, 5, and 10. As students responded, I followed-up via email with additional questions. Questions for the middle and final questionnaires were developed in response to the types of answers received in earlier questionnaires.

Data Analysis

As I read through each journal, follow-up, and discussion posting, I looked for themes. It became apparent to me that participants were also describing their experience of learning to learn in this environment in addition to providing insights about online discussion and interaction. I added an additional question to be answered in this study: How do new online learners experience this environment (in general)?

I started with a list of expected general themes (personal issues, other people issues, technology issues, course issues), gained from the literature, and added additional sub-themes as they became apparent. The general codes I began with served as containers for the sub-codes that emerged. In addition, a general code for general asynchronous discussion and online learning issues emerged. The following sub-themes were coded:

Themes	Primary Sub-Themes
1. General online learning and /asynch discussion issues	1.1 Lack of immediacy of response/Disjointed nature of discussion 1.2 Need authentic activities to make discussion "real" 1.3 F2F/Visual cues/Written communication vs. spoken/ Hard to connect names with real people 1.4 24/7 / More work/effort than F2F class 1.5 Helpful posts: a solution to problems/others work keeps me on track/feedback/instructor comments 1.6 Collegiality develops over time and with right design 1.7 Benefits of asynchronous discussion and/or online learning
2. Personal issues	2.1 Self-consciousness/Looking stupid/How I will be perceived/How much to reveal/Others know so much more than me 2.2 My own efforts make a difference to the discussion and to the course/ You get what you put in/I can do this. 2.3 Feel timid about asking for help or pushing for own needs.
3. Other people issues	3.1 Want comments and feedback from other learners
4. Technology issues	4.1 Difficulty of following the discussion/thread
5. Course issues	5.1 Small groups work desired 5.2 Post to complete assignments/Posting is required

Table 1: Themes and Sub-Theme Codes

Venita Doughty, another doctoral student, helped me evaluate discussion forum postings for type of posting and audience of the postings. This was done in order to understand how students used the discussion forum, and provided additional insights into the second and third research questions.

Results

Study participants were primarily mid career adults, working in K-12, higher education, or corporate training, with advanced degrees (or working on an advanced degree). The mean age was 43 years of age, with a range between 24 and 59 years of age. The mean level of education was master's degree.

The nature of the certificate tends to attract people with an interest and aptitude for technology, but many students expressed technical frustrations during the course. The range of skills needed to build instructional websites is broad, and even those with relatively higher technical skills coming into the program experienced difficulties with the range of skills taught.

Many expressed a great deal of nervousness about learning online and learning these skills from the outset.

In the following sections, I will describe the themes that emerged and provide some examples of participant comments that illustrate many of the themes and sub-themes. Pseudonym initials and the journal number precede excerpted comments.

General online learning and /asynchronous discussion issues

One of the most pervasive themes that emerged in participants' journals, follow-ups, and discussion postings was that communicating through online asynchronous discussion was generally not nearly as compelling as face-to-face discussion. For many, it felt disjointed. Many participants expressed this much more strongly at the beginning and middle of the course than towards the end. Many of the participants, however, came to find communicating this way as acceptable as the course continued.

The three participants who chose not to continue with the certificate program after the course ended, TZ, CY, and AH, expressed strong negative feelings about online discussion, and these feelings continued throughout the course. A related theme was how the lack of visual cues made communication difficult. A number of the study participants expressed difficulty with knowing who was who. On the other hand, one participant felt that it was actually easier to know about the people in the course in this medium.

Many participants described the challenges of communicating in a written medium. Spoken communication, for most, conveyed subtle and not so subtle benefits over written. Some also felt increased anxiety about communicating in this way. JH felt cautious about communicating in writing and it impacted her willingness to provide substantive feedback. She described an incident where she strongly questioned another student's conclusions and began to write out a response but then changed her mind about posting it. The lack of visual cues in written communication also impacted understanding.

Many of the study participants felt that learning this way felt like a lot more work than learning in a traditional face-to-face classroom. The commitment felt more like 24/7 rather than a more typical face-to-face class where the commitment was "Tuesdays from 5-9 PM."

Despite the challenges, many of the study participants began to see positive aspects of communicating publicly over time. Collegiality and the sense of a shared experience developed over time and under the right circumstances. The right circumstances turned out to be a publicly posted final project and the expectation (assigned and graded) to provide substantive peer feedback on others' projects. Many participants emphasized that this type of authentic activity (rather than "forced interaction") was just the thing to make them feel connected to others and that more of these types of assignments were needed.

Personal issues

One of the most consistent and pervasive comments that emerged, especially in the first and second journals and discussion postings at the beginning of the course was self-consciousness and fear of looking stupid to others. Many of the study participants asserted that others knew an awful lot more than they did. These remarks matched and extended the remarks made about the nature of written communications described earlier.

Issues with others

When asked in the second set of journal questions what would make participants more likely to interact in the discussion forum, the most consistent answer was more feedback from other learners.

Technology Issues

Some participants felt that following conversation in the discussion form was confusing, disjointed, and time consuming. Some participants adjusted well to the technology over time but others continued to struggle with it. For those that struggled, the technology augmented the disjointed and time-consuming nature of communication.

Course Issues

A number of participants expressed a desire for working in smaller groups. Participants wrote that it would be easier and more comfortable to get know people this way and felt that they would feel more connected and less anxious.

A number of participants chastised me for making participation in the discussion forum such a large part of the course evaluation (it comprised 20% of the final grade). Many said they felt forced to participate. Some said discussion and participation were essentially a waste of their time. They preferred to spend the time in more solitary activities.

Time…

An emerging meta-theme that tied together all the others was the element of time. Many of the study participants began to see positive aspects of asynchronous discussion and learning as the course progressed. Many saw that challenges were balanced by benefits, and that both challenges and benefits could exist at the same time. A few even described benefits over learning in a face-to-face setting. Some of the challenges (e.g., takes more time) also contained benefits (e.g., more time to digest).

In general, posting numbers increased over time. Social postings and postings to provide information to others in the class went from 16 in Project 1 to in 104 Project 7. At the beginning of the course, many of the posting were targeted towards the instructor. By the end of the course, most of the postings were targeted towards the other students in the course. In general, the postings of those that chose not to increased over the course, too, but they did not increase nearly as much as the others. There did not appear to be a dramatic change in type or audience over time.

Correlational and linear regression analysis was performed with all of the Likert-like questions, the course grade, number of discussion postings, and whether participants continued with the certificate program. These analyses showed the following significant correlations and predictive values.

Correlated Factors	R	R^2	Significance
Personal satisfaction journal 1 / Personal satisfaction journal 3	.851	.725	.004
Computer skills journal 1 / Continue with the program	.683	.407	.035
Personal satisfaction journal 3 / Continue with the program	.684	.415	.032
Personal satisfaction journal 1 AND Computer skills journal 1 / Personal satisfaction journal 3	.949	.901	.001
Number of total discussion postings / How well obtained skills journal 3	.598	.357	.004

Table 2: Significant Correlations and Predictive Values

Paired dependent t tests for changes in personal satisfaction between journal 1 and 3 were not significant. There were no significant correlations with grade received in the course.

Discussion

How do new online learners view online discussions?

The study participants viewed online discussions in many different ways, sometimes at the same time. At first, most found the discussions to be more challenging than beneficial. Over time, benefits began to become apparent to many of the participants. Others' postings provided insights and helped keep them on track. Others' problems provided comfort for those also experiencing problems. The final project provided an opportunity for authentic feedback that engaged most of the participants and helped them see the value of interaction. Some participants never connected and these participants did not continue with the certificate program.

What factors influenced participation? What makes participation more likely? Less likely?

The factor that participants said would influence them to participate the most is feedback from others. It is interesting that only one of the participant's reflections included insights about how their actions influenced others. It appears that it may be helpful to assist learners in gaining early "ah-has" about the value of reciprocal interaction.

Many of the participants expressed irritation that participation was required and some said they only participated *because* it was required. It became clear that authentic activities provided a better impetus for interaction than simply ordering interaction for the sake of interaction. Number of postings correlated moderately highly with participants assessment of whether they obtained the skills they desired in the course.

Do learners' views and participation change over time, as the course progresses?

Participants' views and participation changed a great deal over the ten weeks of the course. Instead of seeing only challenges, they began to see challenges *and* benefits. Postings, in general, increased. Social and informative postings increased dramatically. This occurred across the board but occurred much more for folks who were adapting to the environment. This provides yet another rationale for helping people adapt early, whenever possible.

How do new online learners experience this environment (in general)?

This is not necessarily an easy environment for all to adapt to. It takes perseverance, motivation, and a willingness to get past feeling inept and/or anxious. Not all adapt. The high correlation between personal satisfaction in journal 1 and in journal 3 confirms how critical it is that people feel successful early on. It also points to the importance of willingness to deal with uncertainty at the outset.

Conclusions And Opportunities For Further Study

The thoughts and feelings of these participants may not be representative of all online learners but should provide food for thought about the scope of thoughts and feelings of new online learners as they attempt to cope with interacting and learning in this new way. It would be beneficial to replicate this study with different audiences and content.

One of my primary conclusions was that instructional strategies are critical in the learning environment. Those that lower fear and promote quick success at the outset may affect participation and persistence. Authentic activities that involve students with each other early on may reduce fear and make the environment more compelling. Additionally, since this environment may not be optimal or acceptable for everyone, it may be necessary to help potential learners ascertain the suitability of the environment at the outset. When learning in this environment is necessary, we may need to provide additional supports in order to make it satisfactory.

References

Gunawardena, C. N., & Zittle, F. J. (1997). Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. American Journal of Distance Education, 11(3), 8-26.

Nunn, C. (1996). Discussion in the College Classroom: Triangulating Observational and Survey Results. Journal of Higher Education 67(3), 243-266.

Ormrod, J.E. (2000). Educational Psychology: Developing Learners. Upper Saddle River, NJ: Merrill.

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